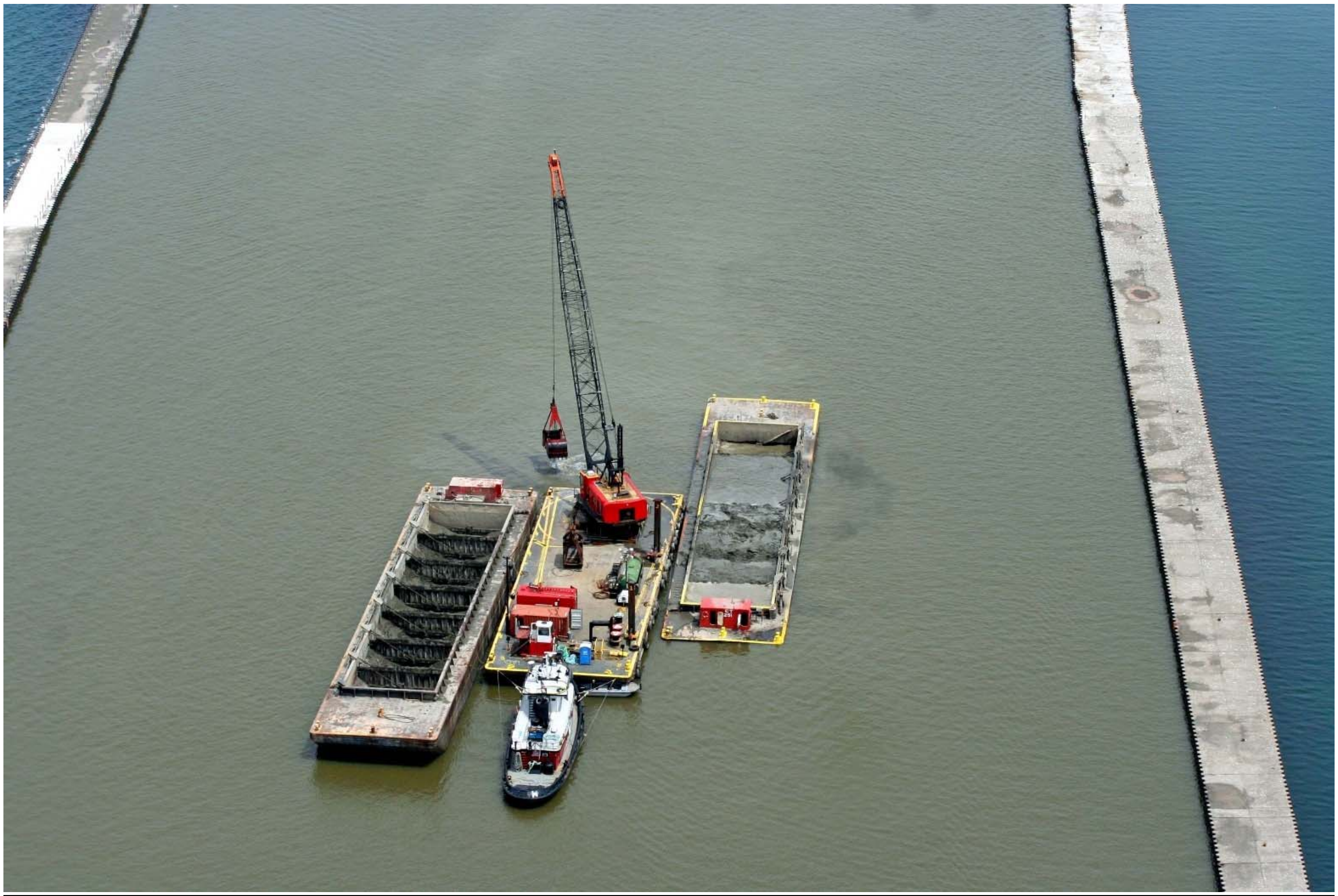
ROCHESTER EMBAYMENT AREA OF CONCERN

Restrictions on Dredging Activities
Beneficial Use Impairment Removal Report

NOVEMBER 2018



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Rochester Embayment Area Of Concern

Restrictions on Dredging Activities

Beneficial Use Impairment (BUI) Removal Report

November 2018

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Prepared for:
Rochester Embayment AOC – Remedial Advisory Committee (RAC)

This Beneficial Use Impairment (BUI) Removal Report was prepared by the New York State Department of Environmental Conservation (NYSDEC) in cooperation with the Monroe County Department of Public Health (MCDPH), and was substantially funded by the United States Environmental Protection Agency (USEDPA) through the Great Lakes Restoration Initiative (GLRI). The NYSDEC and MCDPH acknowledge the significant efforts of the Remedial Advisory Committee (RAC) in engaging stakeholders and the public throughout the BUI removal process. For more information, please contact either the Remedial Action Plan Coordinator at MCDPH or the AOC Coordinator at NYSDEC Division of Water.

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I. Introduction

This Beneficial Use Impairment (BUI) Removal Report identifies the background, criteria, supporting data, and rationale to remove the "Restrictions on Dredging Activities" BUI from the Rochester Embayment Area of Concern (AOC). The status of this BUI is currently designated as "Impaired" due primarily to concerns from the Remedial Advisory Committee (RAC) of the impacts that overflow dredging could have on the Genesee River and Lake Ontario, specifically from acute toxicity within the water column and the resuspension of contaminated sediments.

To assess the condition of this BUI, the RAC developed a series of specific BUI removal criteria that would need to be met in order to address the water quality concerns associated with dredging practices performed within the AOC. The three current removal criteria were developed by the RAC to address sediment chemistry evaluation pertaining to open lake disposal of dredged materials, overflow dredging, and regulatory requirements.

Following an evaluation of applicable data sets and evidence gathered to address this impairment, the New York State Department of Environmental Conservation (NYSDEC) has determined that the specific criteria needed to remove BUI 7 – Restrictions on Dredging Activities have been met for the Rochester Embayment AOC. The Rochester Embayment RAC is in agreement with this determination and fully supports the removal of this BUI. Accordingly, the intent of this removal report is to present the supporting evidence and rationale which justifies the removal of the Restrictions on Dredging Activities BUI from the Rochester Embayment AOC.

II. Background

In the Great Lakes Basin, the International Joint Commission (IJC) has identified 43 Areas of Concern (AOC) where pollution from past industrial production and waste disposal practices has created hazardous waste sites and contaminated sediments. Up to fourteen BUIs, or indicators of poor water quality, are used to evaluate the condition of an AOC.

The Rochester Embayment AOC encompasses the lower portion of the Genesee River from the mouth of the river up to the Lower Falls in Rochester, NY and the portion of Lake Ontario within a straight line drawn from Bogus Point to Nine Mile Point (**Figure 1**). Remedial Action Plan (RAP) coordination is led by the Monroe County Department of Public Health (MCDPH), in collaboration with the local RAC (**Appendix A**).

The Rochester Embayment was originally listed as an AOC due to the known or suspected presence of multiple BUIs, including Restrictions on Dredging Activities, which is generally considered impaired when "contaminants in sediments exceed standards, criteria, or guidelines such that there are restrictions on dredging or disposal activities" (IJC, 1991).

All AOCs have a RAP that is developed in three stages: Stage I that identifies specific problems, Stage II which outlines the restoration work needed, and Stage III (not yet developed for the Rochester Embayment AOC) which documents the cumulative completion of all restoration activities and provides delisting justification for the entire AOC. Currently, the Rochester Embayment RAP consists of the Stage I and Stage II RAP documents, which identify the causes of and restoration plans for the BUIs throughout the AOC. Ultimately, through the progressive development of each component, a Stage III RAP will be developed which will document the completion of all the identified remedial efforts and restoration activities within the AOC. In addition, this final stage will display how the completed efforts satisfy each of the BUI removal criterial goals and objectives, as well as a recommendation that the AOC designation be removed and the AOC is officially delisted.

According to the Stage I RAP for the Rochester Embayment AOC (MCDPD, 1993), the Restrictions on Dredging Activities BUI is listed as “impaired” for the Lower Genesee River portion of the AOC, and “not impaired” for the Rochester Embayment of Lake Ontario portion of the AOC. This determination was made as a result of Monroe County’s concern of the impacts that overflow dredging could have on the Lower Genesee River, specifically acute toxicity within the water column and the resuspension of contaminated sediments. At the request of Monroe County, NYSDEC prohibited overflow dredging in Rochester Harbor. Additionally, the Stage I RAP indicated that the restriction on overflow dredging should be maintained in order to prevent excessive turbidity at public beaches.

A sediment evaluation approach was initially selected as the BUI removal criteria: “When contaminants in sediments do not exceed standards, criteria or guidelines such that there are restrictions on dredging or disposal activities.” This BUI removal criterion matched IJC BUI removal guidance for restrictions on dredging activies and provided a more comprehensive evaluation of sediment chemistry that would be resuspended in the water column during dredging activities, while also incorporating regulatory requirements and standards.

Throughout the RAC’s meeting history, the removal criteria for the Restrictions on Dredging Activities BUI have been refined and better defined to incorporate a complete and comprehensive assessment of site conditions. During the May 18, 2012 RAC meeting the most recent BUI removal criteria were approved, which consisted of three criteria that addressed sediment chemistry evaluation and open lake disposal, overflow dredging, and regulatory requrements.

A. BUI Removal Criteria

The BUI removal criteria for the Restrictions on Dredging Activities BUI were developed by the RAC in order to address the water quality concerns associated with dredging practices performed within the AOC. Through the guidance of technical subcommittees, it was the RAC’s determination during a meeting held on May 18, 2012, that if the following criteria could be achieved the restrictions on dredging BUI for the AOC could be removed.

As determined by the RAC, the removal criteria for the Restrictions on Dredging Activities BUI are as follows:

1. Due to conditions created by overflow dredging, it will be prohibited in the Genesee River.

2. Sediments from routine commercial and recreational navigation channel areas historically dredged by the USACE will meet standards for Open Lake Disposal.
3. Sites outside of the historically dredged channel will be required to follow the current or future NYSDEC/ACOE/USEPA permitting processes and meet the associated standards.

The above BUI removal criteria are consistent with United States Environmental Protection Agency (USEPA) Delisting Guidance document (USPC, 2001) and the International Joint Commission (IJC) delisting guidelines (IJC, 1991).

B. Endpoint

The endpoint to restore this BUI is achieved by satisfying each of the above criteria, which will ensure that the area's environment and overall water quality are adequately protected. As further described below, each of the listed BUI removal criteria have been satisfactorily met as a result of State and Federal permitting requirements and standards. Therefore, removal of the Restrictions on Dredging Activities BUI from the Rochester Embayment AOC is warranted and proposed by the RAC committee members.

C. BUI Removal Comments and Report Preparation

The following questions were considered when evaluating whether to proceed with the change in status for the Restrictions on Dredging Activities BUI:

1. Are sufficient data available to assess the status of this BUI in terms of the specific removal criteria?
2. Does the information available regarding restoration of the impaired beneficial use support the BUI removal criteria?
3. Does the RAC and general public concur that the BUI removal criteria have been met?

NYSDEC and MCDPH prepared this evaluation and included a thorough review of technical reports and supporting documents.

III. Technical Guidance Resources

In order to evaluate each of the BUI removal criteria, a series of historical references, permitting requirements, and guidance documents have been utilized to assess sediment conditions and future dredging operational restrictions within the Rochester Embayment AOC. Through the resources described below, the RAC was able to determine that the sediment quality as well as future screening requirements for dredging and disposal operations would justify removal of the Restrictions on Dredging Activities BUI.

A. ***Technical Guidance Resource #1*: New York State Technical & Operational Guidance Series 5.1.9 – "In Water and Riparian Management of Dredged Material"**

The NYSDEC developed the *New York State Technical & Operational Guidance Series 5.1.9 – "In Water and Riparian Management of Sediment and Dredged Material"* (TOGS 5.1.9) in an effort to develop a "uniform and balanced approach to dredging projects" throughout the waters of New York State (NYSDEC, 2004). This document provides detailed guidance on how to properly assess, plan, permit, dredge, evaluate, and monitor a dredging project. Through this document, a dredging project can be comprehensively designed to ensure that all environmental concerns are considered and addressed.

In-water sediment dredging is a necessary yet complicated process, often resulting in the short term resuspension of fine and coarse grain material that degrades water quality and impacts the fish and wildlife species within the system. Additionally, for dredged management units where chemical or biological contaminants have been deposited, unregulated dredging operations can result in further contaminant distribution through sediment and chemical transport. Therefore, ensuring that adequate delineation of contaminants and dredging boundaries, best management practices, and placement methods are implemented throughout the planning and implementation process is imperative to protect water quality and avoid increased degradation of the water column and surrounding sediments.

The TOGS 5.1.9 guidance document is the primary resource used by the NYSDEC technical staff during the evaluation and permitting of dredging projects. Its content outlines the necessary permit requirements but also incorporates guidance that is to be used to identify appropriate ways of assessing sediment quality, performing dredging, and managing dredged materials. If a project failes to adhere to the TOGS guidance, it will typically not be permitted. Though each dredging project is unique and requires individual analysis for permitting, guidance through TOGS 5.1.9 provides a blueprint on all project components necessary in obtaining a dredging permit through New York State that is consistent with all regulations and regulatory requirements, to ensure water quality and environmental conditions are managed and maintained.

B. ***Technical Guidance Resource #2:* Great Lakes Dredged Material Testing and Evaluation Manual**

The *Great Lakes Dredged Material Testing and Evaluation Manual* (GLTM) was developed through the combined efforts of the USEPA and the USACE, in order to "present guidance on testing and evaluation for proposed discharges of dredged material into the United States waters of the Great Lakes Basin" (USEPA & USACE, 1998). The manual's evaluation process is based on a tiered approach that integrates chemical, physical, and biological factors in order to determine the impacts that the dredging activities and materials will have on the environment. Each subsequent tier offers a greater level of intensity in the evaluation of the dredged material, providing additional evidence beyond standard chemical analysis. This allows for a complete and comprehensive determination, based on multiple factors and site specific considerations.

The initial tier for the GLTM performs a basic analysis on the project, based on available information and background conditions, while successive tiers incorporate more detailed and specialized tests which provide additional scientific information used in the determination process. Within each tier it will be concluded that either "1) available information is not sufficient to make a contaminant determination, or 2) available information is sufficient to make a contaminant determination." A determination will conclude if the project and dredged material will or will not have "unsuitable, adverse, contaminant-related impacts" (USEPA & USACE, 1998). If a determination is unable to be made, additional information will be needed therefore requiring progression to the next evaluation tier.

The GLTM is used by the USACE to evaluate all dredging projects throughout the Great Lakes Basin, as it provides a comprehensive evaluation of the dredging and disposal practices appropriate for a dredging project. This testing manual is especially useful when beneficial reuse and open lake disposal options are considered, as it evaluates direct impacts to aquatic biota and overall water quality beyond standard chemical threshold values. It is also used by NYSDEC staff in permitting of dredge activities, as it provides additional levels of verification to TOGS 5.1.9 through scientific processes in determining ultimate and direct impacts to the environment.

IV. BUI Indicator Status Resolution

The Rochester Embayment AOC's Restrictions on Dredging Activities BUI has been assessed through a series of State and Federal policies and permit requirements, which conclude that each of the removal criteria has been adequately achieved. Though all dredging projects are unique and site specific, requiring individual assessments to site specific conditions and objectives, the established removal criteria for this BUI provide for the continued protection of water quality conditions within the AOC, therefore justifying removal.

A. Restrictions on Dredging BUI, Criteria 1: Overflow Dredging

Overflow dredging is the process of allowing excess water that accumulates within the dredge barge during dredging to overflow as it's filled. This process increases the dredged material loading, resulting in fewer disposal trips and optimizing the operational efficiency of the project. However, as the excess water is decanted back into the river system, lower density particles can overflow the barge and cause an increase in turbidity. An increase of turbidity within the water column can potentially result in acute toxicity for many aquatic biota and the recontamination and dispersion of contaminants through the re-suspension of compounds. Therefore, this practice is primarily used with caution and for sediment that has been properly evaluated and determined to be without appreciable contamination (no toxicity to aquatic life).

TOGS 5.1.9 approaches overflow dredging in a conservative manner, recommending that the practice be permitted on only a site specific basis following detailed review, and when dredged sediments are classified as "Class A – No Appreciable Contamination (No Toxicity to aquatic life)" (NYSDEC, 2004). In summation, though overflow dredging can be considered for site specific projects, it is only permissible under very specific and conservative circumstances which demonstrate that water quality and environmental conditions will not be adversely impacted as a result of the overflow.

The Genesee River's federal navigation channel is routinely dredged by the USACE, with the most recent permitting of the operations and dredging occurring in 2016. These operations require that the USACE obtain a "Protection of Waters" permit from the NYSDEC to ensure regulations and environmental conditions are maintained. The NYSDEC evaluated the proposed operations and issued a permit (Permit ID: 8-2614-00604/00006) with a series of conditions which were required in order to ensure the environment and ecosystem were adequately protected. The prohibition of overflow dredging is included as condition four of the permit, stating "Under no circumstances is the dredging operations to be conducted in such a manner that water, and/or suspended sediments, be allowed to be discharged from the vessel by "overflow dredging" or discharged from the vessel(s) other than at the approved open-lake disposal site" (**Appendix B**). This permit condition is maintained within the permitting records for this location and will be incorporated within future navigational dredging permits unless sufficient precautions and environmental justification is provided.

Though a complete prohibition on overflow dredging has not been established within the AOC, site specific evaluations and permit conditions have been incorporated into past and future dredging operations, therefore addressing the concerns associated with overflow dredging practices. Through both the technical guidance documents (i.e., TOGS 5.1.9 and GLTM) and permitting requirements specifically set for the Rochester Embayment AOC, the overflow dredging concerns emphasized with BUI removal criteria 1 have been adequately addressed.

B. Restrictions on Dredging BUI, Criteria 2: Open Lake Disposal

Open Lake Disposal is often proposed for large dredging projects where significant sediment volumes are generated, typically associated with routine maintenance of Federal Navigation Channels, which make alternative placement options difficult and expensive. While Open Lake Disposal is cautiously used due to the resuspension and deposition of fine grain material, it is acceptable in certain circumstances where it can be shown not to result in adverse impacts to the environment, aquatic biota or the placement location. According the Stage I RAP; "As of 1992, sediments from the Genesee River are deemed suitable for open lake disposal" (MCDPD, 1993).

The GLTM's tiered approach is used in the evaluation of dredged material proposed for Open Lake Disposal, as it provides multiple tiers of evidence on the overall effects and impacts the material will have from both a physical and biological perspective. As described above, the subsequent tiers of the GLTM provide information used in determining if the material will cause adverse impacts based on specific testing conditions which replicate conditions during OLD. If the advanced testing verifies that Open Lake Disposal is appropriate, the practice will be permissible.

Dredging within the Genesee River's federal navigation channel is performed by the USACE, during routine maintenance of the channels navigable depths. In 2016, the NYSDEC issued a Protection of Waters – Water Quality Certification Permit, which authorized the USACE to perform routine dredging within the federal navigation channel of the Genesee River, within the Rochester Embayment AOC boundaries. The permit also identified that OLD would be permitted within a specified Lake Ontario disposal site. "Dredging of an estimated maximum of 450,000 cubic yards of material from the federal navigational channel and placement of the material at the authorized Lake Ontario open-lake disposal site" (**Appendix B**).

The USACE utilized the GLTM in order evaluate the dredging practices for the navigational dredging project and determine acceptable disposal methods which would not result in adverse impacts to the environment. In accordance with the GLTM, the material from within the federal navigation channel was analyzed and compared to both a Lake Ontario reference area as well as the proposed OLD placement area, in order to determine if adverse or unacceptable related impacts would be expected from Open Lake Disposal of the dredged material. Determinations were based on an analysis and comparison of the material's physical and chemical (inorganics, metals, PAHs, pesticides, PCBs) composition. In addition, advanced testing was performed in order to predict the release of contaminants into the water column, which was then directly compared to applicable water quality standards.

The testing results and comparison analysis allowed for a determination to be made on the applicability and impacts that Open Lake Disposal would have on the area. The analysis also incorporated historical sampling/evaluations from previous dredging projects within the project area in order to provide additional data and supporting documentation. It was concluded that Open Lake Disposal would be an acceptable disposal method for the Rochester Embayment navigation channel material due to the lack of adverse impacts to the environment; "Evaluation of Rochester Harbor and offshore Lake Ontario sediments shows that the open lake placement of dredged sediments at the existing, authorized open-lake placement area is not expected to cause unacceptable, adverse, contaminated-related impacts."

The NYSDEC evaluated the sampling results and conclusions presented by the USACE and determined that Open Lake Disposal was an acceptable practice for the proposed navigational maintenance dredging. A Protection of Waters – Water Quality Certification permit was issued on February 1, 2016.

In May 2016, the USACE conducted an evaluation of sediment within the Federal navigation channels of Rochester Harbor at the mouth of the Genesee River. The objective of this project was to determine whether dredged sediment within Rochester Harbor met the guidelines for Open Lake Disposal. As a result of the evaluation, the USACE determined that Open Lake Dispoal of sediment within the Federal navigation channels would not cause contaminant-related impacts, and that Open Lake Disposal was an acceptable disposal method for this material. The 2016 sediment evaluation report prepared by USACE is included as **Appendix C**.

Though additional sampling and advanced analysis will be required for future proposals to perform Open Lake Disposal, the USACE has obtained appropriate permits to perform Open Lake Disposal within the Rochester Embayment navigation channel for over 30 years. While there is no reason to assume that future dredging projects will not meet Open Lake Disposal critiera, similar advanced testing procedures and analysis through the GLTM will be required inorder to justify the practice and obtain appropriate permits. Therefore, this BUI removal criterion is considered to be satisfied.

C. Restrictions on Dredging BUI, Criterion 3: Permitting for Dredging Operations Located Outside of the Federal Navigation Channel

In September 2011, Battelle conducted sediment sampling on behalf of USEPA's Great Lakes National Program Office (GLNPO) throughout the lower 6 miles of the Genesee River to characterize sediment outside of the federal navigation channel, and to determine if sediment remediation was necessary under the Great Lakes Legacy Act (GLLA). Overall, the sediment data suggest that the average contaminant levels fall within the Class B sediment quality threshold per TOGS 5.1.9 (Battelle, 2012). For class B sediments, dredging and riparian placement may be conducted with several restrictions that are applied based upon site-specific concerns and knowledge coupled with sediment evaluation (NYSDEC, 2004). The final summary report for the site characterization project is included as **Appendix D**.

The policy of New York State, set forth in Title 5 of Article 15 of the Environmental Conservation Law (ECL), is to preserve and protect the State's lakes, rivers, streams and ponds. The Protection of Waters Regulatory Program was developed by the NYSDEC to prevent undesirable activities on water bodies by establishing and enforcing regulations. According to the Protection of Waters regulation 608/608.5 (Use and Protection of Waters/Excavation or placement of fill in navigable waters), a permit is required for excavation or placement of fill in navigable waters of the State, below the mean high water level, including adjacent and contiguous marshes and wetlands: "*Permit required.* No person, local public corporation or interstate authority may excavate from or place fill, either directly or indirectly, in any of the navigable waters of the State or in marshes, estuaries, tidal marshes and wetlands that are adjacent to and contiguous at any point to any of the navigable waters of the State, and that are inundated at mean high water level or tide, without a permit issued pursuant to this Part."

Similarly, the USACE, NYS Office of General Services (NYSOGS), and the NYS Department of State (NYSDOS) have similar laws and permitting requirements which regulate in water projects. In an effort to ensure individual projects obtain all necessary permits, across multiple regulatory agencies, a Joint Application was developed. This application form is exclusively for activities affecting streams, waterways, waterbodies, coastal areas, sources of water, and endangered and threatened species, based on project specific conditions and objectives; and identifies NYSDEC, USACE, NYSOGS, and NYSDOS permitting requirements. The application is utilized by these agencies in order to ensure permitting requirements and appropriate methodologies are incorporated into the project.

The Joint Application form ensures that all necessary and current permitting requirements are obtained and properly regulated throughout the project design and implementation process. This ensures that a consistent and comprehensive permitting process is implemented for all inwater projects, including dredging activities. These controls and regulatory process ensures that all projects abide by all regulatory requirements, are protective to the environment, and incorporates appropriate best management practices for all stages of the project. As a result, all areas within the AOC will be properly addressed and permitted within the AOC. Therefore BUI criteria 3 has been satisfied.

V. Conclusions

As discussed within this document, the established BUI removal criteria have been adequately achieved and therefore justify removal of BUI 7 – Restrictions on Dredging Activities for the Rochester Embayment AOC.

Due to the fact that all dredging projects are unique, specific restrictions and requirements are difficult to implement. However, as a result of a series of environmental regulations, permit conditions, and monitoring studies, future dredging operations will be evaluated and permitted in a selective and conservative manner that is protective of environmental conditions. Through these regulatory measures and technical guidance documents overflow dredging, open lake disposal, and proper permitting, each of the BUI removal critieria will be sustained.

A. Removal Statement

In the Stage I and Stage II RAPs for the Rochester Embayment AOC, the Restrictions on Dredging Activities BUI was originally listed as Impaired for the Lower Genesee River portion of the AOC. This designation was made as a result of Monroe County's concern of the impacts that overflow dredging could have on the waterbody, specifically acute toxicity within the water column and the resuspension of contaminated sediments.

In order to assess the status of the Restrictions on Dredging Activities BUI, the NYSDEC consulted the New York State Technical & Operational Guidance Series 5.1.9 – "In Water and Riparian Management of Sediment and Dredged Material" (TOGS 5.1.9) and the Great Lakes Dredged Material Testing and Evaluation Manual (GLTM) as technical guidance resources. These documents are used by the USEPA, USACE, and NYSDEC in the evaluation of dredged material and ultimately in the permitting process associated with dredging activities. TOGS 5.1.9 and the GLTM were used in the permitting of 2016 maintenance dredging in the Genesee River's federal navigational channel by the USACE. This dredging project was used to re-assess the removal criteria for the Restrictions on Dredging Activities BUI.

Following an evaluation of applicable data sets and evidence gathered to address this impairment, the New York State Department of Environmental Conservation (NYSDEC) has determined that the specific criteria needed to remove BUI 7 – Restrictions on Dredging Activities have been met. The RAC fully supports the recommendation that the Restrictions on Dredging Activities BUI for the Rochester Embayment AOC be removed from the list of impaired BUIs.

B. BUI Removal Steps (To be completed as steps are taken)

	Completed	*Date*	*Step Taken*
1.	√	8/1993	BUI first documented as “Impaired” in the Stage I RAP.
2.	√	5/2012	BUI removal criteria revised with RAC consensus.
3.	√	12/2017	RAP advisory committee agreed to proceed forward with BUI removal.
4.	√	3/15/2018	Public meeting advertised and held, information, outreach, and comment on removal recommendation conducted (included a 30-day public comment period) – see Appendix F.
5.	√	8/1/2018	Comments assembled, re-drafted BUI removal report prepared to include necessary changes.
6.	√	8/29/2018	NYSDEC (in consultation with USEPA R2) completes final modifications to the Restrictions on Dredging Activities BUI removal document.
7.	√	TBD	Coordinate the formal transmittal of the BUI removal with USEPA GLNPO and communicate result with IJC.
8.	√	TBD	Communicate results to local RAP Coordination for appropriate recognition and follow-up.

C. Post-Removal Responsibilities

Following removal of the Restrictions on Dredging Activities BUI, the organizations listed below will continue ongoing environmental programs to ensure that the restored beneficial use is protected and continues to remain unimpaired. The environmental programs relating to this beneficial use are: dredged material testing, evaluation, and permitting, and coordination of the Rochester Embayment RAC.

1. New York State Department of Environmental Conservation

NYSDEC will continue to evaluate dredging projects throughout the Rochester Embayment AOC, and will continue using TOGS 5.1.9 as well as GLTM in the issuance of permits for dredging proposals. TOGS 5.1.9 provides a blueprint on all project components necessary in obtaining a dredging permit through New York State that is consistent with all regulations and regulatory requirements, to ensure water quality and environmental conditions are managed and maintained. This will also ensure that the BUI removal criteria are sustained into the future.

2. United States Army Corps of Engineers

The USACE will continue to use GLTM as a technical guidance resource in the assessment of dredging projects in the Rochester Embayment AOC. USACE will continue to perform routine navigational dredging in the lower Genesee River, and will do so in accordance with all applicable procedures, standards, and guidance.

3. United States Environmental Protection Agency

The USEPA will continue to provide funding for RAP/RAC Coordination and technical assistance to the extent that resources are available to support the removal of remaining BUIs and ultimately the Delisting of the AOC. NYSDEC Great Lakes Program staff are anticipated to assist with these efforts.

4. Monroe County Department of Public Health

With EPA/GLRI funding, MCDPH currently provides a Coordinator for the AOC RAP, facilitation with RAC efforts, and technical assistance for AOC documentation and project design. With ongoing funding support, MCDPH will continue in these roles to assist the RAC and USEPA in achieving the long-term goal of delisting the Rochester Embayment AOC.

5. Remedial Advisory Committee

The RAC will continue to forward the objectives of the RAP by evaluating, supporting, and documenting the restoration of the Rochester Embayment AOC, until all of the Beneficial Use Impairments are restored and the long-term goal of delisting the AOC can be achieved.

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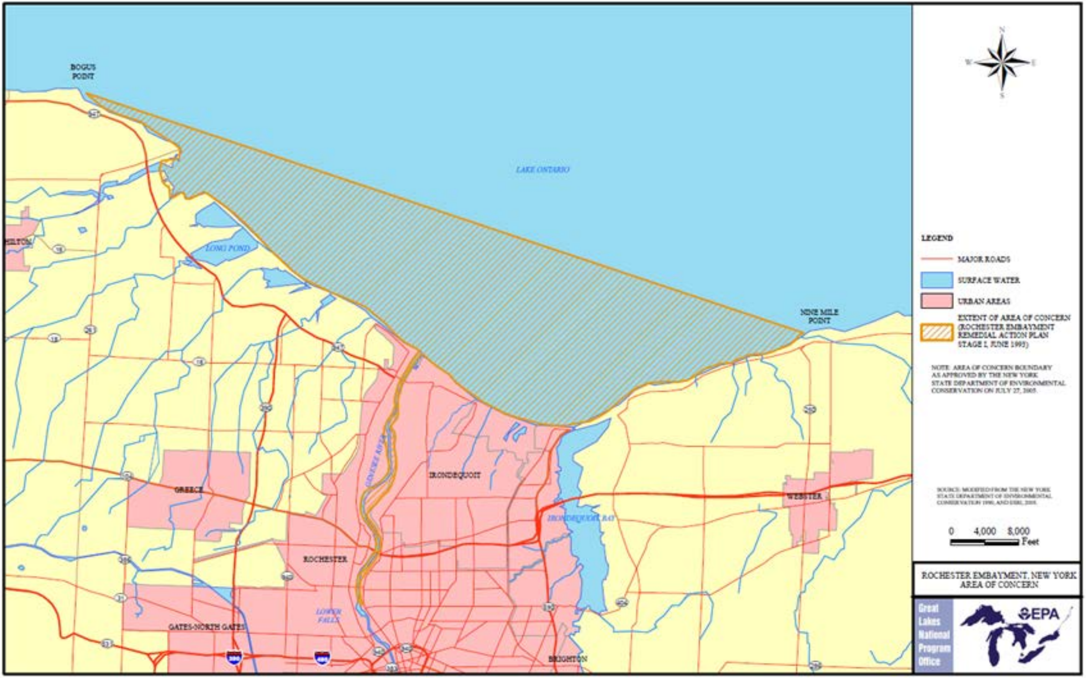
Figure 1
Map of the Rochester Embayment AOC



BOGUS POINT
LAKE ONTARIO
LONG POND
HILTON
NINE MILE POINT
GREECE
IRONDEQUOIT
ROCHESTER
WEBSTER
IRONDEQUOIT BAY
GENESEE RIVER
LOWER FALLS
GATES-NORTH GATES
BRIGHTON
LEGEND
MAJOR ROADS
SURFACE WATER
URBAN AREAS
EXTENT OF AREA OF CONCERN (ROCHESTER EMBAYMENT REMEDIAL ACTION PLAN STAGE I, JUNE 1993)
NOTE: AREA OF CONCERN BOUNDARY AS APPROVED BY THE NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION ON JULY 27, 2005.
0 4,000 8,000 Feet
ROCHESTER EMBAYMENT, NEW YORK AREA OF CONCERN
Great Lakes National Program Office
EPA

Appendix A
List of Rochester Embayment RAC Members

Appendix A

List of Remedial Advisory Committee Members

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Michael Kuzia-Carmel	NYSDEC	michael.kuzia-carmel@dec.ny.gov

Appendix B

NYSDEC Permit ID: 8-2614-00604/00006

PERMIT

Under the Environmental Conservation Law (ECL)

Permittee and Facility Information

Permit Issued To:
U S DEPT OF THE ARMY

THE PENTAGON
WASHINGTON, DC 20310

Facility:
ROCHESTER HARBOR MAINTENANCE DREDGING
GENESEE RIVER
ROCHESTER, NY

Facility Location: in ROCHESTER in MONROE COUNTY
Facility Principal Reference Point: NYTM-E: 288 NYTM-N: 4792.7
Latitude: 43°15'26.3" Longitude: 77°36'42.6"
Project Location: Genesee River Navigational Channel
Authorized Activity: Dredging of an estimated maximum of 450,000 cubic yards of material from the Federal Navigational Channel and placement of the material at the authorized Lake Ontario open-lake disposal site.

Permit Authorizations

Water Quality Certification - Under Section 401 - Clean Water Act
Permit ID 8-2614-00604/00006
Reissuance Effective Date: 2/1/2016 Expiration Date: 12/31/2017

NYSDEC Approval

By acceptance of this permit, the permittee agrees that the permit is contingent upon strict compliance with the ECL, all applicable regulations, and all conditions included as part of this permit.

Permit Administrator: THOMAS P HALEY, Deputy Regional Permit Administrator
Address: NYSDEC Region 8 Headquarters
6274 E Avon-Lima Rd
Avon, NY 14414

Authorized Signature: ____ Date ___/____/____

Permit Components

NATURAL RESOURCE PERMIT CONDITIONS

WATER QUALITY CERTIFICATION SPECIFIC CONDITION

GENERAL CONDITIONS, APPLY TO ALL AUTHORIZED PERMITS

NOTIFICATION OF OTHER PERMITTEE OBLIGATIONS

NATURAL RESOURCE PERMIT CONDITIONS - Apply to the Following Permits: WATER QUALITY CERTIFICATION

1. **Conformance With Plans** All activities authorized by this permit must be in strict conformance with the approved plans submitted by the applicant or applicant's agent as part of the permit application. Such approved plans were prepared by the U.S. Army Corps of Engineers, and included in the December 13, 2013 dated permit application, including but not limited ot the information contained in the December 13, 2013 Public Notice LOHD-14, and received by the NYSDEC on December 16, 2013.

2. **Conformance with Plans - Addenda** In addition to plans referenced in the Condition titled "Conformance with Plans," the activities authorized by this permit must be in strict conformance with the following approved plans and/or submissions made as part of the permit application: December 15, 2015 email from James Miller, U.S. Army Corps of Engineers (include Attachment A).

3. **Rochester Harbor Dredging Restrictive Dates** All dredging and disposal shall be performed during the period between April 30th and September 15th. If a hopper dredge is to be used to perform the work, the operation will be completed by August 15th.

4. **Overflow Dredging Prohibited** Under no circumstances is the dredging operation to be conducted in such a manner that water, and/or suspended sediments, be allowed to be discharged from the vessel by "overflow dredging" or discharged from the vessel(s) other than at the approved open-lake disposal site.

5. **Pre-Dredging Meeting Notification** This office requests that a two week advance notification of the Corps Pre-dredging meeting(s) with the selected contractor and reserves the right to attend and participate in this meeting.

6. **Dreding Site Visit** This office also requests that an onsite field visit be scheduled within two weeks of the beginning of the dreding operation. This would include, but not be limited to vessels used in the dredging and/or disposal activities. The purpose of the meeting is to observe and comment on the compliance of the dredging operation.

7. **Precautions Against Contamination of Waters** All necessary precautions shall be taken to preclude contamination of any wetland or waterway by suspended solids, sediments, fuels, solvents, lubricants, epoxy coatings, paints, concrete, leachate or any other environmentally deleterious materials associated with the project.

WATER QUALITY CERTIFICATION SPECIFIC CONDITIONS

1. **Water Quality Certification** The NYS Department of Environmental Conservation hereby certifies that the subject project will not contravene effluent limitations or other limitations or standards under Sections 301, 302, 303, 306 and 307 of the Clean Water Act of 1977 (PL 95-217) provided that all of the conditions listed herein are met.

GENERAL CONDITIONS - Apply to ALL Authorized Permits:

1. Facility Inspection by The Department The permitted site or facility, including relevant records, is subject to inspection at reasonable hours and intervals by an authorized representative of the Department of Environmental Conservation (the Department) to determine whether the permittee is complying with this permit and the ECL. Such representative may order the work suspended pursuant to ECL 71- 0301 and SAPA 401(3).

The permittee shall provide a person to accompany the Department's representative during an inspection to the permit area when requested by the Department.

A copy of this permit, including all referenced maps, drawings and special conditions, must be available for inspection by the Department at all times at the project site or facility. Failure to produce a copy of the permit upon request by a Department representative is a violation of this permit.

2. Relationship of this Permit to Other Department Orders and Determinations Unless expressly provided for by the Department, issuance of this permit does not modify, supersede or rescind any order or determination previously issued by the Department or any of the terms, conditions or requirements contained in such order or determination.

3. Applications For Permit Renewals, Modifications or Transfers The permittee must submit a separate written application to the Department for permit renewal, modification or transfer of this permit. Such application must include any forms or supplemental information the Department requires. Any renewal, modification or transfer granted by the Department must be in writing. Submission of applications for permit renewal, modification or transfer are to be submitted to:

Regional Permit Administrator
NYSDEC Region 8 Headquarters
6274 E Avon-Lima Rd
Avon, NY14414

4. Submission of Renewal Application The permittee must submit a renewal application at least 30 days before permit expiration for the following permit authorizations: Water Quality Certification.

5. Permit Modifications, Suspensions and Revocations by the Department The Department reserves the right to exercise all available authority to modify, suspend or revoke this permit. The grounds for modification, suspension or revocation include:

a. materially false or inaccurate statements in the permit application or supporting papers;

b. failure by the permittee to comply with any terms or conditions of the permit;

c. exceeding the scope of the project as described in the permit application;

d. newly discovered material information or a material change in environmental conditions, relevant technology or applicable law or regulations since the issuance of the existing permit;

e. noncompliance with previously issued permit conditions, orders of the commissioner, any provisions of the Environmental Conservation Law or regulations of the Department related to the permitted activity.

6. Permit Transfer Permits are transferrable unless specifically prohibited by statute, regulation or another permit condition. Applications for permit transfer should be submitted prior to actual transfer of ownership.

NOTIFICATION OF OTHER PERMITTEE OBLIGATIONS

Item A: Permittee Accepts Legal Responsibility and Agrees to Indemnification
The permittee, excepting state or federal agencies, expressly agrees to indemnify and hold harmless the Department of Environmental Conservation of the State of New York, its representatives, employees, and agents ("DEC") for all claims, suits, actions, and damages, to the extent attributable to the permittee's acts or omissions in connection with the permittee's undertaking of activities in connection with, or operation and maintenance of, the facility or facilities authorized by the permit whether in compliance or not in compliance with the terms and conditions of the permit. This indemnification does not extend to any claims, suits, actions, or damages to the extent attributable to DEC's own negligent or intentional acts or omissions, or to any claims, suits, or actions naming the DEC and arising under Article 78 of the New York Civil Practice Laws and Rules or any citizen suit or civil rights provision under federal or state laws.

Item B: Permittee's Contractors to Comply with Permit
The permittee is responsible for informing its independent contractors, employees, agents and assigns of their responsibility to comply with this permit, including all special conditions while acting as the permittee's agent with respect to the permitted activities, and such persons shall be subject to the same sanctions for violations of the Environmental Conservation Law as those prescribed for the permittee.

Item C: Permittee Responsible for Obtaining Other Required Permits
The permittee is responsible for obtaining any other permits, approvals, lands, easements and rights-of-way that may be required to carry out the activities that are authorized by this permit.

Item D: No Right to Trespass or Interfere with Riparian Rights
This permit does not convey to the permittee any right to trespass upon the lands or interfere with the riparian rights of others in order to perform the permitted work nor does it authorize the impairment of any rights, title, or interest in real or personal property held or vested in a person not a party to the permit.

Appendix C

USACE Rochester Harbor Dredged Sediment Evaluation, December 2016

US Army Corps
of Engineers
Buffalo District

Rochester Harbor Dredged Sediment Evaluation

Rochester, New York

December 2016

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Contents

1.0 Introduction

Sampling and testing of sediments and water was conducted to evaluate sediment quality within the Federal navigation channels of Rochester Harbor, New York. Sediments within maintained areas of the harbor are periodically sampled, tested and evaluated to corroborate the Section 404 Clean Water Act (CWA) contaminant determination that placement of dredged sediments at a specified site in the open waters of Lake Ontario would not cause unacceptable, adverse, contaminant-related impacts (40 CFR 230.11[d]).

1.1 Project Area

Rochester Harbor, New York is located at the mouth of the Genesee River on Lake Ontario, and contains Lake Approach and Entrance Channels in lake, as well as a River Channel and Upper Turning Basin in the river (Figure 1). These Federal navigation channels are deep-draft (authorized depths range from -21 to -24 feet LWD[1]) and designed to accommodate commercial navigation.

The Federal navigation project is situated within the designated Rochester Embayment Area of Concern (AOC). The existing restrictions on dredging activities beneficial use impairment (BUI) for this AOC relates to restrictions on "overflow dredging." This activity involves the discharge of supernatant from the dredging vessel at the dredging site during the dredging process. "Overflow dredging" has the potential to release dissolved contaminants and bacteria back to the river, and results in turbidity. Reductions in loadings of bacteria, nutrients and contaminants to the river as a result of Combined Sewage Overflow Abatement would now result in lower releases of these parameters during "overflow dredging."

Rochester Harbor generally requires maintenance dredging on a semi-annual basis to facilitate commercial, deep-draft navigation. As sediments deposit through sedimentation and accumulate as shoals, they tend to obstruct deep-draft commercial navigation in the channels, thus requiring regular maintenance dredging. About 220,000 cubic yards (CY) of sediments are dredged during each dredging operation. Recent harbor maintenance dredging has occurred in 2014 and 2015.

The most recent testing and evaluation of maintenance-dredged sediments was conducted in 2012 (USACE 2012), based on data collected in 2004, 2005 and 2012. This evaluation determined that dredged material from maintained Federal navigation channels meets Federal guidelines for open lake placement.

1.2 Project Objectives

The objective of this report is to evaluate whether sediments dredged from Rochester Harbor meet contaminant determination CWA Section 404(b)(1) Guidelines for open-lake placement at 40 CFR 230.11(d). Previous testing and evaluation of sediments (USACE [2012]) concluded that these dredged sediments met contaminant determination guidance. This

[1] Low Water Datum: Elevation 243.3 feet above mean water level at Rimouski, Quebec. International Great Lakes Datum 1985.

evaluation is in accordance with formal CWA guidance prescribed in the following dredged sediment testing and evaluation manuals:

- Great Lakes Dredged Material Testing and Evaluation Manual (U.S. Environmental Protection Agency (USEPA)/USACE 1998a).

- Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. – Testing Manual (USEPA/USACE 1998b).

2.0 Sediment Testing and Analysis

2.1 Sample Collection and Processing

On May 25, 2016, surface grab and core sediment samples were collected from locations within the harbor (Figure 2) and open-lake (Figure 3). Twelve discrete samples (RH-1 through RH-12) were collected across the navigation channel for chemical and physical analysis. RH-1 through RH-3 and RH-5 through RH-9 were surface grab samples and RH-4 (turning basin near river mouth) and RH-10 through RH-12 (upstream limit of navigation channel) were core samples. Core samples were attempted to project depth within areas of the harbor that have not been typically maintained and have experienced substantial shoaling, however in each case refusal was encountered prior to project depth. Sample RH-4 reached refusal at a sediment depth of five feet, at an approximate elevation of 229.2 feet, about seven feet above the project elevation of 222.3 feet. Samples RH-10 through RH-12 each reached refusal at a sediment depth of 3 feet, at a minimum estimated elevation of 225.2 feet, about three feet above the project elevation of 222.3 ft. The entire recovered core contents were composited for sample analysis. Water depths in harbor sample areas ranged from -9 to -23 feet LWD.

To characterize lake bottom sediments, two deep water-lake areas offshore of Rochester were sampled for physical and chemical analysis: the open lake placement area (RD) and an open lake reference area (RL) (Figure 3). Surface grab sampling was conducted at four discrete locations within each lake area for physical and chemical analysis: RD-1 through RD-4 from RD and RL-1 through RL-4 from RL. Water depths at the open lake placement area ranged from -30 to -43 ft LWD and water depths at the open lake reference area ranged from -47 to -52 ft LWD.

These discrete samples were also composited for chemical and physical analysis of RD (RD-Comp) and RL (RL-Comp) composite samples, respectively. Comparisons between dredged sediments and sediments from the proposed open lake placement area are considered with regard to the identification of contaminants of concern in dredged sediment.

Each sample was subjected to the following laboratory analyses and associated methods:

- metals (23 per TAL, including mercury) – EPA 6000/7000
- total cyanide (CN) – EPA 9010B/9012A
- total Kjeldahl nitrogen (TKN) – EPA 351
- ammonia-nitrogen (NH_3) – EPA 350

- total phosphorus (TP) – EPA 365.4
- polycyclic aromatic hydrocarbons (PAHs) (16 USEPA priority pollutants plus methylnaphthalenes) – EPA 8270C
- pesticides – EPA 8081A
- polychlorinated biphenyls (PCBs) (as Aroclors) – EPA 8082
- total organic carbon (TOC) – EPA 9060
- total oil and grease – EPA 1664
- grain size (sieve and hydrometer) – ASTM D421, D422

Additionally, each harbor sample was subjected to standard elutriate testing, a laboratory simulation to predict the release of contaminants to the water column from the discharge of dredged sediment. Each elutriate sample was analyzed for the same chemical parameters listed for discrete samples. To characterize contaminant concentrations within the Lake Ontario water column, a water grab sample was collected from Lake Ontario for similar analysis, sample RD.

3.0 Sediment Characterization

3.1 Physical Analysis

Sediment grain size data are summarized in Table 1. Generally, sampled harbor and lake sediments consist of grey/brown silty clay with sand. Harbor sediments are predominately silt and clay with fine sand, generally consisting of about 40% silt and clay, and 35% fine sand. Areas of coarser grained sediments are present at the head of the navigation channel, where sediments are 75 to 95% sand and gravel. Sediments at the two lake areas consist of 21 to 39% silt and clay, and 61 to 80% sand and gravel. Sediments at the open lake reference area contain a higher fraction of coarser grained sand (medium sand) than the harbor or placement area sediments.

3.2 Inorganic Analysis

Table 2 summarizes the results of bulk sediment inorganic analyses, including concentrations of CN, NH_3, TKN, TP, total oil & grease and TOC. Cyanide is not detectable in harbor or lake sediments. Concentrations of NH_3, TKN, TP and total oil & grease are not substantially different between harbor and lake samples. TOC ranged from 0.32 to 3.3% in the harbor sediments compared to 0.62 to 2.2% for lake sediments.

3.3 Metals Analysis

Table 3 summarizes the results for bulk sediment metal analyses. Data were reported for aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, total chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium and zinc. Harbor sediment metal concentrations are not substantially different compared to lake sediments, with the exception of cadmium (4.9 mg/kg) and silver (10 mg/kg) in sample RH-12. Silver has previously been detected in harbor sediments at concentrations up to 7.13 mg/kg and at concentrations up to 3.87 mg/kg and 12 mg/kg for the open lake reference and placement areas respectively (USACE 2012). To evaluate the toxicological significance of these concentrations, solid phase toxicity test results from a recent sediment testing and evaluation effort for the Rochester Embayment AOC (Battelle 2012) were considered. As part of this effort, 10-day toxicity testing with the amphipod *Hyalella azteca* indicated no significant reductions to survival for AOC sediments compared to control sediments at average cadmium and silver concentrations of up to 4.64 mg/kg and 16.3 mg/kg respectively. Of the two species that are recommended for dredged sediment toxicity testing, *H. azteca* is considered to be more sensitive to metals. Based on this information, cadmium and silver in dredged sediment are not identified as contaminants of concern.

3.4 PAH Analysis

Table 4 summarizes total PAH concentrations in the bulk sediment samples. PAH laboratory data were reported as 17 individual PAH compounds (16 USEPA priority pollutants and 2-methylnaphthalene). Total PAH concentrations in harbor sediments range from 402 to 2,899 µg/kg. This is similar to the range of 598 to 2,054 µg/kg measured in lake sediments.

3.5 Pesticide Analysis

Table 5 summarizes pesticide concentrations in the bulk sediment samples. Pesticides were generally not detectable in harbor or lake sediments, with the exception of dichlorodiphenyltrichloroethane (DDT) and metabolites dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyldichloroethylene (DDE). Detected total DDT concentrations in harbor sediments range from 0.64 to 2.5 µg/kg, compared to 0.63 to 19.9 µg/kg for lake sediments. Beta chlordane was detected at levels just above the reporting limit in two harbor samples. Based on the infrequent detection of pesticides within harbor sediments and the relatively low levels that were analyzed, sediment associated pesticides are not identified as a contaminant of concern.

3.6 PCB Analysis

Table 6 summarizes total PCB concentrations in the bulk sediment samples. PCB Aroclor laboratory data were reported as seven individual Aroclor mixtures, with Aroclors 1242, 1254 and 1260 being detected. PCB Aroclors are generally not detectable in harbor sediments, with only one detection of 16 µg/kg. PCB Aroclor concentrations are not detectable in placement area sediments, but ranged from 99 to 170 µg/kg in open lake reference sediments.

3.7 Elutriate Test Analysis

The elutriate test is a laboratory preparation used to predict the release of contaminants to the water column resulting from the discharge of dredged sediment. Sediment and water from the dredging site are mixed into a slurry with a sediment to water ratio of 1:4, and subsequently allowed to settle for 1 hour. The resulting supernatant is sampled, centrifuged to remove particulates and then analyzed as the elutriate. Elutriate results can be directly compared to applicable water quality standards to evaluate potential impacts to the water column associated with the discharge of dredged sediment.

Elutriate test results were reported for the same constituents that were analyzed in the sediment samples. The elutriate contaminant concentration data are summarized in Tables 7 through 11. PAHs and PCBs are not detectable in the elutriate samples. Low releases of metals, inorganics (CN, NH_3 and TP) and pesticides (beta-chlordane and delta hexachlorocyclohexane [BHC]) were detected at concentrations that would meet applicable state water quality standards for the protection of aquatic life.

4.0 Conclusion

This evaluation of Rochester Harbor and offshore Lake Ontario sediments shows that the open lake placement of dredged sediments at the existing, authorized open-lake placement area is not expected to cause unacceptable, adverse, contaminant-related impacts. This indicates that the open-lake placement of these dredged sediment meets the contaminant determination portion of the CWA Section 404 (b) (1) Guidelines (40 CFR 230.11[d]). This conclusion is limited to an elevation of 229 feet in the turning basin and an elevation of 225 feet at the head of navigation.

5.0 References

Battele (2012) Site characterization at the Genesee River sediment site, Rochester Embayment AOC, Rochester, New York. Report prepared by Battelle for the USEPA Great Lakes National Program Office.

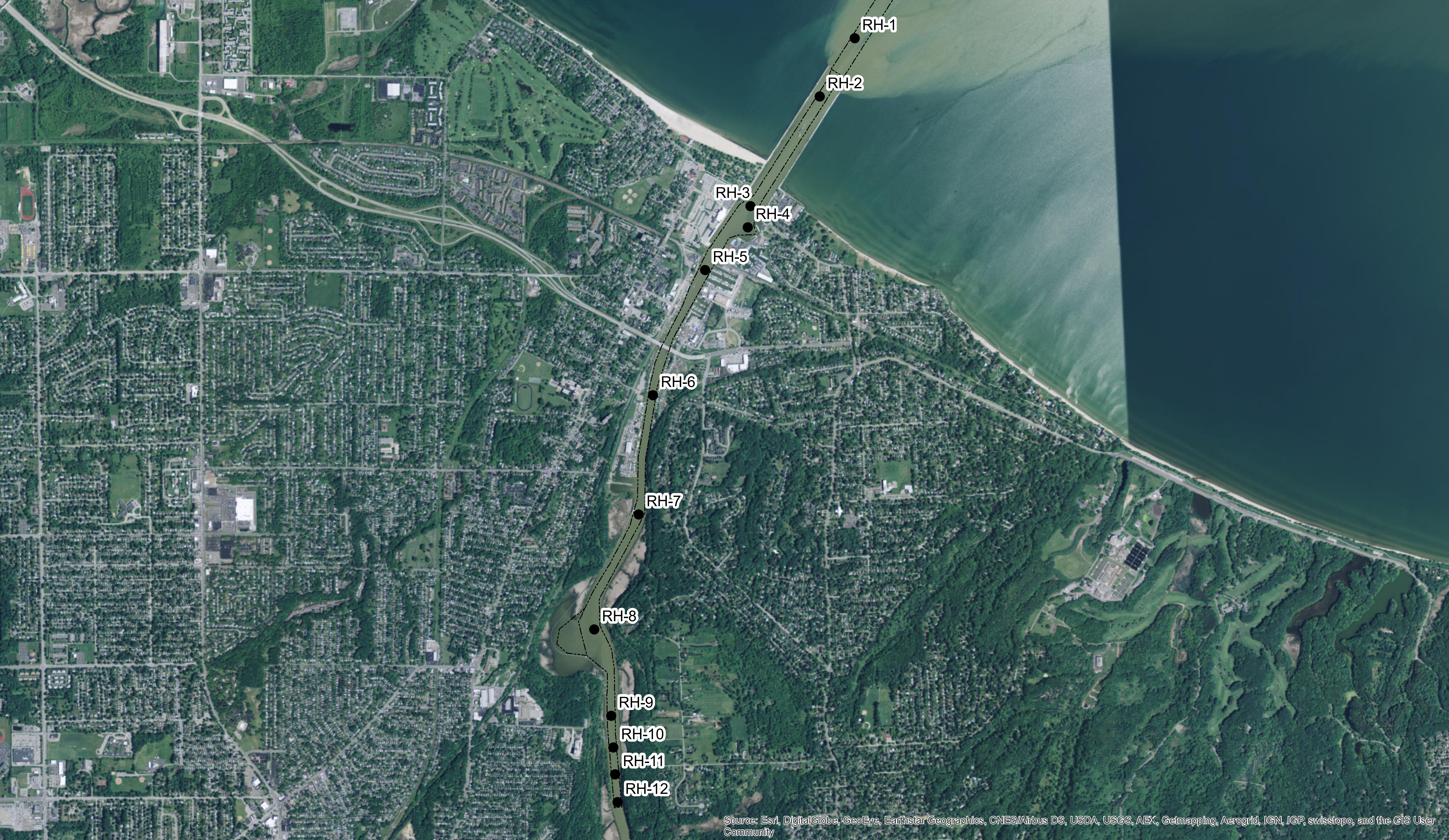
RTI (2016) Analytical data on sediments collected from Rochester Harbor Federal navigation channels and open-lake areas in Lake Ontario.

USEPA, USACE (1998a) Great Lakes Dredged Material Testing and Evaluation Manual.

USEPA, USACE (1998b) Evaluation of dredged material proposed for discharge in waters of the U.S.—Testing Manual.

USACE (2012) Evaluation of Rochester Harbor Federal navigation channel material with respect to suitability for open-lake placement. Report prepared by USACE, Buffalo District.

FIGURES


RH-1
RH-2
RH-3
RH-4
RH-5
RH-6
RH-7
RH-8
RH-9
RH-10
RH-11
RH-12
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community


RL-1
RL-2
RL-3
RL-4
RD-1
RD-2
RD-3
RD-4
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Harbor Sampling Locations

site_id	y_coord	x_coord
RH-1	43° 15.930' N	77° 35.813' W
RH-2	43° 15.738' N	77° 35.975' W
RH-3	43° 15.375' N	77° 36.297' W
RH-4	43° 15.304' N	77° 36.310' W
RH-5	43° 15.164' N	77° 36.507' W
RH-6	43° 14.748' N	77° 36.750' W
RH-7	43° 14.352' N	77° 36.823' W
RH-8	43° 13.970' N	77° 37.031' W
RH-9	43° 13.682' N	77° 36.959' W
RH-10	43° 13.576' N	77° 36.951' W
RH-11	43° 13.487' N	77° 36.944' W
RH-12	43° 13.394' N	77° 36.934' W

Lake Sampling Locations

site_id	y_coord	x_coord
RL-1	43° 17.601' N	77° 37.146' W
RL-2	43° 17.590' N	77° 36.725' W
RL-3	43° 17.358' N	77° 37.149' W
RL-4	43° 17.347' N	77° 36.739' W
RD-1	43° 16.586' N	77° 34.590' W
RD-2	43° 16.586' N	77° 34.267' W
RD-3	43° 16.371' N	77° 34.593' W
RD-4	43° 16.358' N	77° 34.251' W

TABLES

TABLE 1: Rochester Harbor and Lake Ontario Sediment Particle Size Distribution (RTI 2016)

PARTICLE SIZE (%)	ROCHESTER HARBOR											
	RH-01	**RH-02**	**RH-03**	**RH-04**	**RH-05**	**RH-06**	**RH-07**	**RH-08**	**RH-09**	**RH-10**	**RH-11**	**RH-12**
CLAY	9	13	16	20	20	17	14	12	9.8	9	0.1 U	6.7
SILT	36	29	34	21	6.5	21	35	36	33	16	4.6	6.6
FINE SAND	42	40	26	30	53	36	37	20	41	62	77	76
MEDIUM SAND	13	18	24	27	19	24	14	30	16	11	18	8.7
COARSE SAND	0.3	0.5	1.5	1.4	1.1	1.6	0.6	2.8	1	1.7	0.3	1.6
FINE GRAVEL	0.1	0.1 U	0.1	0.1	0.1 U	0.1 U	0.1 U	0.4	0.1 U	0.1 U	0.1	0.1 U
COARSE GRAVEL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL SILT/CLAY	**45**	**42**	**50**	**41**	**27**	**38**	**49**	**48**	**43**	**25**	**5**	**13**
TOTAL SAND/GRAVEL	**55**	**59**	**52**	**59**	**73**	**62**	**52**	**53**	**58**	**75**	**95**	**86**

PARTICLE (%)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	**RD-02**	**RD-03**	**RD-04**	**RL-01**	**RL-02**	**RL-03**	**RL-04**
CLAY	10	9.6	13	18	13	12	18	21
SILT	23	11	26	12	24	20	20	17
FINE SAND	57	76	45	61	32	34	34	23
MEDIUM SAND	8.7	2.7	14	8.1	28	28	24	33
COARSE SAND	0.5	0.6	1.6	0.7	2.6	5	3.5	5.9
FINE GRAVEL	0.1 U	0.3	0.3	0.2	0.2	0.2	0.2	0.5
COARSE GRAVEL	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TOTAL SILT/CLAY	**33**	**21**	**39**	**30**	**37**	**32**	**38**	**38**
TOTAL SAND/GRAVEL	**66**	**80**	**61**	**70**	**63**	**67**	**62**	**62**

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

TABLE 2: Rochester Harbor and Lake Ontario Sediment Inorganics Concentrations (RTI 2016)

PARAMETER (mg/kg)	ROCHESTER HARBOR											
	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
CYANIDE	0.57 UJ	0.5 U	0.52 U	0.47 U	0.53 U	0.57 U	0.48 U	0.67 U	0.53 U	0.51 U	0.43 U	0.47 U
NITROGEN, AMMONIA	88	77	89	52	82	73	120	110	98	110	63	60
NITROGEN, TOTAL KJELDAHL (TKN)	780	300	420	550	550	680	560	890	650	710	260	610
PHOSPHORUS, TOTAL (AS P)	16 J	13	25	22	30	42	20	21	21	9.5	6.6	14
TOTAL OIL & GREASE	160 U	150 U	170	140 U	160	250	150 U	270	250	180	130 U	220
TOTAL ORGANIC CARBON (%)	1.4	0.85	1.2	1.3	0.96	1.7	1.0	1.8	1.3	3.3	0.32 J	0.68
PERCENT MOISTURE (%)	40	33	39	32	36	41	34	51	38	36	23	32

PARAMETER (mg/kg)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	RD-02	RD-03	RD-04	RL-01	RL-02	RL-03	RL-04
CYANIDE	0.48 U	0.49 U	0.48 U	0.47 U	0.56 U	0.55 U	0.56 U	0.57 U
NITROGEN, AMMONIA	72	83	64	51	370	66	70	49
NITROGEN, TOTAL KJELDAHL (TKN)	320	190	200	200	730	690	360	270
PHOSPHORUS, TOTAL (AS P)	14	11	15	21	24	26	23	21
TOTAL OIL & GREASE	150 U	140 U	140 U	150 U	170 U	160 U	170 U	380
TOTAL ORGANIC CARBON (%)	1.3	0.62	1.3	0.93	1.0	1.1	1.1	2.2
PERCENT MOISTURE (%)	32	31	32	32	41	39	41	42

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

J: ESTIMATED RESULT

TABLE 3: Rochester Harbor and Lake Ontario Sediment Metals Concentrations (RTI 2016)

METAL (mg/kg)	ROCHESTER HARBOR											
	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
ALUMINUM	7,900	8,100	8,800	9,400	9,300	10,000	7,700	12,000	8,400	7,000	6,400	8,600
ANTIMONY	6.9	6.6	7.4	7.2	7.4	8.3	6.5	9.1	7.3	7	6	5.8
ARSENIC	5.7	5.4	5.8	6.1	5.1	5.7	5.7	7.6	6.2	6.6	4.1	5.7
BARIUM	55	54	57	60	58	63	48	78	55	54	28	74
BERYLLIUM	0.41	0.38	0.41	0.42	0.43	0.5	0.35	0.59	0.41	0.37	0.27	0.3
CADMIUM	0.26 J	0.73	0.2 J	0.26	0.24 J	0.31	0.15 J	0.23 J	0.21 J	0.24 J	0.11 J	**4.9**
CALCIUM	9,600	7,700	8,700	9,300	8,600	9,900	8,300	9,800	8,400	7,600	3,700	6,300
CHROMIUM, TOTAL	16	15	15	16	16	19	13	20	15	13	9.9	19
COBALT	6.9 J	6.6	7.4	7.1	7.3	8.1	6.4	9.1	7.3	6.9	5.8	5.6
COPPER	57	54	57	57	57	68	49	74	56	53	36	53
IRON	14,000	13,000	17,000	17,000	17,000	19,000	15,000	21,000	17,000	15,000	14,000	15,000
LEAD	12	13	9.1	13	9.9	13	7.8	12	9.4	13	10	26
MAGNESIUM	4,900	4,600	5,700	5,900	5,600	6,000	5,400	6,700	5,500	4,000	3,200	4,300
MANGANESE	380	350	490	450	410	500	410	590	460	460	240	300
MERCURY	0.033	0.039	0.035	0.031	0.024	0.036	0.014	0.027	0.02	0.025	0.013	0.08
NICKEL	19	19	20	20	20	23	17	25	19	17	14	17
POTASSIUM	1,900	1,600	1,800	1,800	1,900	2,200	1,500	2,400	1,600	1,400	990	1,300
SELENIUM	1.3 UJ	1.1 U	1.3 U	1.1 U	1.2 U	1.3 U	1.2 U	1.5 U	1.2 U	1.1 U	1 U	1.1 U
SILVER	1 J	1.9	0.39 J	1.8	1.5	2.2	0.27 J	1.3 J	0.85 J	0.55 J	0.58 J	**10**
SODIUM	98	91	94	95	100	120	90	130	98	92	63	78
THALLIUM	0.45 UJ	0.4 U	0.44 U	0.39 U	0.42 U	0.46 U	0.41 U	0.53 U	0.42 U	0.4 U	0.35 U	0.4 U
VANADIUM	17	15	16	17	17	19	14	20	16	13	10	15
ZINC	62	60	55	61	60	75	47	70	54	61	44	95

METAL (mg/kg)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	RD-02	RD-03	RD-04	RL-01	RL-02	RL-03	RL-04
ALUMINUM	5,700	5,800	7,700	12,000	12,000	9,400	9,900	10,000
ANTIMONY	4	4.2	5.1	7.9	7.1	5.6	5.9	5.8
ARSENIC	2	3.1	4.2	4.9	5.4	2.7	3.8	4.9
BARIUM	34	26	38	55	86	75	85	120
BERYLLIUM	0.19 J	0.18 J	0.27	0.4	0.4	0.31	0.3	0.35
CADMIUM	0.24	0.43	0.18 J	0.41	1.3	0.93	0.74	0.98
CALCIUM	24,000	11,000	11,000	14,000	20,000	43,000	25,000	56,000
CHROMIUM, TOTAL	8.7	9.3	11	17	33	25	21	23
COBALT	3.8	4	5	7.7	6.7	5.4	5.7	5.5
COPPER	29	30	41	61	67	53	52	53
IRON	11,000	11,000	14,000	22,000	20,000	16,000	17,000	17,000
LEAD	6	6.8	8.2	11	29	20	18	20
MAGNESIUM	4,700	4,500	4,800	7,700	8,800	7,800	7,400	6,800
MANGANESE	300	340	330	540	420	360	390	370
MERCURY	0.034	0.039 J	0.035 J	0.033 J	0.71	0.74	0.41	0.58
NICKEL	10	10	13	20	27	21	19	20
POTASSIUM	980	910	1,200	1,700	2,400	1,800	1,700	2,000
SELENIUM	1.1 U	1 U	1.1 U	1.7 U	1.3 U	1.2 U	1.3 U	1.3 U
SILVER	0.56 J	1	1.1	1.7	2.6	1.6	2.3	3.3
SODIUM	86	85	82	110	150	240	160	300
THALLIUM	0.39 U	0.36 U	0.38 U	0.6 U	0.46 U	0.42 U	0.46 U	0.44 U
VANADIUM	9.6	9.9	12	18	22	17	18	17
ZINC	37	47	44	69	130	95	83	87

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

J: ESTIMATED RESULT

TABLE 4: Rochester Harbor and Lake Ontario Sediment PAH Concentrations (RTI 2016)

PAH (µg/kg)	ROCHESTER HARBOR											
	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
2-METHYLNAPHTHALENE	15	17	13 U	12 U	14	19	12 U	16 U	13 U	15	10 U	12 U
ACENAPHTHENE	12 U	20	12 U	15	11 U	34	11 U	15 U	15	16	9.4 U	11 U
ACENAPHTHYLENE	12 U	37	11 U	14	12	16	11 U	27	11 U	20	9.1 U	10 U
ANTHRACENE	24	56	13 U	23	25	82	12 U	28	37	40	17	14
BENZO(A)ANTHRACENE	68	93	42	58	100	200	32	110	95	140	65	52
BENZO(A)PYRENE	80	99	47	67	91	220	34	120	100	150	56	55
BENZO(B)FLUORANTHENE	110	110	67	93	140	290	51	190	140	220	68	79
BENZO(G,H,I)PERYLENE	70	63	44	55	76	170	30	87	80	120	34	46
BENZO(K)FLUORANTHENE	42	44	29	38	46	130	26 U	62	49	74	29	26
CHRYSENE	82	100	55	80	110	260	41	130	110	180	65	62
DIBENZ(A,H)ANTHRACENE	44 U	39 U	42 U	38 U	41 U	44 U	39 U	53 U	42 U	41 U	34 U	38 U
FLUORANTHENE	180	220	110	170	220	520	83	230	270	430	150	130
FLUORENE	16 U	30	15 U	22	15 U	36	14 U	19 U	17	25	12 U	14 U
INDENO(1,2,3-C,D)PYRENE	54	52	33	44	63	140	25	78	66	100	30	36
NAPHTHALENE	30	18	10 U	9.3 U	15	12	9.6 U	13 U	10 U	19	8.2 U	9.3 U
PHENANTHRENE	88	170	48	110	92	300	36	77	150	210	17	43
PYRENE	150	220	91	150	190	470	70	210	230	360	130	120
TOTAL PAHs	**993**	**1,349**	**566**	**939**	**1,194**	**2,899**	**402**	**1,349**	**1,359**	**2,119**	**661**	**663**

PAH (µg/kg)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	RD-02	RD-03	RD-04	RL-01	RL-02	RL-03	RL-04
2-METHYLNAPHTHALENE	49	24	18	19	38	31	39	40
ACENAPHTHENE	35	13	13	14	18	19	18	22
ACENAPHTHYLENE	36	14	19	23	52	44	42	61
ANTHRACENE	91	31	36	31	72	63	52	69
BENZO(A)ANTHRACENE	150	36	89	78	160	140	120	140
BENZO(A)PYRENE	140	30	100	78	200	180	140	170
BENZO(B)FLUORANTHENE	170	38	130	110	240	200	160	220
BENZO(G,H,I)PERYLENE	82	24	66	56	150	130	95	120
BENZO(K)FLUORANTHENE	64	25 U	35	29	77	79	57	66
CHRYSENE	140	37	100	78	160	140	120	150
DIBENZ(A,H)ANTHRACENE	38 U	38 U	38 U	38 U	44 U	42 U	44 U	46 U
FLUORANTHENE	320	88	200	170	250	220	200	260
FLUORENE	46	22	18	20	26	21	26	28
INDENO(1,2,3-C,D)PYRENE	76	19	60	47	120	110	77	98
NAPHTHALENE	84	62	29	34	81	69	73	69
PHENANTHRENE	240	78	100	95	140	110	110	150
PYRENE	280	82	190	160	270	220	210	280
TOTAL PAHs	**2,003**	**598**	**1,203**	**1,042**	**2,054**	**1,776**	**1,539**	**1,943**

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

TABLE 5: Rochester Harbor and Lake Ontario Sediment Pesticide Concentrations (RTI 2016)

PESTICIDE (µg/kg)	ROCHESTER HARBOR											
	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
ALDRIN	0.56 U	0.5 U	0.55 U	0.48 U	0.52 U	0.56 U	0.5 U	0.68 U	0.53 U	0.52 U	0.43 U	0.49 U
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	0.48 U	0.43 U	0.48 U	0.42 U	0.45 U	0.48 U	0.43 U	0.59 U	0.46 U	0.45 U	0.37 U	0.43 U
ALPHA ENDOSULFAN	0.62 U	0.56 U	0.61 U	0.54 U	0.58 U	0.62 U	0.55 U	0.75 U	0.59 U	0.58 U	0.48 U	0.55 U
ALPHA-CHLORDANE	0.62 U	0.55 U	0.61 U	0.53 U	0.57 U	0.62 U	0.55 U	0.75 U	0.59 U	0.58 U	0.48 U	0.54 U
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.59 U	0.53 U	0.58 U	0.51 U	0.55 U	0.59 U	0.53 U	0.72 U	0.57 U	0.55 U	0.46 U	0.52 U
BETA ENDOSULFAN	0.62 U	0.55 U	0.61 U	0.53 U	0.57 U	0.61 U	0.55 U	0.75 U	0.59 U	0.58 U	0.48 U	0.54 U
BETA-CHLORDANE	0.62 U	0.55 U	0.61 U	0.53 U	0.57 U	0.62 U	0.55 U	0.75 U	0.59 U	0.58 U	**0.54 J**	**0.63 J**
CHLORDANE	5.8 U	5.2 U	5.7 U	5 U	5.4 U	5.7 U	5.1 U	7 U	5.5 U	5.4 U	4.4 U	5.1 U
DDD (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHANE)	0.9 U	0.8 U	0.89 U	0.78 U	0.83 U	0.89 U	0.8 U	1.1 U	0.86 U	0.84 U	0.69 U	0.79 U
DDE (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHENE)	0.52 U	**0.64 J**	**1 J**	**1 J**	**1.6 J**	0.52 U	**0.73 J**	0.63 U	**2.5 J**	**1.5**	**0.64 J**	**0.69 J**
DDT (1,1-BIS(CHLOROPHENYL)-2,2,2-TRICHLOROETHANE)	0.58 U	0.52 U	0.57 U	0.5 U	0.54 U	0.58 U	0.52 U	0.7 U	0.56 U	0.54 U	0.45 U	0.51 U
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.49 U	0.43 U	0.48 U	0.42 U	0.45 U	0.48 U	0.43 U	0.59 U	0.46 U	0.45 U	0.37 U	0.43 U
DIELDRIN	0.6 U	0.53 U	0.59 U	0.52 U	0.55 U	0.59 U	0.53 U	0.72 U	0.57 U	0.56 U	0.46 U	0.53 U
ENDOSULFAN SULFATE	0.62 U	0.56 U	0.61 U	0.54 U	0.58 U	0.62 U	0.55 U	0.75 U	0.59 U	0.58 U	0.48 U	0.55 U
ENDRIN	0.64 U	0.57 U	0.63 U	0.55 U	0.59 U	0.63 U	0.57 U	0.77 U	0.61 U	0.59 U	0.49 U	0.56 U
ENDRIN ALDEHYDE	0.65 U	0.58 U	0.64 U	0.56 U	0.6 U	0.64 U	0.58 U	0.78 U	0.62 U	0.61 U	0.5 U	0.57 U
ENDRIN KETONE	0.61 U	0.54 U	0.6 U	0.52 U	0.56 U	0.6 U	0.54 U	0.73 U	0.58 U	0.57 U	0.47 U	0.53 U
GAMMA BHC (LINDANE)	0.5 U	0.45 U	0.5 U	0.44 U	0.47 U	0.5 U	0.45 U	0.61 U	0.48 U	0.47 U	0.39 U	0.44 U
HEPTACHLOR	0.61 U	0.54 U	0.6 U	0.52 U	0.56 U	0.6 U	0.54 U	0.73 U	0.58 U	0.57 U	0.47 U	0.53 U
HEPTACHLOR EPOXIDE	0.61 U	0.55 U	0.6 U	0.53 U	0.57 U	0.61 U	0.54 U	0.74 U	0.59 U	0.57 U	0.47 U	0.54 U
METHOXYCHLOR	0.63 U	0.57 U	0.63 U	0.55 U	0.59 U	0.63 U	0.56 U	0.77 U	0.61 U	0.59 U	0.49 U	0.56 U
TOXAPHENE	8.3 U	7.4 U	8.2 U	7.2 U	7.7 U	8.3 U	7.4 U	10 U	7.9 U	7.8 U	6.4 U	7.3 U

PESTICIDE (µg/kg)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	RD-02	RD-03	RD-04	RL-01	RL-02	RL-03	RL-04
ALDRIN	0.5 U	0.48 U	0.48 U	0.49 U	0.56 U	0.54 U	0.56 U	0.57 U
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	0.43 U	0.41 U	0.42 U	0.43 U	**0.92 J**	**0.96 J**	**2.7**	0.5 U
ALPHA ENDOSULFAN	0.55 U	0.53 U	0.54 U	0.55 U	0.63 U	0.6 U	0.62 U	0.64 U
ALPHA-CHLORDANE	0.55 U	0.53 U	0.53 U	0.55 U	0.62 U	0.6 U	0.62 U	0.63 U
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.53 U	0.51 U	0.51 U	0.52 U	0.6 U	0.57 U	0.59 U	0.61 U
BETA ENDOSULFAN	0.55 U	0.53 U	0.53 U	0.55 U	0.62 U	0.6 U	0.62 U	0.63 U
BETA-CHLORDANE	0.55 U	0.53 U	0.53 U	0.55 U	0.62 U	0.6 U	0.62 U	0.63 U
CHLORDANE	5.1 U	4.9 U	5 U	5.1 U	5.8 U	5.6 U	5.8 U	5.9 U
DDD (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHANE)	0.8 U	0.77 U	0.78 U	0.8 U	**8.1 J**	**14**	**2.2 J**	**5.6**
DDE (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHENE)	**0.69 J**	0.45 U	**0.63 J**	**0.63 J**	**5.7**	**5.9**	**2.4**	**5.2**
DDT (1,1-BIS(CHLOROPHENYL)-2,2,2-TRICHLOROETHANE)	0.52 U	0.5 U	0.5 U	**2.4**	0.59 U	0.56 U	0.58 U	0.59 U
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.43 U	0.42 U	0.42 U	0.43 U	0.49 U	0.47 U	0.49 U	0.5 U
DIELDRIN	0.53 U	0.51 U	0.52 U	0.53 U	0.6 U	0.58 U	0.6 U	0.61 U
ENDOSULFAN SULFATE	0.55 U	0.53 U	0.54 U	0.55 U	0.63 U	0.6 U	0.62 U	0.64 U
ENDRIN	0.56 U	0.54 U	0.55 U	**1 J**	0.64 U	0.62 U	0.64 U	0.65 U
ENDRIN ALDEHYDE	0.58 U	0.55 U	0.56 U	0.57 U	0.65 U	0.63 U	0.65 U	0.66 U
ENDRIN KETONE	0.54 U	0.52 U	0.52 U	0.54 U	0.61 U	0.59 U	0.61 U	0.62 U
GAMMA BHC (LINDANE)	0.45 U	0.43 U	0.44 U	0.45 U	0.51 U	0.49 U	0.51 U	0.52 U
HEPTACHLOR	0.54 U	0.52 U	0.52 U	0.54 U	0.61 U	0.59 U	0.61 U	0.62 U
HEPTACHLOR EPOXIDE	0.54 U	0.52 U	0.53 U	0.54 U	0.62 U	0.59 U	0.62 U	0.63 U
METHOXYCHLOR	0.56 U	0.54 U	0.55 U	0.56 U	0.64 U	0.61 U	0.64 U	0.65 U
TOXAPHENE	7.4 U	7.1 U	7.2 U	7.3 U	8.4 U	8 U	8.3 U	8.5 U

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

J: ESTIMATED RESULT

TABLE 6: Rochester Harbor and Lake Ontario Sediment PCB Concentrations (RTI 2016)

PCB (µg/kg)	ROCHESTER HARBOR											
	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
PCB-1016 (AROCHLOR 1016)	5 U	4.5 U	4.9 U	4.3 U	4.6 U	5 U	4.4 U	6 U	4.8 U	4.7 U	3.8 U	4.4 U
PCB-1221 (AROCHLOR 1221)	5 U	4.4 U	4.9 U	4.3 U	4.6 U	4.9 U	4.4 U	6 U	4.7 U	4.6 U	3.8 U	4.4 U
PCB-1232 (AROCHLOR 1232)	7.4 U	6.7 U	7.3 U	6.4 U	6.9 U	7.4 U	6.6 U	9 U	7.1 U	7 U	5.7 U	6.5 U
PCB-1242 (AROCHLOR 1242)	6.2 U	5.5 U	6.1 U	5.3 U	5.7 U	6.1 U	5.5 U	7.5 U	5.9 U	5.8 U	4.8 U	5.4 U
PCB-1248 (AROCHLOR 1248)	5.8 U	5.2 U	5.7 U	5 U	5.4 U	5.8 U	5.2 U	7 U	5.6 U	5.4 U	4.5 U	5.1 U
PCB-1254 (AROCHLOR 1254)	7 U	**16 J**	6.9 U	6 U	6.5 U	7 U	6.2 U	8.5 U	6.7 U	6.5 U	5.4 U	6.1 U
PCB-1260 (AROCHLOR 1260)	4.8 U	4.3 U	4.8 U	4.2 U	4.5 U	4.8 U	4.3 U	5.9 U	4.6 U	4.5 U	3.7 U	4.3 U
PCB-1262 (AROCHLOR 1262)	4.8 U	4.3 U	4.8 U	4.2 U	4.5 U	4.8 U	4.3 U	5.9 U	4.6 U	4.5 U	3.7 U	4.3 U
PCB-1268 (AROCHLOR 1268)	4 U	3.6 U	4 U	3.5 U	3.8 U	4 U	3.6 U	4.9 U	3.9 U	3.8 U	3.1 U	3.6 U
PCB, TOTAL	4.8 U	**16 J**	4.8 U	4.2 U	4.5 U	4.8 U	4.3 U	5.9 U	4.6 U	4.5 U	3.7 U	4.3 U

PCB (µg/kg)	LAKE ONTARIO							
	OPEN LAKE PLACEMENT AREA				OPEN LAKE REFERENCE AREA			
	RD-01	RD-02	RD-03	RD-04	RL-01	RL-02	RL-03	RL-04
PCB-1016 (AROCHLOR 1016)	4.4 U	4.3 U	4.3 U	4.4 U	5 U	4.8 U	5 U	5.1 U
PCB-1221 (AROCHLOR 1221)	4.4 U	4.2 U	4.3 U	4.4 U	5 U	4.8 U	5 U	5.1 U
PCB-1232 (AROCHLOR 1232)	6.6 U	6.4 U	6.4 U	6.6 U	7.5 U	7.2 U	7.5 U	7.6 U
PCB-1242 (AROCHLOR 1242)	5.5 U	5.3 U	5.3 U	5.5 U	6.2 U	6 U	6.2 U	6.3 U
PCB-1248 (AROCHLOR 1248)	5.2 U	5 U	5 U	5.1 U	5.9 U	5.6 U	5.8 U	5.9 U
PCB-1254 (AROCHLOR 1254)	6.2 U	6 U	6 U	6.2 U	**170**	**150**	**99**	**160**
PCB-1260 (AROCHLOR 1260)	4.3 U	4.1 U	4.2 U	4.3 U	4.9 U	4.7 U	4.9 U	4.9 U
PCB-1262 (AROCHLOR 1262)	4.3 U	4.1 U	4.2 U	4.3 U	4.9 U	4.7 U	4.9 U	4.9 U
PCB-1268 (AROCHLOR 1268)	3.6 U	3.5 U	3.5 U	3.6 U	4.1 U	3.9 U	4.1 U	4.1 U
PCB, TOTAL	4.3 U	4.1 U	4.2 U	4.3 U	**170**	**150**	**99**	**160**

U: NOT DETECTED AT THE SPECIFIED REPORTING LIMIT

J: ESTIMATED RESULT

TABLE 7: Lake Ontario Water Column and Rochester Harbor Sediment Elutriate PAH Concentrations (RTI 2016)

PAH (µg/L)	LAKE ONTARIO WATER COLUMN	ROCHESTER HARBOR SEDIMENT ELUTRIATE											
	RD	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
2-METHYLNAPHTHALENE	0.23 U	0.24 U	0.23 U	0.24 U	0.23 U	0.24 U	0.24 U	0.23 U	0.24 U	0.24 U	0.24 U	0.24 U	0.23 U
ACENAPHTHENE	0.18 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
ACENAPHTHYLENE	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U
ANTHRACENE	0.23 U	0.24 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.24 U	0.24 U	0.23 U	0.23 U
BENZO(A)ANTHRACENE	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U
BENZO(A)PYRENE	0.16 U	0.17 U	0.16 U	0.17 U	0.16 U	0.17 U	0.17 U	0.16 U	0.17 U	0.17 U	0.17 U	0.17 U	0.16 U
BENZO(B)FLUORANTHENE	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U
BENZO(G,H,I)PERYLENE	0.27 U	0.28 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.27 U	0.28 U	0.28 U	0.27 U	0.27 U
BENZO(K)FLUORANTHENE	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U
CHRYSENE	0.2 U	0.21 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.21 U	0.21 U	0.2 U	0.2 U
DIBENZ(A,H)ANTHRACENE	0.24 U	0.25 U	0.24 U	0.25 U	0.24 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.24 U
FLUORANTHENE	0.2 U	0.21 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.21 U	0.21 U	0.2 U	0.2 U
FLUORENE	0.19 U	0.2 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.19 U	0.2 U	0.2 U	0.19 U	0.19 U
INDENO(1,2,3-C,D)PYRENE	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U
NAPHTHALENE	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U	0.21 U
PHENANTHRENE	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U	0.13 U
PYRENE	0.28 U	0.29 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.29 U	0.29 U	0.28 U	0.28 U

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TABLE 8: Lake Ontario Water Column and Rochester Harbor Sediment Elutriate Pesticide Concentrations (RTI 2016)

PESTICIDE (μg/L)	LAKE ONTARIO WATER COLUMN	ROCHESTER HARBOR SEDIMENT ELUTRIATE											
	RD	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
ALDRIN	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U
ALPHA ENDOSULFAN	0.0029 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
ALPHA-CHLORDANE	0.0029 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
BETA ENDOSULFAN	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
BETA-CHLORDANE	0.0029 U	**0.015 J**	**0.018 J**	**0.014 J**	0.003 U	**0.015 J**	**0.012 J**	**0.017 J**	**0.02 J**	**0.017 J**	**0.017 J**	0.003 U	**0.022 J**
CHLORDANE	0.031 U	0.032 U	0.032 U	0.031 U	0.032 U	0.031 U	0.031 U	0.031 U	0.031 U	0.032 U	0.032 U	0.032 U	0.032 U
DDD (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHANE)	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
DDE (1,1-BIS(CHLOROPHENYL)-2,2-DICHLOROETHENE)	0.0024 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U	0.0025 U
DDT (1,1-BIS(CHLOROPHENYL)-2,2,2-TRICHLOROETHANE)	0.0029 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	0.0019 U	**0.021 J**	**0.014**	**0.032**	**0.014 J**	**0.033**	**0.017**	**0.023**	**0.025**	**0.038 J**	**0.014**	**0.016 J**	**0.017 J**
DIELDRIN	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
ENDOSULFAN SULFATE	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
ENDRIN	0.0025 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U	0.0026 U
ENDRIN ALDEHYDE	0.0033 U	0.0034 U	0.0034 U	0.0033 U	0.0034 U	0.0033 U	0.0033 U	0.0033 U	0.0033 U	0.0034 U	0.0034 U	0.0034 U	0.0034 U
ENDRIN KETONE	0.0029 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U	0.003 U
GAMMA BHC (LINDANE)	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U	0.0019 U
HEPTACHLOR	0.0026 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U	0.0027 U
HEPTACHLOR EPOXIDE	0.003 U	0.0031 U	0.0031 U	0.003 U	0.0031 U	0.003 U	0.003 U	0.003 U	0.003 U	0.0031 U	0.0031 U	0.0031 U	0.0031 U
METHOXYCHLOR	0.0028 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U	0.0029 U
TOXAPHENE	0.037 U	0.038 U	0.039 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.039 U	0.039 U	0.039 U	0.038 U

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J: ESTIMATED RESULT

TABLE 9: Lake Ontario Water Column and Rochester Harbor Sediment Elutriate PCB Concentrations (RTI 2016)

PESTICIDE (µg/L)	LAKE ONTARIO WATER COLUMN	ROCHESTER HARBOR SEDIMENT ELUTRIATE											
	RD	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
PCB-1016 (AROCHLOR 1016)	0.03 U	0.031 U	0.031 U	0.03 U	0.031 U	0.03 U	0.03 U	0.03 U	0.03 U	0.031 U	0.031 U	0.031 U	0.031 U
PCB-1221 (AROCHLOR 1221)	0.028 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U	0.029 U
PCB-1232 (AROCHLOR 1232)	0.038 U	0.039 U	0.04 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.039 U	0.04 U	0.04 U	0.04 U	0.039 U
PCB-1242 (AROCHLOR 1242)	0.035 U	0.036 U	0.036 U	0.035 U	0.036 U	0.035 U	0.035 U	0.035 U	0.035 U	0.036 U	0.036 U	0.036 U	0.036 U
PCB-1248 (AROCHLOR 1248)	0.029 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	0.03 U
PCB-1254 (AROCHLOR 1254)	0.037 U	0.038 U	0.039 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.038 U	0.039 U	0.039 U	0.039 U	0.038 U
PCB-1260 (AROCHLOR 1260)	0.033 U	0.034 U	0.034 U	0.033 U	0.034 U	0.033 U	0.033 U	0.033 U	0.033 U	0.034 U	0.034 U	0.034 U	0.034 U
PCB-1262 (AROCHLOR 1262)	0.048 U	0.049 U	0.05 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.05 U	0.05 U	0.05 U	0.049 U
PCB-1268 (AROCHLOR 1268)	0.026 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U	0.027 U
PCB, TOTAL	0.048 U	0.049 U	0.05 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.049 U	0.05 U	0.05 U	0.05 U	0.049 U

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TABLE 10: Lake Ontario Water Column and Rochester Harbor Sediment Elutriate Inorganic Concentrations (RTI 2016)

PARAMETER (mg/L)	LAKE ONTARIO WATER COLUMN	ROCHESTER HARBOR SEDIMENT ELUTRIATE											
	RD	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
CYANIDE	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U	0.0011 U
NITROGEN, AMMONIA	0.041 J	1.7	3.3	1.7	6.1	1.2	1	3.2	5.3	3.8	2.9	0.2	6
NITROGEN, TOTAL KJELDAHL (TKN)	0.13 J	2.9	5.4	2.4	9	2.2	1.4	4	5.5	3.9	3.2	0.22 J	6
PHOSPHORUS, TOTAL (AS P)	0.0047 U	0.019	0.011	0.011	0.0047 U	0.015	0.0061 J	0.016	0.016	0.031	0.024	0.014	0.013
TOTAL OIL & GREASE	0.93 J	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U	0.8 U

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TABLE 10: Lake Ontario Water Column and Rochester Harbor Sediment Elutriate Metal Concentrations (RTI 2016)

METAL (mg/L)	LAKE ONTARIO WATER COLUMN	ROCHESTER HARBOR SEDIMENT ELUTRIATE											
	RD	RH-01	RH-02	RH-03	RH-04	RH-05	RH-06	RH-07	RH-08	RH-09	RH-10	RH-11	RH-12
ALUMINUM	0.0078 J	0.0014 U	0.0076 J	0.0027 J	0.0043 J	0.0027 J	0.0049 J	0.0072 U	0.0051 U	0.0056 U	0.01 J	0.0079 U	0.011 J
ANTIMONY	0.00019 U	0.0019 J	0.0015 J	0.00078 J	0.0009 J	0.0006 J	0.00055 J	0.00041 J	0.00034 J	0.0005 J	0.0014 J	0.00074 J	0.0014 J
ARSENIC	0.00088 J	0.0073	0.0052	0.012	0.0078	0.0086	0.0032	0.0065	0.015	0.0093	0.0051	0.00064 J	0.0035
BARIUM	0.022 J	0.16	0.07	0.12	0.16	0.13	0.13	0.14	0.17	0.14	0.13	0.04	0.13
BERYLLIUM	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U	0.00025 U
CADMIUM	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00027 U	0.00043 J
CALCIUM	35	34	37	44	38	38	39	47	50	43	50	40	39
CHROMIUM, TOTAL	0.00072 J	0.0003 U	0.00082 J	0.00057 U	0.0007 J	0.0008 J	0.0005 U	0.00042 J	0.00067 J	0.00064 J	0.00055 J	0.0008 J	0.00084 J
COBALT	0.00015 J	0.00029 J	0.00036 J	0.00066 J	0.00046 J	0.00034 J	0.00026 J	0.00013 J	0.00052 J	0.00027 J	0.00026 J	0.00012 U	0.00012 U
COPPER	0.0015 J	0.00024 U	0.0024 J	0.00085 J	0.0019 J	0.00084 J	0.0014 J	0.0023 J	0.0008 J	0.0014 J	0.0023 J	0.0041 J	0.0025 J
IRON	0.082 J	0.1 J	0.084 J	0.12 J	0.071 J	0.11 J	0.07 J	0.15 J	1.3	0.29	0.18 J	0.091 J	0.094 J
LEAD	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U
MAGNESIUM	9.1	6.9	9.5	9.2	9.3	7.6	7.7	11	11	9.4	12	9.4	9.4
MANGANESE	0.0043 J	1.6	0.21	2.7	0.69	1.6	1.3	1.8	3.1	2.3	2.9	0.054	0.42
MERCURY	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U	0.000052 U
NICKEL	0.0016 J	0.0002 U	0.002 J	0.0023 J	0.0018 J	0.0017 J	0.0016 J	0.0028 J	0.003 J	0.0026 J	0.0029 J	0.002 J	0.003 J
POTASSIUM	1.5	2.6	3.6	3.1	3.9	2.5	2.4	3.5	3.6	3	3.4	2.2	3.3
SELENIUM	0.0015 U	0.0023 J	0.0015 J	0.0015 U	0.0015 J	0.0017 J	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U	0.0015 U
SILVER	0.00024 U	0.00062 J	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00024 U	0.00032 J
SODIUM	12	13	14	14	15	14	15	17	19	17	17	16	17
THALLIUM	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U	0.00016 U
VANADIUM	0.00072 J	0.00049 U	0.00062 J	0.00055 J	0.00049 U	0.00054 J	0.00049 U	0.00049 U	0.00049 U	0.00049 U	0.00049 U	0.00052 J	0.00049 U
ZINC	0.0018 U	0.027 J	0.0018 U	0.0094 J	0.027 J	0.018 J	0.016 J	0.028 J	0.039 J	0.029 J	0.026 J	0.0025 J	0.025 J

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Appendix D

Task 6: Final Summary Report for Site Characterization at the Genesee River Sediment Site, Rochester Embayment AOC, Rochester, New York, June 2012

TASK 6: FINAL SUMMARY REPORT

for

SITE CHARACTERIZATION AT THE GENESEE RIVER SEDIMENT SITE, ROCHESTER EMBAYMENT AOC, ROCHESTER, NEW YORK

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Work Assignment 2-09
Contract No. EP-W-09-024

June 2012

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ABBREVIATIONS AND ACRONYMS

AA	atomic absorption
AOC	area of concern
ASTM	American Society for Testing and Materials
BUI	beneficial use impairment
CAS	Columbia Analytical Services
CO_2	carbon dioxide
COI	contaminant of interest
DGPS	differential global positioning system
DQO	data quality objective
DRO	diesel range organics
ECD	electron capture detection
ERDC	U.S. Army Engineer Research and Development Center
ER-L	effects range-low
ER-M	effects range-median
ESB	equilibrium partitioning sediment benchmark
ESBTU	estimated ESB toxic unit
GC	gas chromatography
GLLA	Great Lakes Legacy Act
GLNPO	Great Lakes National Program Office
GLWQB	Great Lakes Water Quality Board
ID	identification
NWI	National Wetland Inventory
NYSDEC	New York State Department of Environmental Conservation
ORO	oil range organics
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	probable effect concentration
QA/QC	quality assurance and quality control
QAPP	Quality Assurance Project Plan
RM	river mile
RRO	residual range organics
SQG	sediment quality guideline
TCDD	tetrachlorodibenzo-p-dioxin
TEC	threshold effects concentration
TEF	toxicity equivalency factor

TEQ	toxicity equivalent
TOC	total organic carbon
TRE	toxicity reduction evaluation
USACE	U.S. Army Corps of Engineers
U.S. EPA	United States Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WA	Work Assignment
WHO	World Health Organization

1.0: INTRODUCTION

Under contract to the Chicago-based Great Lakes National Program Office (GLNPO) of the United States Environmental Protection Agency (U.S. EPA), Battelle has completed a characterization of the nature and extent of potential contaminants in the Genesee River from the mouth of the river at Lake Ontario upstream 5.1 miles to the Veteran's Memorial Bridge (NY State Route 104) in Rochester, New York. Specifically, under Task 6 of U.S. EPA Work Assignment (WA) 2-09, Contract Number EP-W-09-024, Battelle developed a Quality Assurance Project Plan (QAPP), performed the environmental assessment, and prepared this summary report. Battelle developed the *Quality Assurance Project Plan (QAPP) for Contaminated Sediment Support; Task 6: Site Characterization at the Genesee River Sediment Site, Rochester Embayment AOC, Rochester, New York*, hereafter referred to as the QAPP (Appendix J; Battelle, 2011), which specifically defines the sampling and analysis procedures utilized during the sediment characterization.

The Great Lakes are among the largest and most complex freshwater ecosystems in the world, providing a home, water, and food to millions of aquatic plants, animals, and people. Harmful pollutants to the Great Lakes include polychlorinated biphenyls (PCBs), heavy metals, oil and grease, and polycyclic aromatic hydrocarbons (PAHs). Contaminants such as PCBs settle into the sediment and enter the food chain when they are ingested by fish, causing adverse effects in human health and the environment. Although discharges of toxic chemicals to the Great Lakes have been reduced in the last 30 years, high concentrations of contaminants persist in the sediment (mud) of some rivers, harbors, and bays as a "legacy" of North America's industrialization.

To help address the contaminated sediment problem, the Great Lakes Legacy Act (GLLA) of 2002 was signed into law on November 27, 2002. The Act authorized $270 million in funding over five years, beginning in 2004, to specifically assist with the cleanup of contaminated sediment in America's 31 Areas of Concern (AOCs). AOCs are designated by the United States and Canada as locations where beneficial consumption, dredging activities, or drinking water consumption have been impaired or restricted. For most of these AOCs, the driving factor causing the impairment is contaminated sediment. U.S. EPA's GLNPO administers the Legacy Act. As of June 2011, 10 remediation projects have been largely completed and several more are scheduled to get under way in 2012. Nearly 1,300,000 cubic yards of sediment have been cleaned up. The GLLA of 2002 is part of a larger strategy to provide a healthy, natural Great Lakes environment for swimming and fishing, as well as a source of clean water for drinking and industrial uses.

The Statement of Work for this project provides the basis for support for site characterization at locations under the reauthorization of the GLLA. The approach outlined below to characterize the sediment quality will allow GLNPO to make rigorous, qualitative assessments based on quantitative data to support upcoming remedial actions at this site as well as provide a baseline of conditions prior to remediation.

In the 1981 report of the Great Lakes Water Quality Board (GLWQB) of the International Joint Commission, the Rochester Embayment of Lake Ontario was identified as a Class B AOC with "... moderate violations of water quality objectives and some indications of fish contamination in Rochester Harbor…" (GLWQB, 1981). In its 1985 report , the GLWQB designated the Rochester Embayment a Category 4 AOC, indicating "causative factors known, but remedial action plan not developed and remedial measures not fully implemented," identifying embayment problems as conventional pollutants, heavy metals, toxic organic substances, contaminated sediments, and fish consumption advisories. The report also identified pollutant sources as municipal and industrial point sources, combined sewage overflows, and in-place pollutants (U.S. EPA Great Lakes Rochester Embayment AOC Web site http://www.epa.gov/glnpo/aoc/rochester.html). This AOC includes approximately 9.6 km (6 miles) of the

Genesee River that is influenced by lake levels from the river mouth to the Lower Falls. While action in intervening years has resulted in reductions in point sources and near-elimination of combined sewage overflows, sediment removal in the lower river has been performed as part of the U.S. Army Corps of Engineers (USACE) navigation project in the port area as well as dredging at piers and within harbors.

The purpose of this site characterization project is to evaluate contamination in areas contiguous to the navigation channel to see if remedial action is necessary to delist or move forward delisting of the dredging beneficial use impairments and to evaluate surface sediments with respect to potential impacts to benthos and fish. A limited habitat assessment was also conducted to evaluate opportunities for integrating habitat restoration with potential remediation. This study to determine if the sediments could be remediated under the GLLA was performed at the request of the New York State Department of Environmental Conservation (NYSDEC).

1.1 Project Area

The Rochester Embayment AOC, Rochester, New York, is formed by the indentation of the Monroe County shoreline between Bogus Point in the town of Parma and Nine Mile Point in the town of Webster. The northern boundary of the embayment is delineated by the straight line between these two points. The Kodak Park manufacturing facility is located on the western side of Genesee River at the southern extent of the project study area. Site operations were initiated in 1891 by company founder George Eastman. Kodak Park currently occupies an area nearly 4 miles long and up to a mile wide with some 125 manufacturing buildings. The facility has 40,000 miles of pipelines, 30 miles of roadways, two power plants, and a wastewater treatment plant that opened in 1957. The treatment process was upgraded to advanced secondary treatment in the 1970s (Kodak, 2012). The primary contaminant of concern released by Kodak is the metal silver, critical to the photographic film chemical process. The study area includes approximately 9.6 km (6 miles) of the Genesee River that is influenced by lake levels, from the river's mouth to the Lower Falls. The drainage area of the embayment is approximately 2,500 square miles (6,475 km^2) in area. More information about the AOC can be found at http://epa.gov/greatlakes/aoc/rochester.html. Figure 1-1 provides an overview of the site location.

When the restriction on dredging beneficial use impairment (BUI) was proposed for delisting, one reviewer objected, indicating that sediments outside the federal navigation channel were too contaminated for open lake disposal, the delisting criteria for the BUI. An additional feature of the restrictions on dredging activities BUI is the prohibition of overflow dredging in the lower Genesee River, due to water quality concerns with regard to oxygen depletion, fecal coliform, ammonia and re-suspension of contaminants. This site characterization was proposed based on this objection and on discussions between U.S. EPA, USACE, NYSDEC, the City of Rochester and the AOC Remedial Action Plan Coordinator.

This site characterization evaluates contamination in areas contiguous to the navigation channel, focusing on shoreline areas likely to be dredged in the foreseeable future.

Additional sediment-related BUIs in the Genesee River are, among others, degradation of fish and wildlife populations and degradation of benthos. This site characterization will generate data that can be used to evaluate sediment contamination potentially impacting benthos and fish, especially reintroduced sturgeon in this area, within the approximately 3-mile upstream stretch of the Genesee River.

Figure 1-1. Site Location Map

1.2 Project Objectives

The primary objectives of this WA task are to:

- Characterize contamination in sediments outside of the navigation channel within the Genesee River
- Evaluate surface sediments with respect to potential impacts to benthos and fish.
- Analyze 15 fish collected by U.S. Fish and Wildlife Service (USFWS) in May 2011 for contaminants of concern.

To achieve these objectives, the following WA objectives were identified:

- Evaluate both historical and recently collected data to determine any data gaps, define a list of chemicals of interest based on the data results with respect to BUI delisting, and evaluate the need to supplement existing data for both surface and subsurface sediment in the Genesee River. The data generated from this study will be summarized in a GLNPO-formatted database.
- Formulate a statistical sampling design based on the data gap assessment and data needs for characterizing sediment contamination in sediments adjacent to the dredge channel that may be dredged in the future and in surface sediments upstream of the dredge channel up to the Veteran's Memorial Bridge (NY State Route 104).

- Collect surface and subsurface sediments and analyze them for chemical, physical and bioavailability/toxicological parameters of interest in the river.
- Perform a limited habitat assessment of the Genesee River nearshore/riparian habitat to identify the major habitat types present and the extent of their coverage to provide information that will help assess future remediation opportunities and options.
- Analyze 30 fish tissue samples from 15 fish (Brown bullhead [*Ameiurus nebulosus*]) collected by USFWS in May 2011 for contaminants of concern. Fish tissue results and a brief discussion are presented in Appendix I – Fish Tissue Technical Memorandum.
- Evaluate the sampling results including, but not limited to:
  a. Estimate the horizontal extent of and concentration of contaminated surface (top 6 inches) sediments upstream of the dredged channel area.
  b. Estimate the vertical and horizontal extent of contaminated sediments outside the navigation channel from Lake Ontario to the terminus of the dredge channel.
  c. Characterize the toxicology, bioaccumulation and bioavailability of contaminants as they currently exist in contaminated sediments.
  d. Summarize the results of the fish tissue samples collected by USFWS and analyzed under this WA.
  e. Summarize the habitat assessment information.
  f. Determine that the project qualitative and quantitative quality objectives and limits have been achieved.
- Present the results in a site characterization report that includes recommendations for next steps should data gaps be evident and/or remedial action be warranted.

The overall approach for establishing the sampling plan for the Genesee River was to follow U.S. EPA's data quality objective (DQO) process, which is documented at the following Web site (http://www.epa.gov/quality/qs-docs/g4-final.pdf). This is a systematic planning tool that first targets one or more management decisions that need to be made for the site in question, and then considers the quantitative information needed to support those decisions, the risk (i.e., consequences and probabilities) of making incorrect decisions, and the minimum amount of data required to support the decisions and adequately control the risks. For Genesee River, the goal of sampling is to characterize the nature and extent of contamination in sediments along the shorelines adjacent to the navigation channel from surface sediments down to the expected maximum depths of potential dredging (current channel dredge depth of 23ft) and in surface sediments upstream of the navigation channel. Future dredging may not be to the same depth as the channel, and data from the appropriate interval are available for specific planning purposes. Data were reviewed and qualitatively assessed with respect to potential impacts to benthos and fish by comparing contaminant concentrations to sediment quality guidelines such as the probable effect concentration (PEC) and incorporating the toxicology data produced by this study. In the case of a contaminant of interest (COI) without an associated PEC, an alternative sediment quality guideline was used. For silver, the effects range-low (ER-L) and the effects range-median (ER-M) was used (Long and Morgan, 1990). For total toxicity equivalent (TEQ) of dioxins and furans, definitions of Class A, B, and C from the NYSDEC Technical and Operational Guidance Series 5.1.9 (NYSDEC, 2004) were used. The benchmarks used are further defined in Section 3.1. The project sample design was developed to provide sufficient data to address this objective within bounds defined by DQOs.

The specific applications of each of the analyses used to derive the sampling plan are detailed in Appendix A of the QAPP, Genesee River Sampling Design (Battelle, 2011). QAPP Appendix A also details the power analysis used to derive the sampling plan. As discussed in QAPP Appendix A, the major limitation of the historical data used to establish the sampling design is that the easting and northing coordinates were either unknown or unable to be incorporated during the short timeframe due to not existing in a database. The analytical results were averaged based on sampling areas but spatial correlation analysis could not be performed. The data report for the study phase presented here details the results of field sampling activities, and summarizes the results of laboratory analyses so that GLNPO can evaluate sediment contamination within the project area. Sample collection and laboratory analyses are described in Section 2. Results of analyses are summarized in Section 3.0. Discussion of results and recommendations are presented in Section 4. Appendix A contains a summary table of sample collection information and copies of field records (log books, chain-of-custody forms). Appendix B provides analytical laboratory results for sediment chemical and physical analyses (data tables, narratives, and quality assurance and quality control [QA/QC] summaries) with the laboratory full reports on DVD only. Appendix C contains the whole sediment toxicity testing results (data summary tables and laboratory report). Appendix D contains summaries of the statistical analyses. Appendix E contains habitat assessment photographs. Appendix F contains sediment chemical concentration figures. Appendix G provides an assessment of data usability. Appendix H contains the third-party data validation report (DVD only). Appendix I contains the Fish Tissue Technical Memorandum. Appendix J contains the responses to the Draft Report Comments. Appendix J contains the project QAPP (DVD only).

2.0: FIELD SAMPLE COLLECTION

Sample collection in support of characterizing the nature and extent of contamination in sediments within the Genesee River AOCs (see Figure 1-1) was performed during a single field sampling event in September 2011. Sampling sites occupied for the collection of sediment samples are shown in Figures 2-1a and 2-1b. Areas shaded with blue in the site figures portray the channel dredge area, while tan shading indicates the area outside of the dredged channel. The locations and analytical approach were developed by GLNPO and Battelle. Overall sampling design and details of the analyses and methods are described in the QAPP (Battelle, 2011). Field survey activities, including mobilization and demobilization, extended over a 7-day period. The first day included staff and equipment mobilization; days two through five included sediment core collection and processing; and day six included the collection of a single sediment core followed by staff and equipment demobilization. Table 2-1 provides the field schedule and a brief summary of daily activities.

Table 2-1. Schedule of Field Activity

Activity	Date
Staff and Equipment Mobilization to Rochester, New York	September 11, 2011
Sediment Sample Collection – three surface grabs and three cores	September 12, 2011
Sediment Sample Collection – four surface grabs and five cores	September 13, 2011
Sediment Sample Collection – 10 surface grabs and 10 cores	September 14, 2011
Sediment Sample Collection – nine surface grabs and nine cores	September 15, 2011
Sediment Sample Collection – 11 surface grabs and one core; habitat survey	September 16, 2011
Habitat Photo Collection Staff and Equipment Demobilization	September 17, 2011

2.1 Sediment Collection

Sediment sampling began on September 12, 2011, and continued through September 16, 2011. Sediment core and surface grab sample collections were performed from U.S. EPA R/V *Mudpuppy II*. The Battelle boat (*Gale Force*) was used in support of operations and habitat photography. Surface sediment samples were collected from all 33 proposed locations plus the required four field duplicate samples (collected at GR-03, GR-13, GR-14, and GR-32) for a total of 37 surface sediment samples (Figures 2-1a and 2-1b). Sediment core samples were collected from all 24 proposed locations (co-located with 24 grab samples) plus one additional location (labeled GR-23M) as well as the required three field duplicate cores (collected at GR-03, GR-13, and GR-14), resulting in a total of 28 cores (Figure 2-1b). Sediment cores collected via vibracore ranged in length from 0.9 at GR-11 to 19.9 ft at GR-16. Ten of the 25 sediment cores did not reach a hard-bottom refusal point during collection.

Table 2-2 provides the coordinates of each sample station as well as the water depth, sediment thickness and elevation. Sediment cores that did not penetrate to refusal are identified. Differential global positioning system (DGPS) coordinates for each sample station were acquired from the on-board unit of the R/V *Mudpuppy II* Trimble Pathfinder Pro XRS system with differential corrections provided by the USACE Beacon to provide sub-meter real-time accuracy. Coordinates were hand recorded into the field logs.

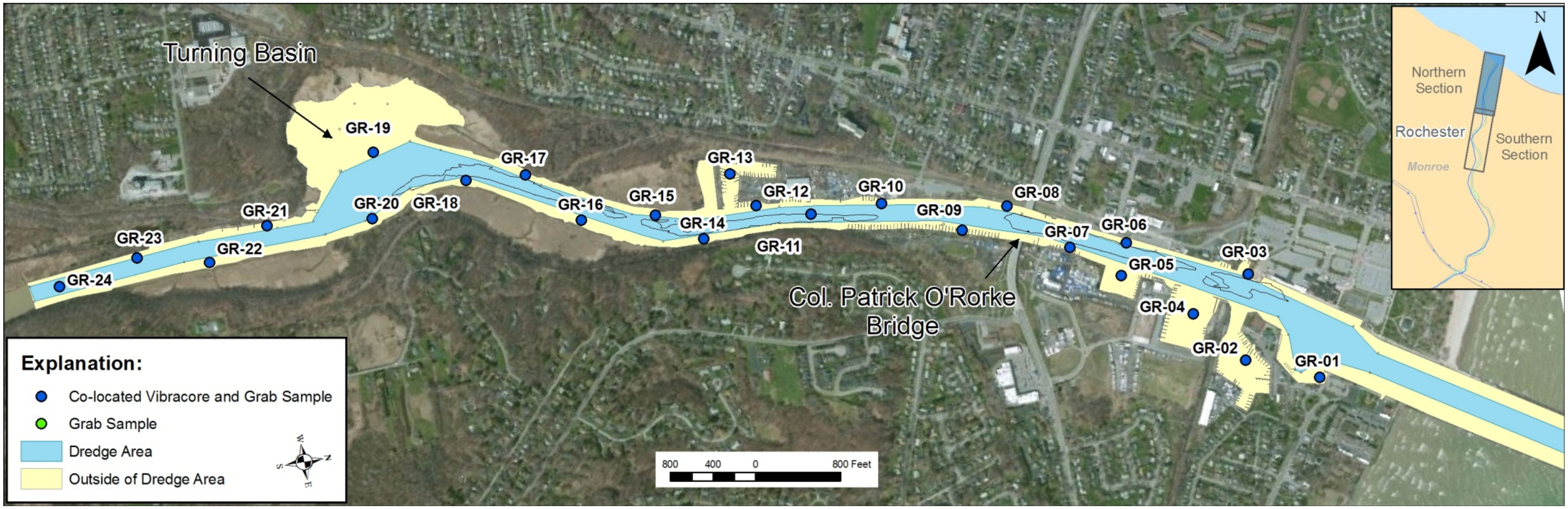

Figure 2-1a. Actual Sediment Sample Locations Adjacent to Dredged Navigation Channel and within Marinas

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Figure 2-1b. Actual Sediment Sample Locations South of Dredged Navigation Channel

Table 2-2. Summary of Core Sample Station Coordinates and Water/Sediment Measurements

Station ID	Samples Collected	Observation Date	Latitude (WGS84; DecDeg)	Longitude (WGS84; DecDeg)	Water Depth[a] (ft)	Sediment Thickness (ft)	Water/Sediment Interface Elevation (ft)	Refusal Elevation (ft)
GR-01	Surface/Core	9/12/2011	43.255253	-77.604240	5.0	15.0	238.3	223.3[b]
GR-02	Surface/Core	9/12/2011	43.253450	-77.605307	8.2	no data	235.1	no data
GR-03	Surface/Core	9/15/2011	43.253920	-77.608308	13.0	9.5	230.3	220.8[b]
GR-03D	Surface Core	9/15/2011	43.253918	-77.608313	13.0	10.0	230.3	220.8[b]
GR-04	Surface/Core	9/12/2011	43.252333	-77.607265	5.4	10.0	237.9	227.9
GR-05	Surface/Core	9/16/2011	43.250695	-77.609078	3.1	8.0	240.2	232.2
GR-06	Surface/Core	9/15/2011	43.250982	-77.610175	13.8	3.5	229.5	226.0
GR-07	Surface/Core	9/15/2011	43.249522	-77.610390	3.6	15.0	239.7	224.7[b]
GR-08	Surface/Core	9/15/2011	43.248120	-77.612227	5.2	14.0	238.1	224.1
GR-09	Surface/Core	9/15/2011	43.246865	-77.611680	-0.6	15.0	243.9	228.9[b]
GR-10	Surface/Core	9/15/2011	43.244952	-77.613137	14.9	7.5	228.4	220.9
GR-11	Surface/Core	9/15/2011	43.243113	-77.613225	16.6	2.0	226.7	224.7
GR-12	Surface/Core	9/15/2011	43.241772	-77.613898	1.9	20.0	241.4	221.4[b]
GR-13	Surface/Core	9/14/2011	43.241237	-77.615162	2.9	12.5	240.4	227.9
GR-13D	Surface/Core	9/14/2011	43.241237	-77.615162	2.9	14	240.4	227.9
GR-14	Surface/Core	9/14/2011	43.240265	-77.613087	9.5	9.0	233.8	224.8
GR-14D	Surface/Core	9/14/2011	43.240257	-77.613093	9.5	9.0	233.8	224.8
GR-15	Surface/Core	9/14/2011	43.239162	-77.614210	11.7	15.0	231.6	216.6[b]
GR-16	Surface/Core	9/14/2011	43.237257	-77.614522	5.6	20.0	237.7	217.7[b]
GR-17	Surface/Core	9/14/2011	43.236040	-77.616453	10.9	5.0	232.4	227.4
GR-18	Surface/Core	9/14/2011	43.234515	-77.616653	11.7	13.0	231.6	218.6
GR-19	Surface/Core	9/13/2011	43.232280	-77.618243	0.4	20.0	242.9	222.9[b]
GR-20	Surface/Core	9/14/2011	43.231958	-77.615945	9.9	15.0	233.4	218.4[b]
GR-21	Surface/Core	9/13/2011	43.229248	-77.616382	6.8	15.0	236.5	221.5[b]
GR-22	Surface/Core	9/14/2011	43.227615	-77.615493	5.3	17.5	238.0	220.5
GR-23	Surface/Core	9/13/2011	43.225798	-77.616123	15.8	6.5	227.5	221.0
GR-23M	Core	9/13/2011	43.225798	-77.615782	11.4	2.0	231.9	229.9
GR-24	Surface/Core	9/13/2011	43.223673	-77.615618	15.2	6.0	228.1	222.1
GR-25	Surface	9/16/2011	43.221803	-77.615030	21.3	NA	222.0	NA
GR-26	Surface	9/16/2011	43.217552	-77.616688	6.4	NA	236.9	NA
GR-27	Surface	9/16/2011	43.214360	-77.620217	12.4	NA	230.9	NA
GR-28	Surface	9/16/2011	43.212535	-77.624558	16.4	NA	226.9	NA
GR-29	Surface	9/16/2011	43.209708	-77.626502	12.7	NA	230.6	NA
GR-30	Surface	9/16/2011	43.205383	-77.626537	15.4	NA	227.9	NA
GR-31	Surface	9/16/2011	43.201927	-77.623957	16.5	NA	226.8	NA
GR-32	Surface	9/16/2011	43.198422	-77.620870	13.7	NA	229.6	NA
GR-32D	Surface	9/16/2011	43.198415	-77.620015	13.7	NA	229.6	NA
GR-33	Surface	9/16/2011	43.193893	-77.620015	13.1	NA	230.2	NA

WGS84 - World Geodetic System 1984

(a) Water depth adjusted to low water datum (243.3 ft) established for Rimouski, Quebec (International Great Lakes Datum, 1985).

(b) Indicated that refusal was not encountered; therefore, actual sediment thickness is unknown.

2.2 Sediment Processing

Individual cores were transferred to an on-shore staging area where Battelle field staff took sample custody. Upon receipt, the identification of each sediment core was verified, and the core was securely stored in an on-site refrigerated trailer pending processing.

Each core was processed independently and the core segments that were generated were transferred into designated sample containers prior to processing the next core. Sediment core processing activities were conducted as follows:

- The core was positioned lengthwise on a clean processing table that was coated with a piece of disposal plastic. The polycarbonate core tube was cut lengthwise on opposing sides with an electric shear to expose the sediment core. The exposed sediment core was then split lengthwise down the middle with a clean knife.
- Each sediment core was measured with a tape measure and marked at 3-foot intervals for identification, evaluation, and segmenting determination.
- The split core was photographed starting at the top of the core (sediment surface) and continuing to the bottom of the core. Each photograph included a placard with the project name, date, sample station identification (ID), and the measuring tape showing the core interval that was documented. Photographs of each core are provided in Appendix A4.
- Core features were described following American Society for Testing and Materials (ASTM) Procedure D2488-93 (ASTM, 1993). Features such as sediment type (silt, clay, sand, etc.), color, consistency, sedimentary structure, and odor were documented. This information was recorded on a core characterization log (Appendix A2). Significant changes or inclusions, such as wood debris, shell hash, and sand layers, were documented at the core depth in which they occurred.
- Cores were segmented into 3-foot sections, e.g., 0 to 3 ft, 3 to 6 ft, 6 to 9 ft, 9 to 12 ft, 12 to 15 ft, 15 to 18 ft, 18 to 21 ft.
    - The target core depth was an elevation equivalent to a dredge depth of -23 ft, or refusal.
    - The final depth interval was adjusted to the final recovery at >9 inches past the previous interval.
    - If the final penetration was <9 inches past the previous interval, that material was combined with the previous interval.
- Sediment from each selected interval was sampled in a manner representative of the entire interval length.
- Each sample was mixed to a uniform color and consistency using an electric mixer equipped with an aluminum paddle.
- After homogenization, samples were transferred into the appropriate pre-labeled, certified-clean containers, stored in the on-site refrigerated trailer or placed on ice and prepared for overnight shipment to the appropriate laboratory.
- The processing table was decontaminated and recoated with a piece of disposable plastic sheeting and the next core was processed in a similar manner.

Table 2-3 summarizes the segmenting and processing of each core and the number of samples that were generated for the following laboratory analyses:

- Total metals (Al, Ag, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Se, Zn)
- Dioxins and furans (bottom segment only)
- PAHs (Modified Analysis; n = 17)
- Pesticides (including Mirex)
- Herbicides
- PCBs as Aroclors
- Diesel range organics (DRO) and residual range organics (RRO)
- Total organic carbon (TOC)
- Total Solids (%)
- Acute/chronic toxicity: 10-day survival and growth test with the amphipod *Hyalella azteca*. Each toxicity sample was produced from specific depth intervals from one to three separate cores (e.g., [3] 0 to 3 ft sections = one sample, [3] 3 to 6 ft sections = a second sample, etc.). The target was three core segments per sample; however, cores were not necessarily the same length, so three segments were not always available for homogenization into the test sample.
- Archive: Sample material was archived when possible as a precaution for sample loss during shipping, analytical difficulties at the laboratory, and for providing material for unforeseen requests for additional analyses. Archived samples will be held for 1 year after collection or 6 months beyond the delivery of the final report, whichever timeline is greater.

Table 2-3. Summary of Sampling and Analyses by Sampling Station

Sample ID	Station ID	Collection Date	Collection Time	Collection Method	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total Metals	Dioxins and Furans [(a)]	Pesticides, PCBs (Aroclors), PAHs (N=17)	Herbicides	DRO/RRO	TOC, Percent Solids	Toxicity Composite	Archive
LA-001	GR-01	9/12/2011	16:53	Grab	0	0.5	X	X				X		
LA-107			16:45	Vibracore	0	3	X		X	X	X	X	A1	
LA-108					3	6	X		X	X	X	X	A2	
LA-109					6	9	X		X	X	X	X	A3	
LA-110					9	12	X		X	X	X	X		X
LA-111					12	14.9	X	X	X	X	X	X		X
LA-002	GR-02	9/12/2011	16:00	Grab	0	0.5	X	X				X		
LA-104			15:51	Vibracore	0	3	X		X	X	X	X	A1	
LA-105					3	6	X		X	X	X	X	A2	
LA-106					6	7.4	X	X	X	X	X	X	A3	
LA-003	GR-03	9/15/2011	11:28	Grab	0	0.5	X	X				X		
LA-162			11:15	Vibracore	0	3	X		X	X	X	X	B1	X
LA-163					3	6	X		X	X	X	X	B2	X
LA-164					6	8.7	X	X	X	X	X	X	B3	X

Table 2-3. Summary of Sampling and Analyses by Sampling Station (Continued)

Sample ID	Station ID	Collection Date	Collection Time	Collection Method	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total Metals	Dioxins and Furans [(a)]	Pesticides, PCBs (Aroclors), PAHs (N=17)	Herbicides	DRO/RRO	TOC, Percent Solids	Toxicity Composite	Archive
LA-003D	GR-03 Duplicate	9/15/2011	11:31	Grab	0	0.5	X	X				X		
LA-159			11:22	Vibracore	0	3	X		X	X	X	X		X
LA-160					3	6	X		X	X	X	X		X
LA-161					6	9.4	X	X	X	X	X	X		X
LA-004	GR-04	9/12/2011	15:10	Grab	0	0.5	X	X				X		
LA-101			14:59	Vibracore	0	3	X		X	X	X	X	A1	
LA-102					3	6	X		X	X	X	X	A2	
LA-103					6	9.8	X	X	X	X	X	X	A3	
LA-005	GR-05	9/16/2011	08:23	Grab	0	0.5	X	X				X		
LA-181			08:20	Vibracore	0	3	X		X	X	X	X	B1	X
LA-182					3	6	X		X	X	X	X	B2	X
LA-183					6	8.0	X	X	X	X	X	X	B3	X
LA-006	GR-06	9/15/2011	17:44	Grab	0	0.5	X	X				X		
LA-173			17:40	Vibracore	0	1.5	X	X	X	X	X	X	B1	X
LA-007	GR-07	9/15/2011	17:07	Grab	0	0.5	X	X				X		
LA-184			16:58	Vibracore	0	3	X		X	X	X	X	C1	X
LA-185					3	6	X		X	X	X	X	C2	X
LA-186					6	9	X		X	X	X	X	C3	X
LA-187					9	12	X		X	X	X	X	C4	X
LA-188					12	14.4	X	X	X	X	X	X	C5	X
LA-008	GR-08	9/15/2011	16:28	Grab	0	0.5	X	X				X		
LA-189			16:18	Vibracore	0	3	X		X	X	X	X	C1	X
LA-190					3	6	X		X	X	X	X	C2	X
LA-191					6	9	X		X	X	X	X	C3	X
LA-192					9	12	X		X	X	X	X	C4	X
LA-193					12	13.8	X	X	X	X	X	X	C5	X
LA-009	GR-09	9/15/2011	15:53	Grab	0	0.5	X	X				X		
LA-194			15:45	Vibracore	0	3	X		X	X	X	X	C1	X
LA-195					3	6	X		X	X	X	X	C2	X
LA-196					6	9	X		X	X	X	X	C3	X
LA-197					9	12	X		X	X	X	X	C4	X
LA-198					12	13.8	X	X	X	X	X	X	C5	X
LA-010	GR-10	9/15/2011	14:35	Grab	0	0.5	X	X				X		
LA-165			14:21	Vibracore	0	3	X		X	X	X	X	D1	X
LA-166					3	6	X		X	X	X	X	D2	X
LA-167					6	6.9	X	X	X	X	X	X	D3	X
LA-011	GR-11	9/15/2011	09:09	Grab	0	0.5	X	X				X		
LA-152			09:01	Vibracore	0	0.9	X	X	X	X	X	X	D1	X
LA-012	GR-12	9/15/2011	13:46	Grab	0	0.5	X	X				X		
LA-199			13:22	Vibracore	0	3	X		X	X	X	X	D1	
LA-200					3	6	X		X	X	X	X	D2	
LA-201					6	9	X		X	X	X	X	D3	
LA-202					9	12	X		X	X	X	X	D4	
LA-203					12	15	X		X	X	X	X	D5	
LA-204					15	16.4	X	X	X	X	X	X	D6	
LA-013	GR-13	9/14/2011	09:09	Grab	0	0.5	X	X				X		
LA-126			08:47	Vibracore	0	3	X		X	X	X	X	E1	X
LA-127					3	6	X		X	X	X	X	E2	X

Table 2-3. Summary of Sampling and Analyses by Sampling Station (Continued)

Sample ID	Station ID	Collection Date	Collection Time	Collection Method	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total Metals	Dioxins and Furans [(a)]	Pesticides, PCBs (Aroclors), PAHs (N=17)	Herbicides	DRO/RRO	TOC, Percent Solids	Toxicity Composite	Archive
LA-128					6	9	X		X	X	X	X	E3	X
LA-129					9	11.9	X	X	X	X	X	X	E4	X
LA-013D	GR-13 Duplicate	9/14/2011	09:10	Grab	0	0.5	X	X				X		
LA-130			09:00	Vibracore	0	3	X		X	X	X	X		X
LA-131					3	6	X		X	X	X	X		X
LA-132					6	9	X		X	X	X	X		X
LA-133					9	12	X		X	X	X	X		X
LA-134					12	13.1	X	X	X	X	X	X		
LA-014	GR-14	9/14/2011	17:25	Grab	0	0.5	X	X				X		
LA-153			17:10	Vibracore	0	3	X		X	X	X	X	E1	X
LA-154					3	6	X		X	X	X	X	E2	X
LA-155					6	8.2	X	X	X	X	X	X	E3	X
LA-014D	GR-14 Duplicate	9/14/2011	17:27	Grab	0	0.5	X	X				X		
LA-156			17:22	Vibracore	0	3	X		X	X	X	X		X
LA-157					3	6	X		X	X	X	X		X
LA-158					6	7.7	X	X	X	X	X	X		X
LA-015	GR-15	9/14/2011	16:33	Grab	0	0.5	X	X				X		
LA-168			16:24	Vibracore	0	3	X		X	X	X	X	E1	X
LA-169					3	6	X		X	X	X	X	E2	X
LA-170					6	9	X		X	X	X	X	E3	X
LA-171					9	12	X		X	X	X	X	E4	X
LA-172					12	13.2	X	X	X	X	X	X	E5	X
LA-016	GR-16	9/14/2011	15:44	Grab	0	0.5	X	X				X		
LA-144			15:40	Vibracore	0	3	X		X	X	X	X	F1	X
LA-145					3	6	X		X	X	X	X	F2	X
LA-146					6	9	X		X	X	X	X	F3	X
LA-147					9	12	X		X	X	X	X	F4	X
LA-148					12	15	X		X	X	X	X	F5	X
LA-149					15	18	X		X	X	X	X	F6	X
LA-150					18	19.9	X	X	X	X	X	X	F7	X
LA-017	GR-17	9/14/2011	14:54	Grab	0	0.5	X	X				X		
LA-151			14:48	Vibracore	0	3.1	X	X	X	X	X	X	F1	X
LA-018	GR-18	9/14/2011	11:51	Grab	0	0.5	X	X				X		
LA-135			11:38	Vibracore	0	3	X		X	X	X	X	F1	X
LA-136					3	6	X		X	X	X	X	F2	X
LA-137					6	9	X		X	X	X	X	F3	X
LA-138					9	12.7	X	X	X	X	X	X	F4	X
LA-019	GR-19	9/13/2011	12:00	Grab	0	0.5	X	X				X		
LA-117			11:46	Vibracore	0	3	X		X	X	X	X	G1	X
LA-118					3	6	X		X	X	X	X	G2	X
LA-119					6	9	X		X	X	X	X	G3	X
LA-120					9	12	X		X	X	X	X	G4	X
LA-121					12	15	X		X	X	X	X	G5	X
LA-122					15	18.2	X	X	X	X	X	X	G6[b]	X
LA-020	GR-20	9/14/2011	10:58	Grab	0	0.5	X	X				X		
LA-139			10:52	Vibracore	0	3	X		X	X	X	X	G1	X
LA-140					3	6	X		X	X	X	X	G2	X
LA-141					6	9	X		X	X	X	X	G3	X

Table 2-3. Summary of Sampling and Analyses by Sampling Station (Continued)

Sample ID	Station ID	Collection Date	Collection Time	Collection Method	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total Metals	Dioxins and Furans [(a)]	Pesticides, PCBs (Aroclors), PAHs (N=17)	Herbicides	DRO/RRO	TOC, Percent Solids	Toxicity Composite	Archive
LA-142					9	12	X		X	X	X	X	G4	X
LA-143					12	14.9	X	X	X	X	X	X	G5	X
LA-021	GR-21	9/13/2011	11:07	Grab	0	0.5	X	X				X		
LA-112			11:05	Vibracore	0	3	X		X	X	X	X	G1	X
LA-113					3	6	X		X	X	X	X	G2	X
LA-114					6	9	X		X	X	X	X	G3	X
LA-115	GR-21	9/13/2011	11:05	Vibracore	9	12	X		X	X	X	X	G4	X
LA-116					12	14.2	X	X	X	X	X	X	G5	X
LA-022	GR-22	9/14/2011	10:00	Grab	0	0.5	X	X				X		
LA-174			09:57	Vibracore	0	3	X		X	X	X	X	H1	X
LA-175					3	6	X		X	X	X	X	H2	X
LA-176					6	9	X		X	X	X	X	H3	X
LA-177					9	12	X		X	X	X	X	H4	
LA-178					12	15	X		X	X	X	X	H5	
LA-179					15	16.2	X	X	X	X	X	X	H6	
LA-023	GR-23	9/13/2011	10:31	Grab	0	0.5	X	X				X		
LA-124			10:22	Vibracore	0	2.2	X	X	X	X	X	X	H1	X
LA-123	GR-23M	9/13/2011	09:56	Vibracore	0	1.1	X	X	X	X	X	X		X
LA-024	GR-24	9/13/2011	08:57	Grab	0	0.5	X	X				X		
LA-125			08:50	Vibracore	0	2.3	X	X	X	X	X	X	H1	X
LA-025	GR-25	9/16/2011	10:56	Grab	0	0.5	X	X	X	X	X	X		
LA-026	GR-26	9/16/2011	10:44	Grab	0	0.5	X	X	X	X	X	X		
LA-027	GR-27	9/16/2011	10:34	Grab	0	0.5	X	X	X	X	X	X		
LA-028	GR-28	9/16/2011	10:24	Grab	0	0.5	X	X	X	X	X	X		
LA-029	GR-29	9/16/2011	10:16	Grab	0	0.5	X	X	X	X	X	X		
LA-030	GR-30	9/16/2011	10:00	Grab	0	0.5	X	X	X	X	X	X		
LA-031	GR-31	9/16/2011	09:46	Grab	0	0.5	X	X	X	X	X	X		
LA-032	GR-32	9/16/2011	09:27	Grab	0	0.5	X	X	X	X	X	X		
LA-032D	GR-32 Duplicate	9/16/2011	09:30	Grab	0	0.5	X	X	X	X	X	X		
LA-033	GR-33	9/16/2011	09:15	Grab	0	0.5	X	X	X	X	X	X		
TOTAL – Surface Grab Samples							37	37	10	10	10	37	0	0
TOTAL – Core Samples							103	28	103	103	103	103	40	87

(a) Dioxin/furans in core samples were measured only in surface grab samples and the deepest core interval.
(b) Volume of sample collected inadequate for toxicity testing.

[shaded box] Field duplicate samples

2.3 In-Field Data

In-field sample collection and processing information, including sediment collection logs for each surface sediment grab and sediment core, photo documentation of individual cores and sample chain-of-custody logs, are provided in Appendix A. Each sample collection log includes a description of the sampling location, observations, number and type(s) of samples collected and any comments. Each core characterization log includes a detailed description of the entire core, sediment core segmenting details, and the assigned sample identification. More specifically, Appendix A1 contains daily operation logs and sediment sample collection observations. Appendix A2 contains core processing logs which provide information on core IDs, collection date and time, core lithology, the core segmentation, and individual sample (core segment) IDs. Appendix A3 provides a record of sample chain of custody forms. Appendix A4 provides photograph documentation of each core. Photographs were collected at 1-ft core intervals. Core photos contain the core identification and length is referenced with a tape measure. Core photos are then collated by core and digitally stitched together into one image of the core. The core photographs, individual and merged, are also provided on a CD-ROM, as Appendix A5.

2.4 Deviations from the QAPP

The following deviations from the QAPP occurred:

- Sediments for three composite samples for toxicity testing were not collected from the surface grabs at nine locations (GR-25 through GR-33). Adequate data were provided from the other 42 toxicity tests and, therefore, this deviation is not deemed to significantly affect the project goals. Levels of contamination in surface sediments at these nine locations were less than core samples that were tested for toxicity and did not show significant toxicity.
- In calculating the dioxin TEQs for evaluation of results, toxicity equivalency factors (TEFs) developed by the World Health Organization (WHO) in 2005 (Van den Berg et al., 2006) were used rather than the 1998 International TEFs developed by the North Atlantic Treaty Organization (1998) that were used to develop the sediment guidance in (NYSDEC, 2004). Use of the 2005 TEFs represents the most up-to-date evaluation of dioxin toxicity and are considered best practice.
- The QAPP listed the hydrocarbon analyte groups of DRO and oil range organics (ORO) for analysis and quantification. However, the petroleum hydrocarbon group RRO was quantified rather than ORO. The DRO method covers the carbon groups of C10 through C28, the ORO method covers C20 through C35, and the RRO method covers C24 through C36. The results reported cover similar ranges (RRO has one extra carbon range included). The overlap between the two groups was reduced by reporting RRO instead of ORO, thus increasing the resolution of the results. This change is not considered to have any significant impact on the data quality.
- The QAPP listed percent solids as an analyte. CAS and this report are presenting moisture data as percent solids. Percent solids converts to percent moisture essentially as % Moisture = 100 - % Solids. There are some minor measuring differences, but these differences do not significantly impact the use of these data.

3.0: SUMMARY OF SITE CHARACTERIZATION RESULTS

This section presents a summary of the analytical, toxicological, and habitat assessment results. Sediment cores were analyzed for physical and chemical parameters as outlined in Table 3-1. Analyses were performed by Columbia Analytical Services (CAS) at its labs in Houston, Texas and Kelso, Washington. The USACE Engineer Research and Development Center (ERDC) provided toxicological testing following the methods listed in Table 3-1. The analytical methods used are standard U.S. EPA or ASTM methods that have been slightly modified for environmental matrices and improved detection limits. Laboratory reports for each individual parameter are presented as Appendices B1 (CAS Houston data) and B2 (CAS Houston data). Toxicity data from the USACE ERDC laboratory are summarized in Appendix C1; complete reports for toxicity testing are provided in Appendix C2. In addition to the chemical, physical, and biological testing, a limited habitat assessment using available information with field verification using digital photographs was performed by Battelle.

Table 3-1. Methods for Laboratory Analysis

Parameter	Base Method	Lab
Sediments		
Dioxins and Furans	8290A	CAS-Houston
PCBs as Aroclors	8082A (LL)[a]	CAS-Kelso
PAHs (n = 17)	8270D	CAS-Kelso
Pesticides	8081A (LL)	CAS-Kelso
Herbicides	8151a	CAS-Kelso
TPH (DRO/RRO)	8015C	CAS-Kelso
TOC	ASTM D4129-82	CAS-Kelso
Total Metals (Al, Ag, As, Cd, Cr, Cu, Pb, Hg, Mn, Ni, Se, Zn)	6010C (LL)	CAS-Kelso
Mercury (Hg)	7471A	
Moisture Content	ASTM D2216	CAS-Kelso
Porewater		
Ammonia	NA	ERDC
Toxicity Testing		
10 Day solid phase survival (%) and growth with the amphipod *Hyalella azteca*	U.S. EPA 100.1 (U.S. EPA, 2000)	ERDC

NA =
(a) LL method modified for low level analysis.

3.1 Sediment Chemistry Data

Sediment chemistry results have been evaluated for the range and average of detected concentrations, location of the maximum concentration, and, where available, against sediment quality guidelines (SQGs). Sediment chemistry summary data tables are provided in Appendix B. Consensus-based SQGs have been created by several groups of researchers. For this project, the values reported in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* by MacDonald et al. (2000) were utilized. MacDonald et al. (2000) defines two benchmarks: the threshold effects concentration (TEC; below which adverse effects are not expected to occur) and the probable effect concentration (PEC; above which adverse effects are likely). These two benchmarks are calculated using the geometric mean of three to six TEC/PEC-type values from published sediment quality guidelines.

One objective of this study is to use the benchmarks to determine the likelihood that a contaminant is below a concentration of potential concern. The data can be expressed within a hypothesis test to demonstrate that the arithmetic mean sediment contaminant concentration for a particular COI is lower than the applicable TEC or PEC. MacDonald et al. (2000) provides consensus-based SQGs for freshwater sediments for 27 analytes measured in this study. The MacDonald SQGs do not include two contaminants of high interest for the Genesee River — silver and dioxins and furans. For silver, the SQGs provided in Long and Morgan (1990) were used. Long and Morgan (1990) provide two benchmarks, the ER-L and the ER-M, which are similar to the MacDonald et al. (2000) TEC/PEC benchmarks. For dioxins and furans, the TEQ was calculated using the WHO 2005 methods (Van den Berg, 2006; Section 2.4). The TEQ was then compared to the NYSDEC Technical and Operational Guidance Series 5.1.9, which lists three classes of sediment quality thresholds for dredged material proposed for in-water/riparian placement (NYSDEC, 2004). The classes are:

- Class A - No appreciable contamination (no toxicity to aquatic life)
- Class B - Moderate contamination (chronic toxicity to aquatic life)
- Class C - High contamination (acute toxicity to aquatic life).

Class A and Class C criteria were selected as most comparable to the TEC and PEC criteria, respectively, and were used in evaluating total TEQ results.

Table 3-2 lists all of the benchmark values used and their source. For data evaluation, non-detects have been calculated using one-half of the method detection limit value for all analytes except total TEQ for dioxins and furans, and PCB Aroclors. In these two cases, non-detects were considered zero. Field duplicate data are not included in the tabular, graphic, or statistical analyses of data.

3.1.1 Dioxins and Furans (Modified Analysis). CAS analyzed 65 sediment samples (58 primary samples and seven field duplicate samples) for dioxins and furans using methods defined in U.S. EPA SW-846 8290A. A 10-g sample was spiked with internal standards and extracted using toluene by either Soxhlet extraction apparatus or accelerated solvent extractor. Following solvent exchange to hexane, sample cleanup procedures (sulfuric acid, column chromatography using silica gel and activated carbon) were used to remove interferences. The final extract was spiked with recovery internal standards and analyzed by high-resolution gas chromatograph/high-resolution mass spectrometer. The results were reported for the 17 individual 2,3,7,8-substituted dioxins and furans, total congener classes, and total TEQs. Total TEQ was calculated by multiplying the concentration of each of the 17 2,3,7,8-substituted dioxins and furans by a toxicity factor (WHO, 2005) used to equate each individual congener to the toxicity of the most toxic congener 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and adding them together for a total TEQ. All results were reported as ng/kg dry weight.

Dioxins and furans were only analyzed in the surface sediments and in the deepest 3-foot segment of each core. Dioxins were detected in 100% of the samples analyzed. Table 3-3 and Figures 3-1a and 3-1b summarize the total TEQ results by depth. The largest percentage of samples with total TEQ results above the NYSDEC Class A benchmark (4.5 ng/kg) occurred in the 12 to 15 ft core segments (71%). Two samples, one each from the 12 to 15 ft core segment of Stations GR-20 and GR-21, also had results above the Class C limit of 50 ng/kg (80.4 ng/kg for GR-21 and 69.8 ng/kg for GR-20). The GR-21 (12 to 15 ft) segment also had the highest concentration of 11 of the 17 2,3,7,8-substituted dioxins and furans (80.4 ng/kg), including the highest concentration of 2,3,7,8-TCDD (3.37 ng/kg).

Table 3-2. Sediment Quality Guidelines Used for Data Evaluation

Analyte	Class	SQG		NYSDEC TOGS 5.1.9 Sediment Classification			Units
		TEC[(a)]	PEC[(a)]	A[(b)]	B[(b)]	C[(b)]	
Arsenic	Metal	9.79	33.0	< 14	14 - 53	> 53	mg/kg dry wt
Cadmium	Metal	0.99	4.98	< 1.2	1.2 - 9.5	> 9.5	mg/kg dry wt
Chromium	Metal	43.4	111	NA	NA	NA	mg/kg dry wt
Copper	Metal	31.6	149	< 33	33 - 207	> 207	mg/kg dry wt
Lead	Metal	35.8	128	< 33	33 - 166	> 166	mg/kg dry wt
Mercury	Metal	0.18	1.06	< 0.17	0.17 - 1.6	> 1.6	mg/kg dry wt
Nickel	Metal	22.7	48.6	NA	NA	NA	mg/kg dry wt
Anthracene	PAH	57.2	845	NA	NA	NA	µg/kg dry wt
Fluorene	PAH	77.4	536	NA	NA	NA	µg/kg dry wt
Naphthalene	PAH	176	561	NA	NA	NA	µg/kg dry wt
Phenanthrene	PAH	204	1170	NA	NA	NA	µg/kg dry wt
Benz(a)anthracene	PAH	108	1050	NA	NA	NA	µg/kg dry wt
Benzo(a)pyrene	PAH	150	1450	NA	NA	NA	µg/kg dry wt
Chrysene	PAH	166	1290	NA	NA	NA	µg/kg dry wt
Dibenz(a,h)anthracene	PAH	33.0	135	NA	NA	NA	µg/kg dry wt
Fluoranthene	PAH	423	2230	NA	NA	NA	µg/kg dry wt
Pyrene	PAH	195	1520	NA	NA	NA	µg/kg dry wt
Total PAHs	PAH	1610	22800	< 4000	4000-35000	> 35000	µg/kg dry wt
Total PCBs as Total Aroclors	PCB	59.8	676	< 100	100 - 1000	> 1000	µg/kg dry wt
gamma-BHC (lindane)	Pesticide	2.37	4.99	NA	NA	NA	µg/kg dry wt
Chlordane	Pesticide	3.24	17.6	< 3	3 - 36	>36	µg/kg dry wt
Dieldrin	Pesticide	1.90	61.8	<110	110 - 480	> 480	µg/kg dry wt
Sum of DDT +DDD + DDE (Total DDx)	Pesticide	5.28	572	< 3	3 - 30	> 30	µg/kg dry wt
Endrin	Pesticide	2.22	207	NA	NA	NA	µg/kg dry wt
Heptachlor Epoxide	Pesticide	2.47	16	NA	NA	NA	µg/kg dry wt
Mirex	Pesticide			< 1.4	1.4 - 14	> 14	µg/kg dry wt
Analyte	**Class**	**ER-L[(c)]**	**ER-M[(c)]**	NA	NA	NA	**Units**
Silver	Metal	1.0	3.7	NA	NA	NA	mg/kg dry wt
Analyte	**Class**	**Class A[(b)]**	**Class C[(b)]**	NA	NA	NA	**Units**
Dioxin TEQ	Dioxin	<4.5	>50	<4.5	4.5 - 50	>50	ng/kg dry wt

(a) MacDonald et al., 2000
(b) NYSDEC, 2004
(c) Long and Morgan, 1990

Table 3-3. Total TEQ– Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (ng/kg dry wt)			Standard Deviation	Location of Maximum	Percent above NYSDEC Benchmark (Class A) (4.5 ng/kg)	Percent above NYSDEC Benchmark (Class C) (50 ng/kg)
			Minimum	Maximum	Mean				
0-0.5	33	33	0.143	38.4	2.3	6.7	GR-12	9	0
0-3	6	6	0.079	10.1	3.5	3.9	GR-17	33	0
3-6	0	0	NA	NA	NA	NA	NA	NA	NA
6-9	6	6	0.020	22.6	10.2	11.2	GR-14	50	0
9-12	2	2	0.076	39.5	19.8	27.9	GR-18	50	0
12-15	7	7	0.069	80.4	26.1	34.0	GR-21	71	29
15-18	3	3	0.007	5.7	3.6	3.1	GR-22	67	0
18+	1	1	0.051	0.051	0.051	NA	GR-16	0	0

NA = not applicable

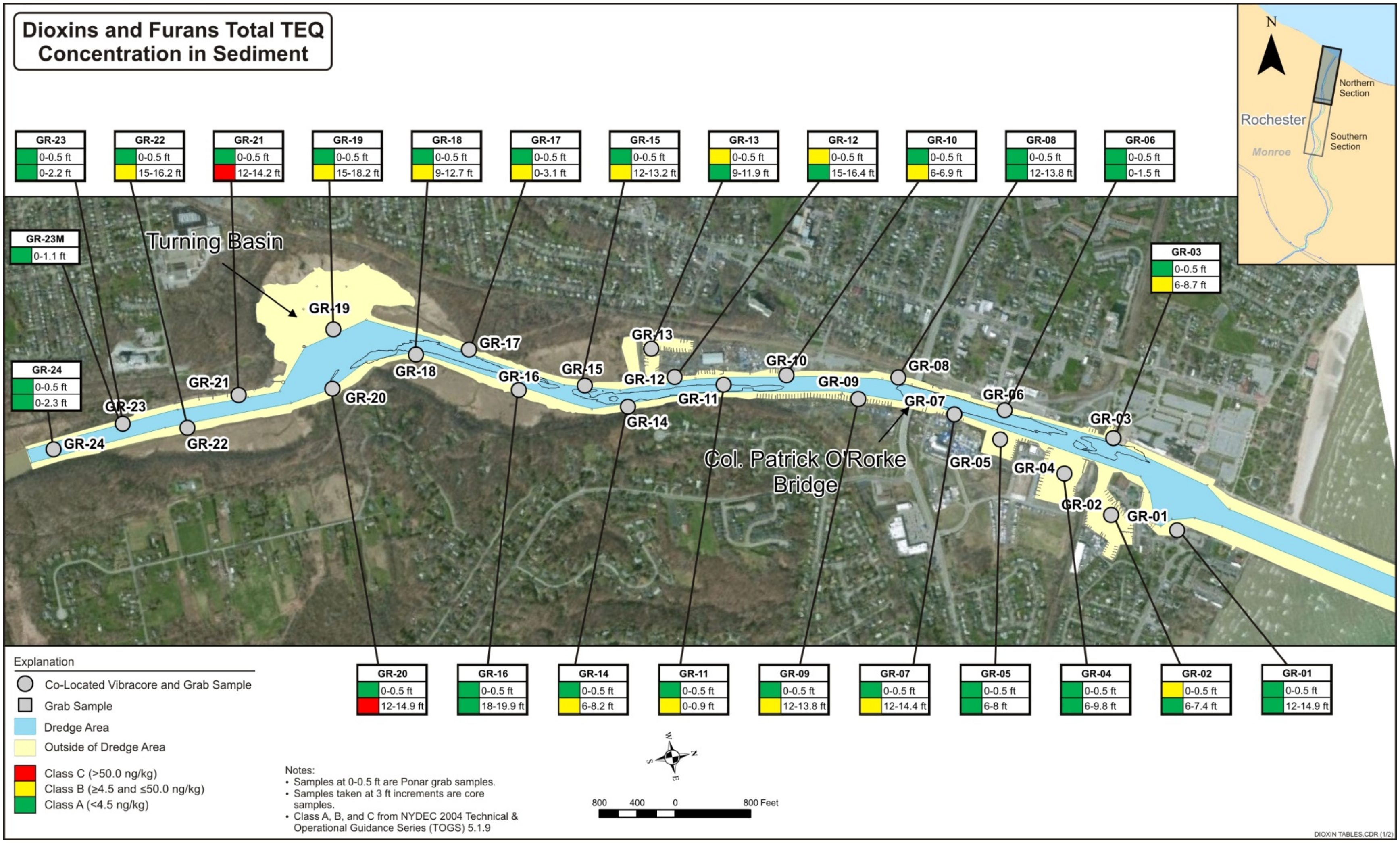

Figure 3-1a. Dioxins and Furans TEQ Levels in Sediment 2011-September

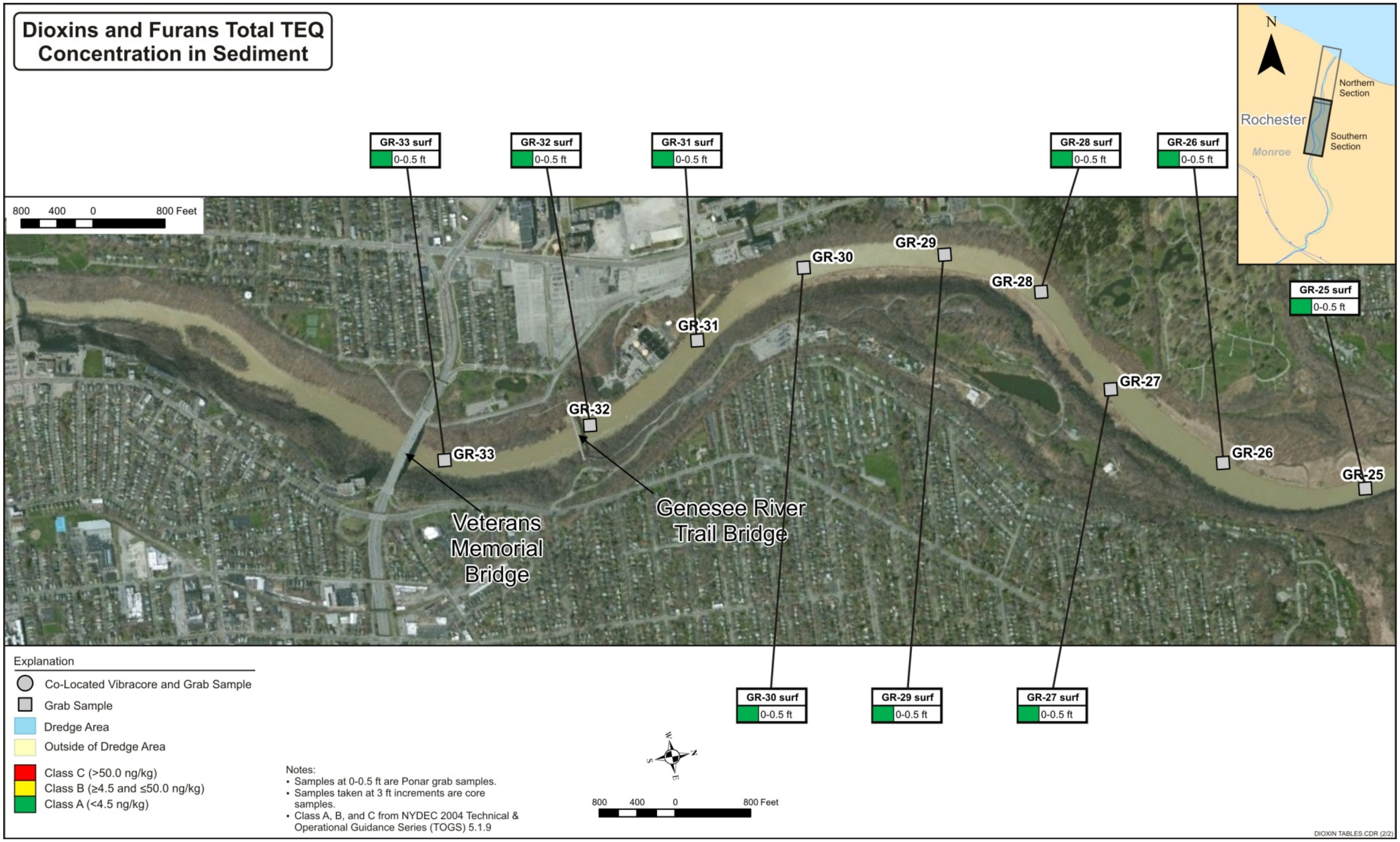

Figure 3-1b. Dioxins and Furans TEQ Levels in Sediment 2011-September

3.1.2 PCBs as Aroclors (Modified Analysis). CAS analyzed 113 sediment samples (101 primary samples and 12 field duplicate samples) for PCB Aroclors using methods defined in U.S. EPA SW-846 8082A. A 40-g sample was spiked with internal standards and extracted using Soxhlet (Method 3540), automated Soxhlet (Method 3541) or ultrasonic extraction (Method 3550) procedures. Sample cleanup procedures were used to remove interferences. Samples were analyzed by gas chromatography (GC) with electron capture detection (ECD). Aroclors were identified by comparing the retention times of three to six peaks with the respective retention times of an authentic standard and by comparison of elution patterns to those of Aroclor standards. The results are reported as Aroclors as µg/kg dry weight.

PCB laboratory data were reported as nine individual Aroclors. Of the nine Aroclors, only four were detected above the reporting detection limit (Aroclors 1248, 1254, 1260, and 1268). Out of 101 samples analyzed, Aroclor 1260 was the most frequently detected (84% of samples), followed by Aroclor 1254 (67% of samples), and 1248 (39% of samples). Aroclor 1268 was detected in only one sample. The range of Aroclor concentrations detected are shown in Table 3-4.

Table 3-4. Summary of Aroclor Detections

Quantity of Samples	Quantity of Detects	Chemical Name	Concentration (µg/kg)			Standard Deviation	Location of Maximum	Percent above TEC	Percent above PEC
			Minimum	Maximum	Mean				
101	84	Aroclor 1260	ND	120	38	38	GR-14 (3-6 ft) GR-14 (6-9 ft) GR-22 (12-15 ft)	NA	NA
101	67	Aroclor 1254	ND	230	54	65	GR-21 (9-12 ft) GR-18 (6-9 ft) GR-20 (9-12 ft)	NA	NA
101	39	Aroclor 1248	ND	240	38	65	GR-20 (9-12 ft)	NA	NA
101	1	Aroclor 1268	ND	40	NA	NA	GR-08 (6-9 ft)	NA	NA

ND = non-detect
NA = not applicable

For graphical and tabular presentation and further discussion within this report, PCB concentrations are expressed as total Aroclors, which were calculated by summing the Aroclor concentrations detected above the reporting limits. If an individual Aroclor was reported below the detection limit, a value of 0 was used for that Aroclor in the summation. Table 3-5 shows a basic statistical summary of total Aroclor concentrations detected in each segment interval across the project area. Total Aroclors were not detected above the PEC in any of the samples. Concentrations above the TEC occurred between 0 to 15 ft, with the largest percentage of detects above TEC (79% of samples) occurring in the 6 to 9 ft segment. Additionally, total Aroclor concentrations are summarized graphically as a function of depth per each sample station in Figures 3-2a and 3-2b.

Table 3-5. Total Aroclors – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (µg/kg dry wt)			Standard Deviation	Location of Maximum	Percent above TEC (60 µg/kg)	Percent above PEC (676 µg/kg)
			Minimum	Maximum	Mean				
0-0.5	9	9	2.1	15.2	7.7	5.1	GR-31	0	0
0-3	25	22	ND	410	69	98.2	GR-06	28	0
3-6	19	19	6	530	189	162	GR-14	63	0
6-9	19	15	ND	570	179	164	GR-18	79	0
9-12	13	10	ND	570	222	226	GR-21	62	0
12-15	11	8	ND	365	122	142	GR-20	55	0
15-18	4	1	ND	24	6.0	12	GR-19	0	0
18+	1	0	ND	ND	ND	NA	NA	0	0

ND = non-detect
NA = not applicable

3.1.3 Pesticides (Modified Analysis). CAS analyzed 113 sediment samples (101 primary samples and 12 field duplicate samples) for pesticides using the methods defined in U.S. EPA SW-846 8081A. Samples were spiked with internal standards and extracted using Soxhlet (Method 3540) or automated Soxhlet extraction (Method 3541) procedures. Sample cleanup procedures were used to remove interferences, then extracts were spiked with reference internal standards and analyzed by GC/ECD. Results are reported as µg/kg dry weight.

Table 3-6 shows a summary of the individual pesticides identified, the minimum and maximum concentrations, and the number of samples resulting in pesticide detection. Non-detects were given the value of one-half of the detection limit. The predominant pesticides reported were 4,4'-DDD, 4,4'-DDE and 2,4'-DDD.

Due to the prevalent detection of DDE, DDD and DDT, additional data evaluation was conducted to determine the segment intervals at which detections of these analytes occurred. For the purpose of this evaluation, the sum of all six DDE, DDD, and DDT isomers that were measured was used and is referred to as Total DDx. These data are shown in Table 3-7. The maximum concentration of DDx was detected at Station GR-22 within the 3 to 6 ft segment.

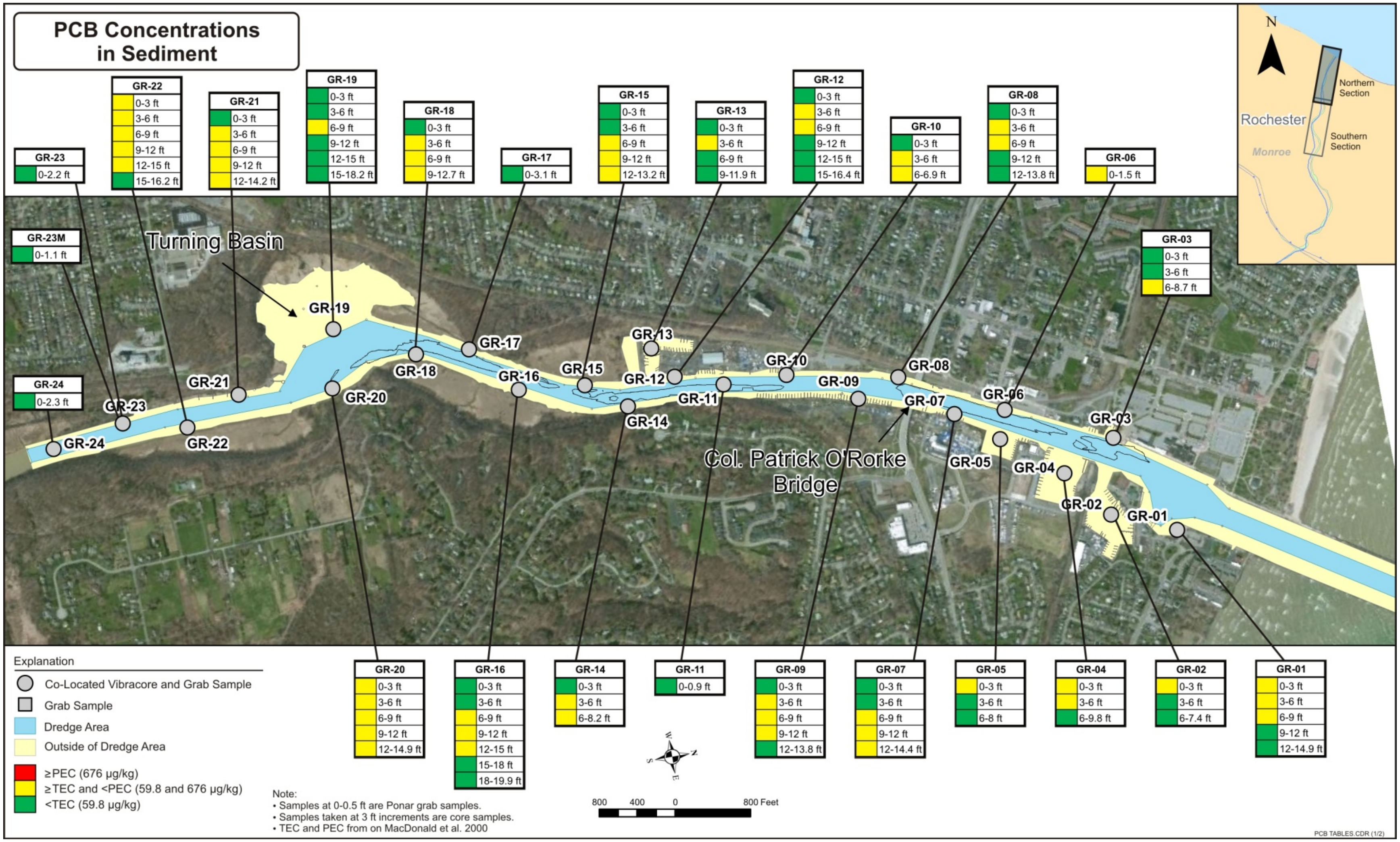

Figure 3-2a. Total PCB (Aroclor) Concentrations in Sediment 2011-September

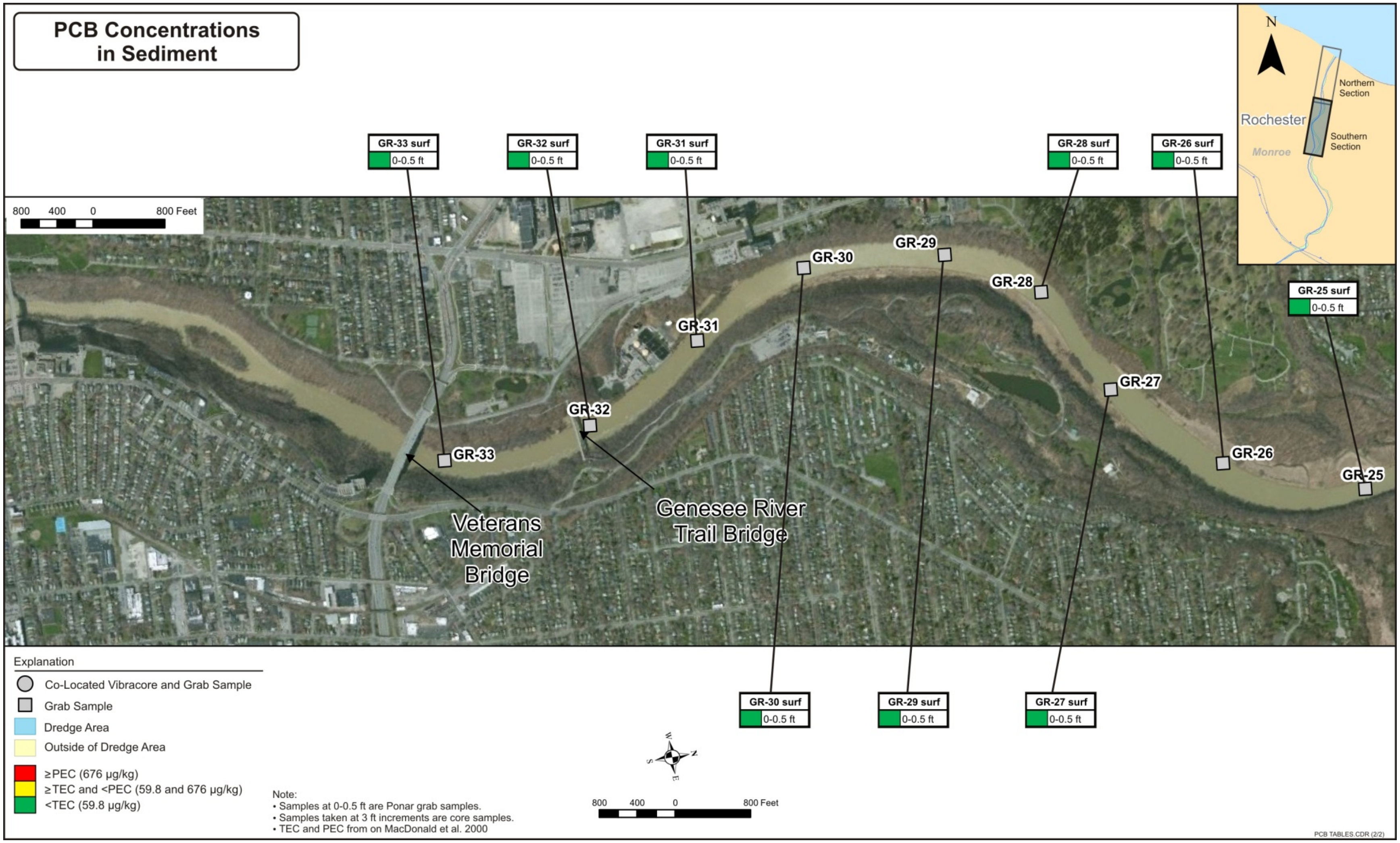

Figure 3-2b. Total PCB (Aroclor) Concentrations in Sediment 2011-September

Table 3-6. Summary of Pesticide Detections

Quantity of Samples	Quantity of Detects	Chemical Name	Concentration (µg/kg)			Standard Deviation	Location of Maximum	Percent above TEC[(a)]	Percent above PEC[(a)]
			Minimum	Maximum	Mean				
101	78	4,4'-DDD	0.055	72	4.07	8.76	GR-22 (3-6 ft)	NA	NA
101	72	4,4'-DDE	0.055	14	2.42	2.65	GR-22 (3-6 ft)	NA	NA
101	63	2,4'-DDD	0.065	35	1.94	4.30	GR-22 (3-6 ft)	NA	NA
101	31	Methoxychlor	0.095	4.7	0.82	0.97	GR-20 (9-12 ft)	NA	NA
101	27	gamma-Chlordane	0.045	5.7	0.23	0.67	GR-13 (3-6 ft)	NA	NA
101	22	cis-Nonachlor	0.06	1.3	0.23	0.33	GR-06 (0-3 ft)	NA	NA
101	13	4,4'-DDT	0.085	8.5	0.48	1.11	GR-20 (12-15 ft)	NA	NA
101	10	Endrin aldehyde	0.06	2.9	0.34	0.64	GR-07 (9-12 ft)	NA	NA
101	7	Chlorpyrifos	0.075	0.89	0.13	0.14	GR-13 (0-3 ft)	NA	NA
101	6	Endrin ketone	0.047	0.88	0.14	0.17	GR-06 (0-3 ft)	NA	NA
101	6	gamma-BHC (Lindane)	0.04	2.9	0.31	0.32	GR-13 (0-3 ft)	1	0
101	5	delta-BHC	0.037	0.88	0.13	0.15	GR-14 (3-6 ft)	NA	NA
101	4	2,4'-DDT	0.029	1.7	0.19	0.27	GR-14 (6-9 ft)	NA	NA
101	4	Endosulfan sulfate	0.055	0.55	0.12	0.12	GR-14 (3-6 ft)	NA	NA
101	4	Hexachlorobutadiene	0.105	1.85	0.14	0.18	GR-03 (0-3 ft)	NA	NA
101	3	trans-Nonachlor	0.044	2.6	0.24	0.36	GR-14 (3-6 ft)	NA	NA
101	3	Chlordane	0.95	38	3.45	5.37	GR-22 (12-15 ft)	43	3
101	2	alpha-Chlordane	0.05	4.1	0.32	0.54	GR-13 (3-6 ft)	NA	NA
101	2	alpha -BHC	0.055	0.38	0.07	0.05	GR-07 (0-3 ft)	NA	NA
101	2	Hexachlorobenzene	0.1	0.86	0.12	0.09	GR-14 (3-6 ft)	NA	NA
101	1	Aldrin	0.08	0.53	0.10	0.07	GR-09 (9-12 ft)	NA	NA
101	0	Oxychlordane	0.0425	0.38	0.06	0.06	ND[b]	NA	NA
101	0	alpha-Endosulfan	0.0315	0.90	0.15	0.18	ND[b]	NA	NA
101	0	beta-BHC	0.09	0.38	0.11	0.06	ND[b]	NA	NA
101	0	beta-Endosulfan	0.07	2.65	0.27	0.55	ND[b]	NA	NA
101	0	Dieldrin	0.07	2.60	0.36	0.46	ND[b]	2[c]	0[c]
101	0	Endrin	0.047	1.25	0.08	0.16	ND[b]	0	0
101	0	Heptachlor	0.06	0.1	0.06	0.004	ND[b]	NA	NA
101	0	Heptachlor Epoxide	0.042	0.16	0.05	0.02	ND[b]	0	0
101	0	Hexachloroethane	0.165	0.265	0.17	0.01	ND[b]	NA	NA
101	0	Isodrin	0.085	0.375	0.11	0.07	ND[b]	NA	NA
101	0	Mirex	0.0495	25.5	0.60	2.81	ND[b]	NA	NA
101	0	2,4'-DDE	0.08	1.85	0.25	0.25	ND[b]	NA	NA
101	0	Toxaphene	2.4	80	18.6	17.1	ND[b]	NA	NA

(a) TEC and PEC values are included in Table 3-2.
(b) Compounds not detected, Min/Max/Mean calculated from detection limit data
(c) Indicates percent of detection limit values above the benchmark.
Not Applicable. Benchmark not established for this compound

Table 3-7. Total DDx– Statistical Summary

Segment Interval (ft.)	Quantity of Samples	Quantity of Detects	Concentration (µg/kg)			Standard Deviation	Location of Maximum	Percent above TEC[a] (5 µg/kg)	Percent above PEC[a] (572 µg/kg)
			Minimum	Maximum	Mean				
0-0.5	9	9	1.03	2.03	1.55	0.29	GR-31	0	0
0-3	25	25	0.92	11.8	4.03	3.19	GR-06	32	0
3-6	19	19	0.50	122	19.6	29.6	GR-22	68	0
6-9	19	15	0.37	37.8	11.9	10.8	GR-18	74	0
9-12	13	11	0.37	22.6	10.3	8.48	GR-22	62	0
12-15	11	8	0.37	25.7	7.86	9.25	GR-20	45	0
15-18	4	2	0.37	6.23	2.63	2.83	GR-19	25	0
18+	1	0	0.37	0.37	0.37	NA	NA	0	0

(a) TEC and PEC values are included in Table 3-2.

3.1.4 Herbicides (Modified Analysis). CAS analyzed 113 sediment samples (101 primary samples and 12 field duplicate samples) for 10 herbicides using the methods defined in U.S. EPA SW-846 8151A. The 10 herbicides included Dalapon, Dicamba, MCPP, MCPA, Dichlorprop, 2,4-D, 2,4,5-T, Silvex, 2,4-DB, and Dinoseb. A 30-g sample was spiked with internal standard, adjusted to a pH less than 2 and the herbicides in both acid and derivatized forms were extracted with ethyl ether. Derivatives of the phenoxy acid herbicides in the extract were hydrolyzed to the acid form by the addition of sodium hydroxide. The samples were acidified, and the acid herbicides extracted. The acids were then converted to their methyl esters using diazomethane. Samples were analyzed by GC/ECD and reported as µg/kg. None of the 10 herbicides were detected in any of the samples, thus there is no tabular, graphical, or analytical treatment of the data.

3.1.5 Polycyclic Aromatic Compounds (Modified Analysis). CAS analyzed 113 sediment samples (101 primary samples and 12 field duplicate samples) for PAHs using the methods defined in U.S. EPA SW-846 8270D-SIM-PAHs. Samples were spiked with internal standards, extracted, cleaned up using gel permeation chromatography, and spiked with recovery internal standards. The extracts were analyzed by GC/MS in the selective ion monitoring mode. Identification of the analytes of interest was performed by comparing the retention times of the analytes with the respective retention times of an authentic standard, and by comparing mass spectra of analytes with mass spectra of reference materials. Quantitative analysis was performed by using the authentic standard to produce a response factor and calibration curve, and using the calibration data to determine the concentration of an analyte in the extract. The concentration in the sample is reported as µg/kg dry weight.

PAH laboratory data are reported as 18 individual PAH compounds and as a total of the 16 priority PAHs (total PAH). Table 3-8 provides the results for individual and total PAHs. The maximum concentration of individual PAHs was most commonly measured in two core segments, GR-13 (0 to 3 ft) and GR-16 (12 to 15 ft). Table 3-9 gives an indication of the distribution of total PAHs by depth. Sixty-nine percent of the samples (71/101) exceeded the TEC for the total of 16 priority PAHs, while only one sample exceeded the PEC for total PAHs (GR-13, 0 to 3 ft).

Table 3-8. Summary of PAH Detections

Quantity of Samples	Quantity of Detects	Chemical Name	Concentration (µg/kg) Minimum	Maximum	Mean	Standard Deviation	Location of Maximum	Percent above TEC[(a)]	Percent above PEC[(a)]
101	101	Pyrene	1.1	4500	572	764	GR-13 (0-3 ft)	79	7
101	101	1-Methylnaphthalene[b]	0.5	760	49	107	GR-16 (12-15 ft)	NA	NA
101	100	Phenanthrene	0.7	4200	419	616	GR-16 (12-15 ft)	51	7
101	100	Fluoranthene	0.5	5700	566	791	GR-13 (0-3 ft)	38	5
101	100	Benzo(g,h,i)perylene	0.4	1700	148	202	GR-13 (0-3 ft)	NA	NA
101	100	Naphthalene	0.3	810	62	124	GR-22 (15-18 ft)	11	2
101	100	2-Methylnaphthalene[(b)]	0.2	750	57	97	GR-16 (12-15 ft)	NA	NA
101	99	Chrysene	0.4	2900	277	378	GR-13 (0-3 ft)	56	3
101	99	Benzo(a)anthracene	0.4	1800	251	312	GR-13 (0-3 ft)	72	5
101	98	Fluorene	0.3	730	74	109	GR-16 (12-15 ft)	26	1
101	97	Anthracene	0.3	1300	121	186	GR-16 (12-15 ft)	50	2
101	95	Benzo(a)pyrene	0.4	2300	244	315	GR-13 (0-3 ft)	54	1
101	94	Acenaphthene	0.4	760	63	106	GR-16 (12-15 ft)	NA	NA
101	93	Benzo(k)fluoranthene	0.4	1200	105	147	GR-13 (0-3 ft)	NA	NA
101	92	Dibenz(a,h)anthracene	0.4	430	39	55	GR-13 (0-3 ft)	32	4
101	92	Acenaphthylene	0.3	200	33	36	GR-16 (12-15 ft)	NA	NA
101	101	Total PAH (N=16)	10	29083	3450	4479	GR-13 (0-3 ft)	69	1

(a) TEC and PEC values are included in Table 3-2.
(b) Not included in Total PAH
NA = not available

As part of the evaluation of the PAH concentrations throughout the sediment profile, equilibrium partitioning sediment benchmarks (ESBs) for PAH mixtures were calculated for each sediment sample following U.S. EPA (2003). The U.S. EPA guidance describes the theoretical aspects and application of this procedure in evaluating the potential for direct toxicological effects to benthic organisms associated with exposure to 34 individual PAH compounds in a given sediment sample. The approach is based on a number of assumptions including additivity of toxicological response, presence of equilibrium conditions between the sediment matrix and porewater, and that only the fraction of a compound that is dissolved interstitially is relevant in terms of benthic exposures (U.S. EPA, 2003).

Table 3-9. Total PAHs – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (µg/kg)			Standard Deviation	Location of Maximum	Percent above TEC (1610 µg/kg)	Percent above PEC (22,800 µg/kg)
			Minimum	Maximum	Mean				
0-0.5	9	9	526	16739	3200	5142	GR-31	56	0
0-3	25	25	739	29083	3157	5541	GR-13	60	4
3-6	19	19	1189	15048	2765	3062	GR-13	79	0
6-9	19	19	16.8	6585	2675	1927	GR-01	74	0
9-12	13	13	19.5	15490	4411	4034	GR-01	77	0
12-15	11	11	16.7	20670	6137	6545	GR-16	82	0
15-18	4	4	9.90	10330	3108	4898	GR-22	50	0
18+	1	1	35.6	35.6	NA	NA	GR-16	0	0

As the sample analysis quantified only 16 of the 34 PAHs identified in the guidance document, $\sum ESBTU_{FCV}$ was calculated as the sum of the ESBTU values for 13 of the 34 PAHs. This sum was then multiplied by an uncertainty factor of 11.5, a 95% confidence level adjustment factor used to correct for the contributions of the unmeasured PAHs in order estimate the toxicological contributions of all 34 PAHs (U.S. EPA, 2003). The estimated adjusted ESB toxic units ($\sum ESBTU_{FCV}$) for each sample station are presented in Table 3-10. The adjusted $\sum ESBTU_{FCV}$ ranged from 0.007 to 51.8 and were greater than one at all but 14 of the sample collection stations. Sums exceeding one indicate that sensitive benthic organisms could be unacceptably affected. Of the 14 sample stations that had sums less than one, all but one were from sampling depths deeper than 6 feet.

It is important to recognize that the ESBTUs do not consider the potential for bioaccumulation hazards to higher trophic level organisms or interactive effects (e.g., antagonistic, additive or synergistic) between PAHs and other potential chemical constituents in sediment (U.S. EPA, 2003). Other factors, including the presence of other partitioning phases (e.g., soot carbon), the existence of non-equilibrium conditions, and potential photo-toxicological effects may also be important under specific circumstances (U.S. EPA, 2003).

3.1.6 Total Petroleum Hydrocarbons: Diesel Range Organics and Residual Range Organics. CAS analyzed 113 sediment samples (101 primary samples and 12 field duplicate samples) for TPH/RRO and DRO following CAS methods based on U.S. EPA Method 8015C. A 30-g sample was spiked with internal standard, extracted by sonication using methylene chloride, cleaned up to remove interferences, and analyzed by GC/flame ionization detector for individual alkanes (n-C10 through C36), which were summed to determine DRO (C10-C28) and RRO (C25-C36). DRO and RRO results are reported as mg/kg. Tables 3-11 and 3-12 provide the results of DRO and RRO analysis by depth. On average, the DRO and RRO concentrations increased with depth through the 9 to 12 ft segment interval and then decreased again at depths lower than 12 ft.

Table 3-10. Total PAH 16 Concentrations and Adjusted PAH ESB Toxic Unit

Sample ID	Station ID	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total PAH 16 (µg/kg)	Adjusted ESBTU
LA-107	GR-01	0	3	5472	3.492
LA-108		3	6	4215	3.616
LA-109		6	9	6585	6.611
LA-110		9	12	15490	12.395
LA-111		12	14.9	14930	15.057
LA-104	GR-02	0	3	3085	2.886
LA-105		3	6	2619	1.337
LA-106		6	7.4	916	1.330
LA-162	GR-03	0	3	1750	2.398
LA-163		3	6	1999	3.177
LA-164		6	8.7	2187	2.906
LA-101	GR-04	0	3	1879	2.300
LA-102		3	6	1762	1.066
LA-103		6	9.8	26	**0.022**
LA-181	GR-05	0	3	1835	2.149
LA-182		3	6	1189	1.085
LA-183		6	8.0	17	**0.017**
LA-173	GR-06	0	1.5	4089	5.481
LA-184	GR-07	0	3	1820	1.463
LA-185		3	6	1760	1.563
LA-186		6	9	4011	3.911
LA-187		9	12	5264	6.047
LA-188		12	14.4	6535	6.127
LA-189	GR-08	0	3	825	1.061
LA-190		3	6	1959	2.560
LA-191		6	9	5342	5.233
LA-192		9	12	6605	10.262
LA-193		12	13.8	36	**0.087**
LA-194	GR-09	0	3	4427	4.336
LA-195		3	6	1914	2.295
LA-196		6	9	2957	3.060
LA-197		9	12	6170	5.132
LA-198		12	13.8	9645	6.758
LA-165	GR-10	0	3	1765	2.552
LA-166		3	6	2904	3.767
LA-167		6	6.9	3608	4.477
LA-152	GR-11	0	0.9	1663	2.571
LA-112	GR-21	0	3	1488	1.893
LA-113		3	6	2579	2.420
LA-114		6	9	2175	3.264
LA-199	GR-12	0	3	1177	1.442
LA-200		3	6	1385	1.903
LA-201		6	9	1844	1.966
LA-202		9	12	19	**0.041**
LA-203		12	15	17	**0.040**
LA-204		15	16.4	10	**0.021**
LA-126	GR-13	0	3	29083	14.857
LA-127		3	6	15048	6.175
LA-128		6	9	170	**0.018**
LA-129		9	11.9	21	**0.007**
LA-153	GR-14	0	3	1627	2.860
LA-154		3	6	3066	3.427
LA-155		6	8.2	6500	5.559
LA-168	GR-15	0	3	1014	1.325
LA-169		3	6	1912	2.800
LA-170		6	9	3059	3.017
LA-171		9	12	2423	2.838
LA-172		12	13.2	4866	6.991
LA-168		0	3	1014	1.325
LA-144	GR-16	0	3	970	1.550
LA-145		3	6	1263	**0.982**
LA-146		6	9	2439	3.859
LA-147		9	12	5566	5.259
LA-148		12	15	20670	24.520
LA-149		15	18	121	**0.225**
LA-150		18	19.9	36	**0.054**
LA-151	GR-17	0	3.1	1449	2.297
LA-135	GR-18	0	3	1288	2.047
LA-136		3	6	1555	2.342
LA-137		6	9	2657	2.425
LA-138		9	12.7	3301	3.294
LA-117	GR-19	0	3	985	1.441
LA-118		3	6	1955	2.718
LA-119		6	9	2283	2.892
LA-120		9	12	1413	2.065
LA-121		12	15	1770	2.691
LA-122		15	18.2	1970	2.553
LA-139	GR-20	0	3	1835	3.060
LA-140		3	6	1804	2.523
LA-141		6	9	2802	5.249
LA-142		9	12	2044	2.139
LA-143		12	14.9	2294	2.534
LA-025	GR-25	0	0.5	526	2.843
LA-026	GR-26	0	0.5	1279	1.949
LA-027	GR-27	0	0.5	728	2.852

Table 3-10. Total PAH 16 Concentrations and Adjusted PAH ESB Toxic Unit (Continued)

Sample ID	Station ID	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total PAH 16 (µg/kg)	Adjusted ESBTU
LA-115		9	12	3064	3.097
LA-116		12	14.2	2391	1.985
LA-174	GR-22	0	3	1546	1.636
LA-175		3	6	1653	2.149
LA-176		6	9	1244	1.510
LA-177		9	12	5967	5.035
LA-178		12	15	4357	2.888
LA-179		15	16.2	10330	2.393
LA-124	GR-23	0	2.2	739	2.724
LA-123	GR-23M	0	1.1	3748	1.957
LA-125	GR-24	0	2.3	3360	22.819

Bold indicates adjusted ESBTU values < 1.0.

Sample ID	Station ID	Sediment Depth Top (ft)	Sediment Depth Bottom (ft)	Total PAH 16 (µg/kg)	Adjusted ESBTU
LA-028	GR-28	0	0.5	602	2.941
LA-029	GR-29	0	0.5	1647	4.666
LA-030	GR-30	0	0.5	2809	5.454
LA-031	GR-31	0	0.5	16739	20.103
LA-032	GR-32	0	0.5	2428	8.575
LA-033	GR-33	0	0.5	2045	3.786

Table 3-11. DRO – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC	Percent above PEC
			Minimum	Maximum	Mean				
0-0.5	9	9	28	250	67	70	GR-31	NA	NA
0-3	25	25	24	510	135	105	GR-13	NA	NA
3-6	19	19	54	590	290	166	GR-13	NA	NA
6-9	19	19	44	920	364	244	GR-08	NA	NA
9-12	13	13	26	680	382	204	GR-01	NA	NA
12-15	11	11	29	570	348	220	GR-16	NA	NA
15-18	4	4	24	490	196	220	GR-22	NA	NA
18+	1	1	27	27	27	NA	GR-16	NA	NA

NA = not applicable

Table 3-12. RRO – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC	Percent above PEC
			Minimum	Maximum	Mean				
0-0.5	9	9	77	930	224	270	GR-31	NA	NA
0-3	25	25	35	2200	362	403	GR-13	NA	NA
3-6	19	19	160	2100	582	428	GR-13	NA	NA
6-9	19	19	140	1200	640	305	GR-14	NA	NA
9-12	13	13	68	1500	658	361	GR-01	NA	NA
12-15	11	11	70	1000	553	346	GR-22	NA	NA
15-18	4	4	62	800	335	350	GR-22	NA	NA
18+	1	1	72	72	72	NA	GR-16	NA	NA

NA = not applicable

3.1.7 Metals. CAS analyzed 140 sediment samples (125 primary samples and 15 field duplicate samples) for total metals using the methods defined in U.S. EPA Method SW-846 6010C. A representative aliquot of sample was digested and analyzed by inductively coupled plasma atomic emission spectrometry. Data are reported for aluminum, arsenic, cadmium, total chromium, copper, lead, manganese, nickel, selenium, silver, and zinc. Mercury was determined using the methods defined in U.S. EPA Method SW-846 7471A. Mercury was reduced to its elemental state and aerated from solution and measured with an atomic absorption (AA) spectrometer. The samples were extracted by treating 0.5 grams of well-homogenized sample with reagent water, heat and potassium permanganate solution and reduced with sodium chloride-hydroxylamine hydrochloride. Samples were spiked prior to acidification and analyzed by AA where the mercury vapor passes through a cell positioned in the light path of the AA; absorbance was measured as a function of mercury concentration. Results for metals are reported as mg/kg dry weight.

Table 3-13 summarizes the results for each of the metals. Only silver, cadmium, lead, and mercury were detected above the PEC (or ER-M for Ag), with silver having the highest percent exceedance. A closer evaluation of the distribution of these four metals by depth is included in Tables 3-14, 3-15, 3-16, and 3-

17. Silver concentrations in sediment are shown in Figures 3-3a and 3-3b, depicting levels above the ER-M on both sides of the Genesee River, in most depth intervals from locations GR-01 to G-23, and in the surface sample from GR-26. Cadmium was the only other metal notably exceeding its PEC. Cadmium data are provided graphically in Figures 3-4a and 3-4b, showing concentrations above the PEC in core samples on both sides of the river from GR-03 to GR-22. Graphics for all metals are provided Appendix F.

Table 3-13. Summary of Metals Detections

Quantity of Samples	Quantity of Detects	Chemical Name	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC[(a,b)]	Percent above PEC[(a,b)]
			Minimum	Maximum	Mean				
125	125	Aluminum	3920	16400	9716	2296	GR-02	NA	NA
125	125	Arsenic	3.5	19	7.8	2.8	GR-14	14	0
125	116	Cadmium	0.02	15	2.7	3.5	GR-18	50	20
125	125	Total Chromium	6.1	43	20	7.9	GR-14	0	0
125	125	Copper	7.8	89	33	15	GR-08	43	0
125	125	Lead	10	201	35	27	GR-05	38	2
125	125	Manganese	198	683	437	97	GR-02	NA	NA
125	125	Mercury	0.01	3.3	0.2	0.3	GR-28	31	1
125	125	Nickel	11	35	23	4.7	GR-02	54	0
125	81	Selenium	0.3	1.7	0.8	0.4	GR-15	NA	NA
125	113	Silver[2]	0.1	35	10	9.0	GR-14	84	67
125	125	Zinc	38	317	124	67	GR-18	NA	NA

(a) TEC and PEC values are included in Table 3-2.
(b) For silver, ER-L replaces TEC and ER-M replaces PEC.

Table 3-14. Silver – Statistical Summary

Segment Interval (ft.)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above ER-L (1 mg/kg)	Percent above ER-M (3.7 mg/kg)
			Minimum	Maximum	Mean				
0-0.5	33	31	0.1	25.3	4.4	6.4	GR-12	79	27
0-3	25	25	0.2	15.5	8.2	4.2	GR-18	88	84
3-6	19	19	2.6	25.4	12.8	6.2	GR-14	100	95
6-9	19	16	0.1	35.2	15.2	11.3	GR-14	84	79
9-12	13	11	0.1	34.6	16.3	11.9	GR-20	85	85
12-15	11	9	0.1	30.3	13.5	10.0	GR-21	82	73
15-18	4	2	0.1	8.3	3.7	4.3	GR-22	50	50
18+	1	0	0.1	0.1	0.1	NA	NA	0	0

Table 3-15. Cadmium – Statistical Summary

Segment Interval (ft.)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC (1 mg/kg)	Percent above PEC (5 mg/kg)
			Minimum	Maximum	Mean				
0-0.5	33	28	0.02	10.5	0.51	1.8	GR-12	3	3
0-3	25	25	0.07	11.1	1.94	2.5	GR-20	56	12
3-6	19	19	0.28	11	4.64	3.3	GR-20	79	42
6-9	19	19	0.14	15.1	4.50	4.5	GR-18	79	32
9-12	13	12	0.02	12.7	4.47	4.6	GR-21	69	31
12-15	11	10	0.02	9.04	2.74	3.1	GR-21	64	27
15-18	4	2	0.02	2.44	0.94	1.7	GR-19	50	0
18+	1	1	0.04	0.04	0.04	NA	GR-16	0	0

Table 3-16. Lead – Statistical Summary

Segment Interval (ft.)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC (35.8 mg/kg)	Percent above PEC (128 mg/kg)
			Minimum	Maximum	Mean				
0-0.5	33	33	10	49	20	10	GR-12	9	0
0-3	25	25	12	69	26	13	GR-13	12	0
3-6	19	19	16	201	56	48	GR-05	58	11
6-9	19	19	12	87	43	20	GR-08	68	0
9-12	13	13	11	82	43	20	GR-01	69	0
12-15	11	11	11	70	41	19	GR-09	64	0
15-18	4	4	10	85	35	35	GR-22	25	0
18+	1	1	12	12	12	NA	GR-16	0	0

Table 3-17. Mercury – Statistical Summary

Segment Interval (ft.)	Quantity of Samples	Quantity of Detects	Concentration (mg/kg)			Standard Deviation	Location of Maximum	Percent above TEC (0.18 mg/kg)	Percent above PEC (1.06 mg/kg)
			Minimum	Maximum	Mean				
0-0.05	33	33	0.01	3.32	0.15	0.57	GR-28	9	3
0-3	25	25	0.02	0.54	0.09	0.10	GR-02	4	0
3-6	19	19	0.03	0.76	0.18	0.17	GR-02	37	0
6-9	19	19	0.02	0.59	0.21	0.15	GR-14	58	0
9-12	13	13	0.02	0.48	0.22	0.15	GR-01	69	0
12-15	11	11	0.01	0.37	0.21	0.14	GR-09	64	0
15-18	4	4	0.01	0.24	0.10	0.10	GR-22	25	0
18+	1	1	0.03	0.03	0.03	NA	GR-16	0	0

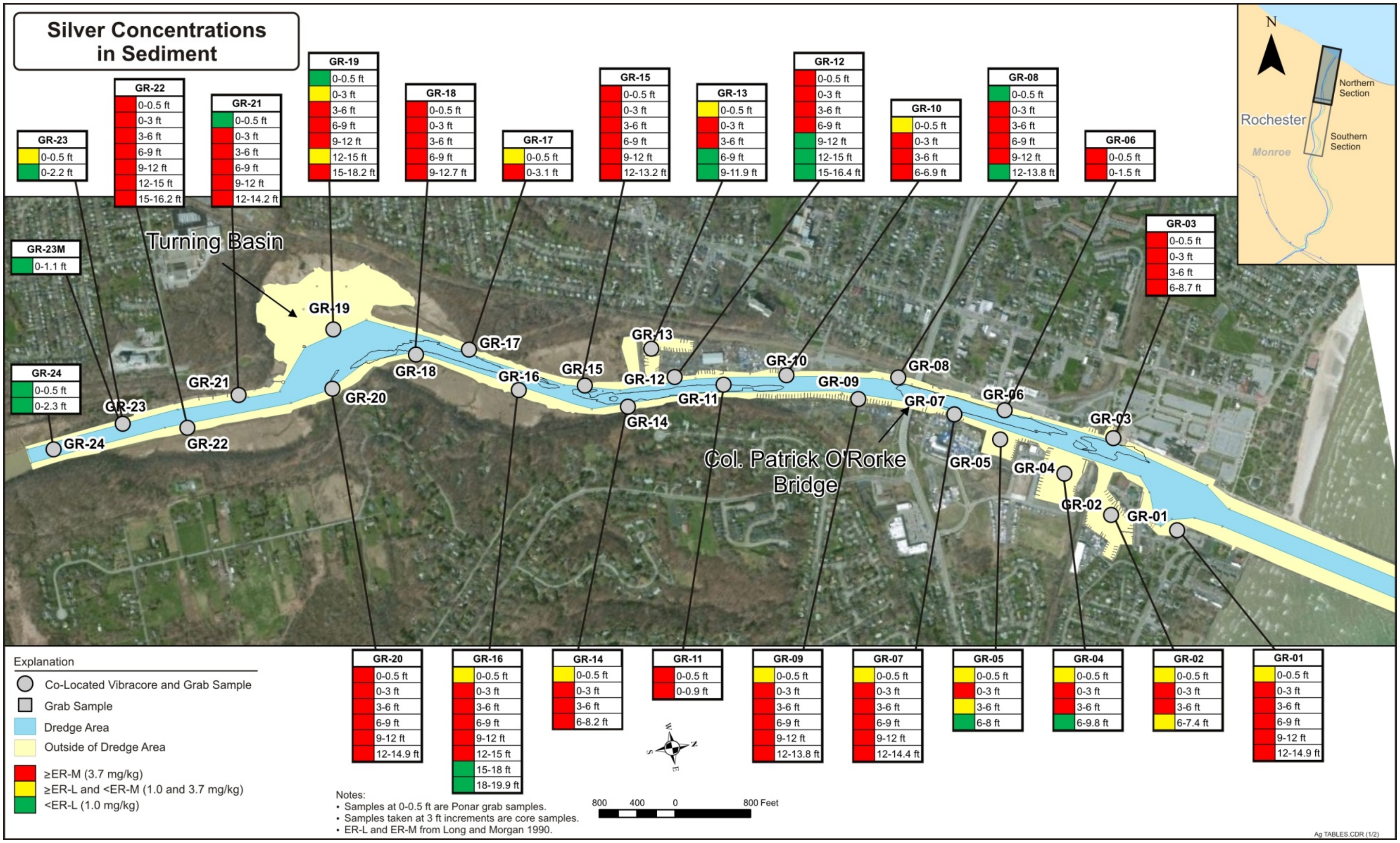

Figure 3-3a. Silver Concentrations in Sediment 2011-September

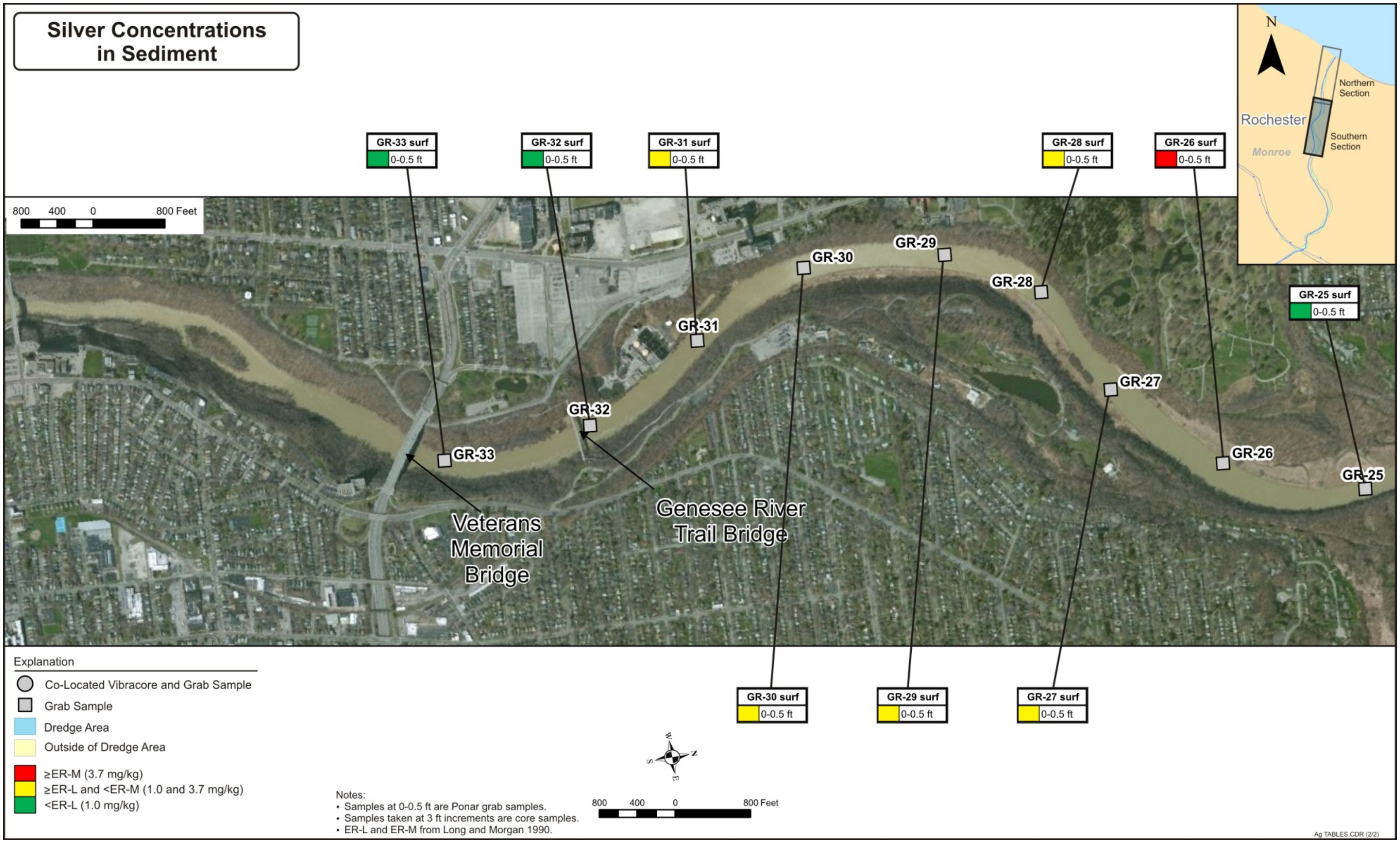

Figure 3-3b. Silver Concentrations in Sediment 2011-September

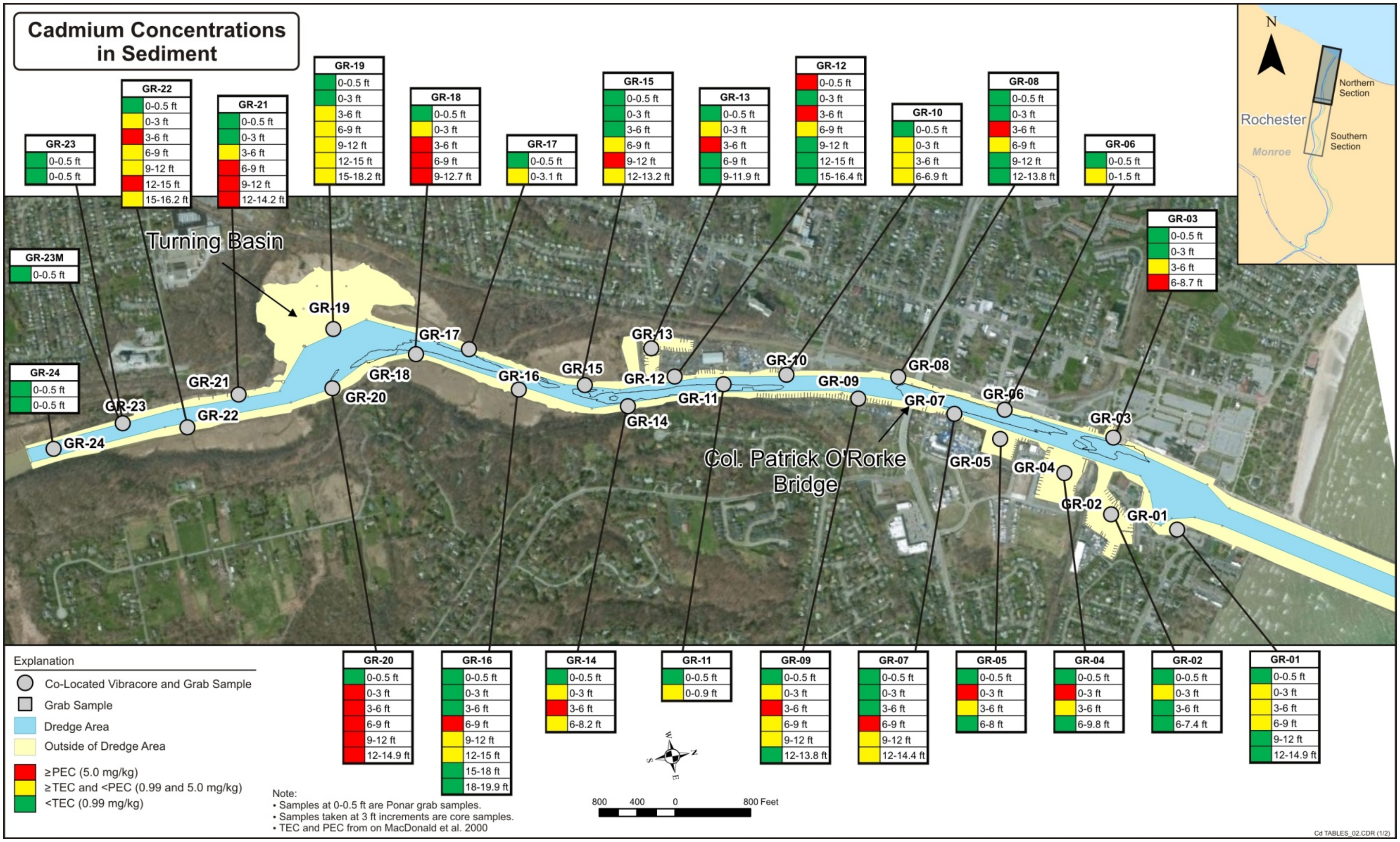

Figure 3-4a. Cadmium Concentrations in Sediment 2011-September

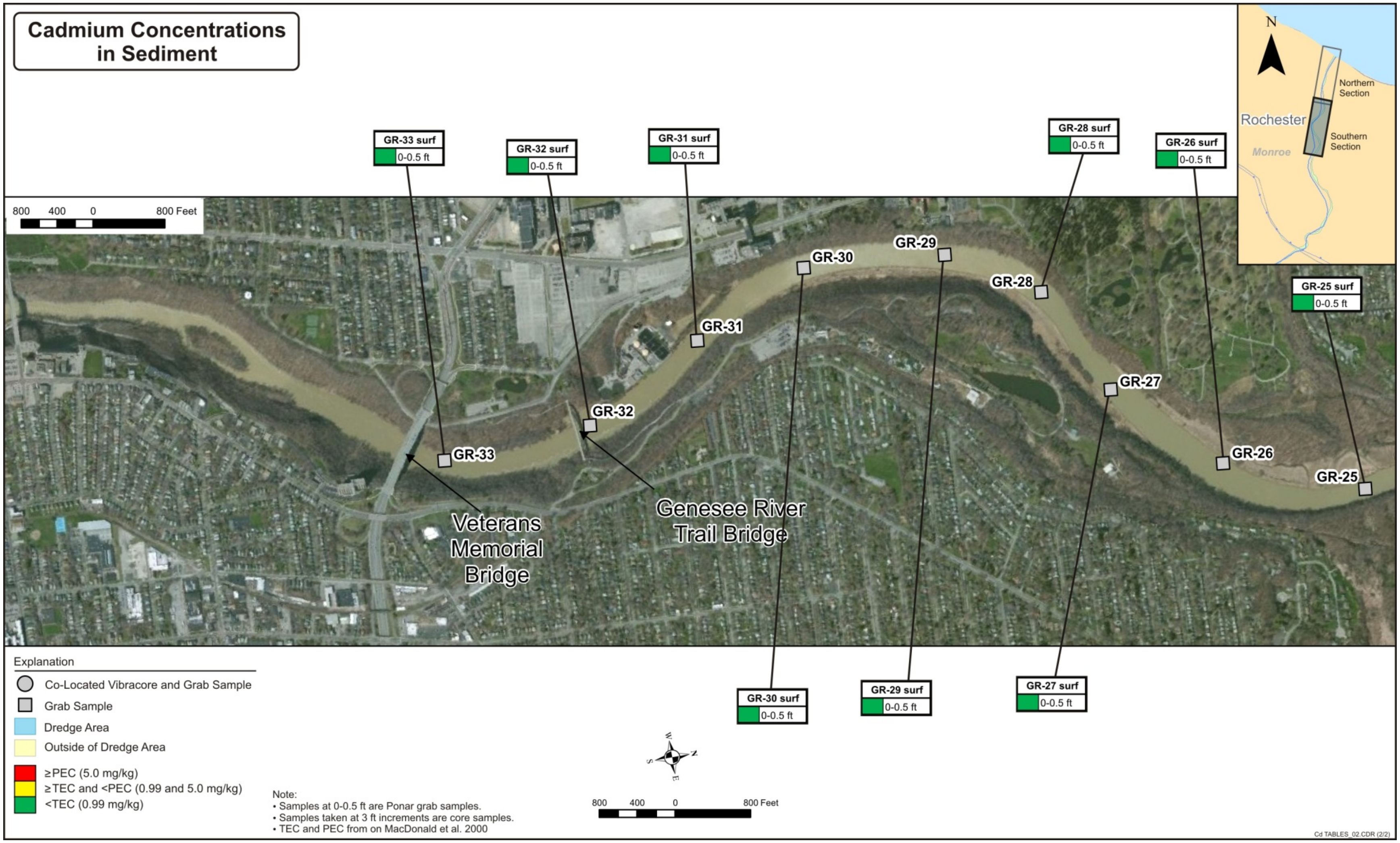

Figure 3-4b. Cadmium Concentrations in Sediment 2011-September

3.1.9 Total Organic Carbon. CAS analyzed 140 sediment samples (125 primary samples and 15 field duplicate samples) for TOC analyses following procedures based on ASTM D4129-82 (ASTM, 2005), modified for soil and sediment matrices. Sample preparation consisted of drying, homogenization, and acidification to remove carbonates and bicarbonates. The samples were combusted in a high-temperature furnace in a stream of oxygen to form carbon dioxide (CO_2), which was analyzed using a CO_2 coulometer. Interfering gases, such as halogens, sulfur, nitrogen oxides, and water, were removed by chemical scrubbers prior to CO_2 measurement. All results were reported as percent carbon on a dry weight basis.

Overall, TOC ranged from 0.17 to 12.6% with an average of 1.37% and standard deviation of 1.29%. Table 3-18 provides results of TOC by depth. On average, the percent TOC was relatively uniform across all depths, ranging from 0.91 to 2.41%.

Table 3-18. TOC – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Concentration (%)			Standard Deviation	Location of Maximum	Percent above TEC	Percent above PEC
			Minimum	Maximum	Mean				
0-0.5	33	33	0.17	2.76	0.91	0.49	GR-13	NA	NA
0-3	25	25	0.21	2.83	1.17	0.60	GR-23M	NA	NA
3-6	19	19	0.86	3.17	1.47	0.65	GR-13	NA	NA
6-9	19	19	0.79	12.6	1.91	2.60	GR-13	NA	NA
9-12	13	13	0.74	4.45	1.63	0.92	GR-13	NA	NA
12-15	11	11	0.60	2.28	1.39	0.57	GR-22	NA	NA
15-18	4	4	0.66	7.01	2.41	3.07	GR-22	NA	NA
18+	1	1	1.03	1.03	1.03	NA	GR-16	NA	NA

3.1.10 Percent Solids. CAS determined percent solids in sediment samples according to ASTM D2216 (ASTM, 2010) to determine the amount of water present in sample aliquots. Percent solids was determined by drying a well-homogenized aliquot of sample and was calculated as the percent ratio of wet to dry weight for each analytical aliquot.

A summary of the percent solids data is shown in Table 3-19. The average percent solids was relatively consistent across the samples both along the length of the river and the core depth intervals.

Table 3-19. Total Solids – Statistical Summary

Segment Interval (ft)	Quantity of Samples	Quantity of Detects	Percent Solids (%)			Standard Deviation	Location of Maximum	Percent above TEC	Percent above PEC
			Minimum	Maximum	Mean				
0-0.5	33	33	47	77	65	8	GR-32	NA	NA
0-3	25	25	56	83	70	6	GR-24	NA	NA
3-6	19	19	56	74	69	4	GR-18	NA	NA
6-9	19	19	31	77	68	9	GR-10	NA	NA
9-12	13	13	47	76	70	7	GR-12	NA	NA
12-15	11	11	66	76	72	3	GR-15 GR-12	NA	NA
15-18	4	4	70	79	74	4	GR-12	NA	NA
18+	1	1	70	70	70	NA	GR-16	NA	NA

3.2 Data Analyses

In addition to the sample by sample comparison of sediment contamination data to benchmarks presented in Section 3.1, a summary of the benchmark results are presented in Section 3.2.1. Data were also analyzed using benchmark quotients (Section 3.2.1), presented with NYSDEC TOGS 5.1.9 classifications (Section 3.2.2) and compared statistically several ways (Section 3.2.3).

3.2.1 Benchmark Results

3.2.1.1 Threshold and Probable Effects Benchmark Results. Thirty metals or organic compounds were analyzed during this study and were compared to SQG benchmarks (28 with TEC/PEC values; silver was compared against the ER-L/ER-M and dioxin/furan TEQ was compared against the NYSDEC [2004] benchmarks for Class A and Class C). Nineteen of the 30 benchmark analytes had at least one measurement exceeding their specific probable effects benchmark, but of those 19 analytes, only three analytes (silver, cadmium, and Total DDE) had more than 10% of the samples analyzed exceeding the probable effects benchmark. Table 3-20 provides a summary of the analytes that exceeded the probable effects benchmarks, with their associated threshold effects exceedance results.

Table 3-20. Summary of Benchmark Exceedances

Analyte	Analyte Group	No. of Samples	No. of Samples >Threshold Effects Benchmark	% of Samples >Threshold Effects Benchmark	No. of Samples >Probable Effects Benchmark	% of Samples >Probable Effects Benchmark
Silver	Metal	125	105	84	84	67
Cadmium	Metal	125	63	50	25	20
DDE_sum	Pesticide	101	46	46	13	13
Pyrene	PAH	101	80	79	7	7
Phenanthrene	PAH	101	52	51	7	7
Fluoranthene	PAH	101	38	38	5	5
Benzo_a_anthracene	PAH	101	73	72	5	5
Dibenz_a_h_anthracene	PAH	101	32	32	4	4
Total_TEQ	Dioxin/Furan	58	16	28	2	3
DDD_sum	Pesticide	101	30	30	3	3
Chrysene	PAH	101	57	56	3	3
CHLORDANE	Pesticide	101	43	43	3	3
Anthracene	PAH	101	50	50	2	2
Naphthalene	PAH	101	11	11	2	2
Lead	Metal	125	47	38	2	2
PAH	Metal	101	70	69	1	1
Benzo_a_pyrene	PAH	101	55	54	1	1
Fluorene	PAH	101	26	26	1	1
Mercury	Metal	125	39	31	1	1

3.2.1.2 Benchmark Quotient Results. The SQG benchmark quotient approach, calculating mean values for a set of benchmarks for a single sample, has been defined and described by several publications, e.g., SQGs developed for the National Status and Trends Program (National Oceanic and Atmospheric Administration, 1999) and MacDonald et al., 2000. Benchmark quotients were developed to improve on the predictability of individual chemical benchmarks by evaluating the combined effects of multiple contaminants often found in sediment. Benchmark quotients were calculated for this study by dividing each contaminant concentration by its respective SQG benchmark value, then summing the results for all contaminants (using one-half the detection limit for non detected samples). This total was then divided by the number of contaminants summed. For example, to determine the benchmark quotient for a sample with four contaminants being analyzed for which there are individual PEC benchmarks, the following process would be used.

Step 1: Divide the concentration of each contaminant by its PEC value. For this example, the following values are used:

Concentration of contaminant A/PEC contaminant A = 1.0 (contaminant A concentration is equal to the contaminant A PEC
Concentration of contaminant B/ PEC contaminant B = 1.5 (contaminant B concentration is 1.5x the PEC)

Concentration of contaminant C/ PEC contaminant C = 2.0 (contaminant C concentration is 2x the PEC)
Concentration of contaminant D/ PEC contaminant D = 2.5 (contaminant D concentration is 2.5x the PEC)

Step 2: Sum the results for each contaminant.
1 + 1.5 + 2 + 2.5 = 7

Step 3: Divide this sum (7) by the total number of contaminants (4).
7/4 = 1.75

The resulting mean PEC quotient for this sample is 1.75.

For these calculations for this report, only the TEC/PEC value associated with the sum of PAH (N=16) was used, individual PAH compounds were not included in the quotient calculation to avoid double counting PAH compounds (MacDonald et al., 2000).

MacDonald et al., 2000 reported the following predictive power associated with four quotient benchmark levels:

Quotient Level	Prediction	Predictive Ability (%)
<0.1	Not toxic	90.2
<0.5	Not toxic	82.8
>0.5	Toxic	85.0
>1.0	Toxic	93.3
>1.5	Toxic	94.4

Quotients were calculated in two manners, first with only chemicals having TEC/PEC consensus values, and secondly with TEC/PEC chemicals plus the ER-L/ER-M value for silver and the NYSDEC value for Total TEQ included. A summary of the quotient results are provided in Table 3-21; quotient values for each sample are provided in Table 3-22.

Table 3-21. Summary of Benchmark Quotient Results

	Quotient Source			
Statistic	**TEC Only**	**PEC Only**	**TEC/Ag/TEQ**	**PEC/Ag/TEQ**
Average	0.98	0.19	1.61	0.35
Min	0.21	0.06	0.19	0.05
Max	3.01	0.60	5.72	1.31

While silver often exceeded its individual threshold and probable effects benchmarks, and total TEQ often exceeded the threshold effects benchmark, overall contamination in Genesee River sediment within the study area is relatively lower based on SQG quotient analyses. The average TEC benchmark quotient was 1.61 with silver and TEQ benchmarks included. The average PEC quotient was 0.35. Only one sample exceeded 1.0 for the PEC quotient (the max of 1.31 in the surface sediment grab sample at GR-12). Thirty four out of 125 samples (27.2%) exceeded a PEC quotient of 0.5. These quotient values indicate relatively low probability of negative biological effects from sediment, and this prediction is supported by the toxicity testing results reported in Section 3.3.

3.2.2 Statistical Testing Results. To investigate the nature and extent of contamination Genesee River sediment within the study area the likelihood that the overall average contaminant concentration for a given chemical was below the applicable thresholds of concern (as defined by established benchmarks described earlier) was assessed through statistical testing. Data were statistically compared to the SQG benchmarks as described in Appendix A of the QAPP. This translated to the following hypothesis test:

Null hypothesis H_0: AM ≥ Benchmark
Alternative hypothesis H_1: AM < Benchmark

where
AM= Arithmetic mean sediment contamination concentration

Chemicals with significant p-values ($p<0.05$) will lead to the rejection of the null hypothesis in favor of the alternative hypothesis, i.e. the arithmetic mean sediment contamination concentration for the COI is less than its respective benchmark value. If a p-value was found to be insignificant, we cannot conclude that the arithmetic mean sediment concentration is less than the benchmark value.

Table 3-22. Sediment Quality Guideline Quotients

Sample Location	Sample Segment (ft)	No. of SQG Chemicals (TEC/PEC only)	TEC Quotient	PEC Quotient	No. of SQG Chemicals (TEC/PEC/ Ag/TEQ)	TEC/Ag/TEQ Quotient	PEC/Ag/TEQ Quotient
GR-01	0-0.5	7	0.57	0.18	9	0.68	0.20
GR-01	0-3	15	0.88	0.14	16	1.16	0.22
GR-01	3-6	15	1.46	0.23	16	2.31	0.48
GR-01	6-9	15	1.26	0.23	16	2.18	0.48
GR-01	9-12	15	1.35	0.22	16	2.47	0.54
GR-01	12-15	15	1.12	0.18	17	1.84	0.39
GR-02	0-0.5	7	0.82	0.25	9	1.11	0.30
GR-02	0-3	15	1.12	0.24	16	1.94	0.47
GR-02	3-6	15	0.96	0.22	16	1.61	0.40
GR-02	6-9	15	0.44	0.11	17	0.59	0.15
GR-03	0-0.5	7	0.44	0.14	9	0.86	0.24
GR-03	0-3	15	0.52	0.11	16	1.19	0.29
GR-03	3-6	15	0.83	0.17	16	1.27	0.29
GR-03	6-9	15	1.18	0.23	17	1.74	0.35
GR-04	0-0.5	7	0.57	0.18	9	0.59	0.18
GR-04	0-3	15	1.14	0.22	16	1.63	0.35
GR-04	3-6	15	0.85	0.16	16	1.05	0.22
GR-04	6-9	15	0.27	0.09	17	0.24	0.08
GR-05	0-0.5	7	0.56	0.18	9	0.63	0.19
GR-05	0-3	15	1.13	0.22	16	1.61	0.35
GR-05	3-6	15	1.15	0.24	16	1.24	0.26
GR-05	6-9	15	0.27	0.09	17	0.25	0.08
GR-06	0-0.5	7	0.60	0.19	9	1.85	0.51
GR-06	0-3	15	1.42	0.20	17	1.90	0.34
GR-07	0-0.5	7	0.55	0.17	9	0.69	0.20
GR-07	0-3	15	0.47	0.10	16	0.81	0.20
GR-07	3-6	15	0.48	0.10	16	1.05	0.26
GR-07	6-9	15	2.05	0.30	16	2.91	0.55
GR-07	9-12	15	1.47	0.25	16	2.73	0.60
GR-07	12-15	15	1.27	0.21	17	2.37	0.50
GR-08	0-0.5	7	0.41	0.13	9	0.39	0.12
GR-08	0-3	15	0.35	0.10	16	0.64	0.17
GR-08	3-6	15	1.83	0.31	16	2.95	0.62
GR-08	6-9	15	1.79	0.32	16	3.52	0.79
GR-08	9-12	15	0.66	0.12	16	0.92	0.20
GR-08	12-15	15	0.25	0.08	17	0.23	0.07
GR-09	0-0.5	7	0.48	0.15	9	0.58	0.17
GR-09	0-3	15	0.67	0.14	16	1.20	0.28
GR-09	3-6	15	2.22	0.35	16	3.60	0.74
GR-09	6-9	15	1.40	0.24	16	2.77	0.62

Table 3-22. Sediment Quality Guideline Quotients (Continued)

Sample Location	Sample Segment (ft)	No. of SQG Chemicals (TEC/PEC only)	TEC Quotient	PEC Quotient	No. of SQG Chemicals (TEC/PEC/ Ag/TEQ)	TEC/Ag/TEQ Quotient	PEC/Ag/TEQ Quotient
GR-09	9-12	15	1.08	0.19	16	2.04	0.46
GR-09	12-15	15	1.09	0.21	17	2.39	0.55
GR-10	0-0.5	7	0.44	0.14	9	0.73	0.21
GR-10	0-3	15	0.53	0.12	16	1.27	0.32
GR-10	3-6	15	1.23	0.23	16	1.79	0.39
GR-10	6-9	15	1.17	0.21	17	2.00	0.39
GR-11	0-0.5	7	0.73	0.22	9	2.60	0.71
GR-11	0-3	15	0.66	0.13	17	1.51	0.35
GR-12	0-0.5	7	2.53	0.60	9	5.72	1.31
GR-12	0-3	15	0.38	0.09	16	0.78	0.20
GR-12	3-6	15	1.43	0.25	16	2.42	0.52
GR-12	6-9	15	1.22	0.18	16	1.68	0.32
GR-12	9-12	15	0.21	0.06	16	0.20	0.06
GR-12	12-15	15	0.22	0.07	16	0.21	0.07
GR-12	15-18	15	0.21	0.06	17	0.19	0.06
GR-13	0-0.5	7	0.99	0.28	9	1.33	0.34
GR-13	0-3	15	2.47	0.37	16	2.98	0.52
GR-13	3-6	15	2.64	0.44	16	2.95	0.54
GR-13	6-9	15	0.28	0.08	16	0.28	0.08
GR-13	9-12	15	0.29	0.09	17	0.26	0.08
GR-14	0-0.5	7	0.35	0.11	9	0.55	0.16
GR-14	0-3	15	0.62	0.12	16	1.26	0.30
GR-14	3-6	15	2.05	0.33	16	3.51	0.74
GR-14	6-9	15	1.86	0.32	17	4.01	0.87
GR-15	0-0.5	7	0.49	0.15	9	0.93	0.27
GR-15	0-3	15	0.41	0.11	16	0.87	0.23
GR-15	3-6	15	0.49	0.11	16	1.45	0.37
GR-15	6-9	15	1.08	0.21	16	2.65	0.64
GR-15	9-12	15	1.77	0.31	16	2.90	0.63
GR-15	12-15	15	0.84	0.15	17	1.31	0.25
GR-16	0-0.5	7	0.33	0.11	9	0.37	0.11
GR-16	0-3	15	0.30	0.08	16	0.65	0.17
GR-16	3-6	15	0.34	0.08	16	1.17	0.31
GR-16	6-9	15	1.30	0.23	16	2.65	0.60
GR-16	9-12	15	1.86	0.29	16	2.83	0.56
GR-16	12-15	15	1.64	0.24	16	2.56	0.50
GR-16	15-18	15	0.24	0.07	16	0.23	0.07
GR-16	18+	15	0.24	0.07	17	0.22	0.07
GR-17	0-0.5	7	0.42	0.14	9	0.70	0.21
GR-17	0-3	15	0.69	0.15	17	1.16	0.26
GR-18	0-0.5	7	0.48	0.15	9	1.43	0.40
GR-18	0-3	15	0.44	0.10	16	1.38	0.36
GR-18	3-6	15	1.80	0.27	16	2.33	0.43
GR-18	6-9	15	2.98	0.46	16	4.65	0.94
GR-18	9-12	15	2.36	0.38	17	4.61	0.93
GR-19	0-0.5	7	0.45	0.15	9	0.45	0.14
GR-19	0-3	15	0.36	0.08	16	0.55	0.14
GR-19	3-6	15	0.51	0.11	16	1.00	0.25
GR-19	6-9	15	0.74	0.14	16	1.37	0.32
GR-19	9-12	15	0.56	0.12	16	0.95	0.23
GR-19	12-15	15	0.60	0.13	16	0.78	0.18
GR-19	15-18	15	0.79	0.16	17	1.13	0.25
GR-20	0-0.5	7	0.63	0.19	9	3.19	0.87
GR-20	0-3	15	1.69	0.30	16	2.30	0.48
GR-20	3-6	15	2.51	0.33	16	3.13	0.51

Table 3-22. Sediment Quality Guideline Quotients (Continued)

Sample Location	Sample Segment (ft)	No. of SQG Chemicals (TEC/PEC only)	TEC Quotient	PEC Quotient	No. of SQG Chemicals (TEC/PEC/ Ag/TEQ)	TEC/Ag/TEQ Quotient	PEC/Ag/TEQ Quotient
GR-20	6-9	15	2.50	0.41	16	4.13	0.87
GR-20	9-12	15	2.50	0.41	16	4.50	0.97
GR-20	12-15	15	1.79	0.28	17	3.86	0.70
GR-21	0-0.5	7	0.36	0.12	9	0.35	0.11
GR-21	0-3	15	0.33	0.08	16	0.88	0.23
GR-21	3-6	15	1.09	0.20	16	1.61	0.35
GR-21	6-9	15	2.01	0.34	16	2.70	0.54
GR-21	9-12	15	2.53	0.41	16	4.19	0.88
GR-21	12-15	15	1.77	0.32	17	4.40	0.86
GR-22	0-0.5	7	0.43	0.14	9	1.03	0.29
GR-22	0-3	15	0.90	0.18	16	1.46	0.33
GR-22	3-6	15	3.01	0.30	16	4.00	0.60
GR-22	6-9	15	0.70	0.13	16	0.96	0.21
GR-22	9-12	15	1.58	0.23	16	1.94	0.34
GR-22	12-15	15	2.62	0.42	16	3.25	0.60
GR-22	15-18	15	1.16	0.21	17	1.59	0.32
GR-23	0-0.5	7	0.46	0.15	9	0.66	0.19
GR-23	0-3	15	0.22	0.06	17	0.21	0.05
GR-23M	0-3	15	0.36	0.07	17	0.35	0.07
GR-24	0-0.5	7	0.24	0.08	9	0.23	0.07
GR-24	0-3	15	0.40	0.07	17	0.41	0.08
GR-25	0-0.5	15	0.22	0.06	17	0.25	0.06
GR-26	0-0.5	15	0.33	0.08	17	0.55	0.14
GR-27	0-0.5	15	0.23	0.06	17	0.31	0.08
GR-28	0-0.5	15	1.47	0.26	17	1.37	0.25
GR-29	0-0.5	15	0.31	0.07	17	0.39	0.09
GR-30	0-0.5	15	0.38	0.08	17	0.41	0.09
GR-31	0-0.5	15	1.15	0.16	17	1.11	0.17
GR-32	0-0.5	15	0.33	0.07	17	0.30	0.06
GR-33	0-0.5	15	0.39	0.09	17	0.36	0.09

Benchmark Quotient >1.0
Benchmark Quotient > 0.5

Chemicals included in the analyses:

Metals: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, and Silver

PAH: Anthracene, Fluorene, Naphthalene, Phenanthrene, Benz(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene and Total PAHs

PCB: Total PCBs as Total Aroclors

Pesticides: gamma-BHC (lindane), Chlordane, Dieldrin, Sum of DDT +DDD + DDE (Total DDx), Endrin, Heptachlor Epoxide

Dioxins and furans: dioxin total TEQ

A one-sample t-test to test the above hypothesis was utilized. All chemical concentrations were transformed on the natural log scale in order uphold the assumption of normally distributed data. The log transformed arithmetic mean sediment concentrations were compared to a lower and higher benchmark (also transformed on the natural log scale). The lower benchmark used for most chemicals was the consensus-based threshold effect concentration (TEC) (MacDonald 2000). The exceptions were silver and dioxin total TEQ, which used ER-L (Long and Morgan 1990) and NYSDEC Class A (NYSDEC

2004), respectively. The higher benchmark for most chemicals was the probable effects concentration (PEC) (MacDonald 2000). The exceptions were silver and dioxin total TEQ, which used ER-M (Long and Morgan 1990) and NYSDEC Class C (NYSDEC 2004) benchmarks, respectively. The one-sample t-test was performed over all depth intervals and then by depth interval (0-0.5 ft, 0-3 ft, 3-6 ft, 6-9 ft, 9-12 ft, 12-15 ft and 15-18 ft).

Overall Analysis Results:

Threshold Effects Benchmarks: In the overall one-sample test, 11 out of the 29 chemicals were found to have higher p-values (>0.05). This means that the arithmetic mean sediment concentration could not be concluded to be less than the benchmark value. These chemicals were cadmium, nickel, silver, anthracene, phenanthrene, benzo (a) anthracene, benzo (a) pyrene, chrysene, pyrene, total PAHs and total PCBs. The remaining chemicals had significant p-values (<0.05). This indicated that their arithmetic means were less than their respective benchmark value. These chemicals included arsenic, chromium, copper, lead, mercury, fluorene, naphthalene, dibenz(a,h) anthracene, fluoranthene, gamma-BHC (lindane), chlordane, dieldrin, sum of DDT +DDD + DDE (total DDx), Endrin, heptachlor epoxide, and dioxin total TEQ.

Probable Effects Benchmarks: Silver was the only chemical with a non-significant p-value, meaning that its arithmetic mean could not be concluded to be lower than its benchmark value. The remaining chemicals were found to have p-values less than 0.05.

By Depth Analysis Results:

Table 3-23 (organized by depth) provides lists of the chemicals with arithmetic mean concentrations which are <u>not significantly</u> lower than their respective threshold and probable effects benchmark values (p-value > 0.05).

Threshold Effects Benchmarks: Many metals and organic compounds exceeded their respective threshold benmarks within each depth interval and are listed in Table 3-23.

Table 3-23. Summary of Statistical Results by Depth Interval

Depth Interval (ft)	Threshold Effects Benchmark Exceedence	Probable Effects Benchmark Exceedence
0-0.5	Silver, Phenanthrene, Benz(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene, Total PAHs	None
0-3	Cadmium, Nickel, Silver, Anthracene, Phenanthrene, Benz(a)anthracene, Benzo(a)pyrene, Chrysene, Fluoranthene, Pyrene, Total PCBs, Dioxin TEQ and Total PAHs	Silver
3-6	Cadmium, Copper, Lead, Nickel, Silver, Anthracene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene, PAH, Total PCBs, Chlordane and Total DDx	Silver
6-9	Arsenic, Cadmium, Copper, Lead, Mercury, Nickel, Silver, Anthracene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Fluoranthene, Pyrene, PAH, Total PCBs, Chlordane, Total DDx, and Dioxin TEQ	Silver

Table 3-23. Summary of Statistical Results by Depth Interval (Continued)

Depth Interval (ft)	Threshold Effects Benchmark Exceedence	Probable Effects Benchmark Exceedence
9-12	Arsenic, Cadmium, Copper, Lead, Mercury, Nickel, Silver, Anthracene, Fluorene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene, PAH, Total PCBs, Chlordane, Total DDx and Dioxin TEQ	Silver and Dioxin TEQ
12-15	Arsenic, Cadmium, Copper, Lead, Mercury, Nickel, Silver, Anthracene, Fluorene, Phenanthrene, Benzo(a) anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene, PAH, Total PCBs, Chlordane, Total DDx and Dioxin TEQ	Silver
15-18	Arsenic, Cadmium, Copper, Lead, Mercury, Nickel, Silver, Anthracene, Fluorene, Naphthalene, Phenanthrene, Benzo(a)anthracene, Benzo(a)pyrene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Pyrene, PAH, Chlordane, Total DDx and Dioxin TEQ	Silver, Phenanthrene, Fluoranthene, Pyrene and Dioxin TEQ

Probable Effects Benchmarks: Silver was measured at concentrations signficantly above the probable effects benchmark within all six core intervals. The dioxin and furans TEQ levels exceeded the NYSDEC 2004 Class C benchmark in two intervals, 9-12ft and 15-18ft. The PAH compounds Phenanthrene, Fluoranthene, Pyrene exceeded the PEC in one interval, 15-18ft. While dioxons and furans TEQ values did not exceed probable benchmarks often, they were only measured in surface grab samples and the lowest core interval of each core. Sediment from surface grab samples was generally less contaminated compared to the 0-3ft core interval (note no probable effect benchmark exceedances) and contaminants like cadmium were reduced in lower core intervals. The distribution of dioxins and furans is not documented as well as the other COIs.

3.2.3 NYSDEC TOGS 5.1.9 Sediment Classifications. NYSDEC TOGS 5.1.9 guidelines (NYSDEC, 2004) were not used as the primary source of benchmark data since they are not as comprehensive as desired for this broadly scoped study. Most significant is that silver, the contaminant of highest concern, is not included in TOGS 5.1.9. In addition, many of the TEC/PEC values are more conservative compared to TOGS 5.1.9 values. This is further discussed in Section 4.1. To assess the data within the context of NYSDEC guidance, these classifications are provided in Table 3-24. Note that for the surface samples (0-0.5ft), the TOGS 5.1.9 chemicals with A/B/C classification concentrations were arsenic, cadmium, copper, lead, mercury, and total TEQ. For the other samples, the chemicals were comprised of arsenic, cadmium, copper, lead, mercury, total Aroclor, PAH, total TEQ, total DDx, chlordane, dieldrin, and mirex. Where sediments were rated A, the list of TOGS 5-1-9 chemicals is not provided.

Table 3-24. Sediment Quality Guideline Quotients

Station ID	Vertical Group	NTSDEC TOGS 5.1.9 Class	Chemical(s) Responsible for Class B or C Classification
GR-01	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Total ARO, PAH, Total DDx
	3-6 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	6-9 ft	Class B	Arsenic, Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	9-12 ft	Class B	Copper, Lead, Mercury, PAH
	12-15 ft	Class B	Copper, Lead, Mercury, PAH
GR-02	0-0.5 ft	Class B	Copper, Total TEQ
	0-3 ft	Class B	Arsenic, Cadmium, Copper, Lead, Mercury
	3-6 ft	Class B	Copper, Lead, Mercury
	6-9 ft	Class B	Mercury
GR-03	0-0.5 ft	Class A	
	0-3 ft	Class B	Total DDx, Chlordane, Mirex
	3-6 ft	Class B	Cadmium, Total DDx, Chlordane
	6-9 ft	Class B	Cadmium, Copper, Lead, Mercury, Total TEQ, Total DDx, Chlordane
GR-04	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Copper, Total ARO, Total DDx, Chlordane
	3-6 ft	Class B	Cadmium, Total ARO, Total DDx, Chlordane
	6-9 ft	Class A	
GR-05	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Copper, Lead, Total ARO, Total DDx, Chlordane
	3-6 ft	Class C	Lead
	6-9 ft	Class A	
GR-06	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Lead, Total ARO, PAH, Total DDx, Chlordane
GR-07	0-0.5 ft	Class A	
	0-3 ft	Class B	Total DDx
	3-6 ft	Class A	

Table 3-24. Sediment Quality Guideline Quotients (Continued)

Station ID	Vertical Group	NTSDEC TOGS 5.1.9 Class	Chemical(s) Responsible for Class B or C Classification
	6-9 ft	Class C	Total DDx
	9-12 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	12-15 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total TEQ, Total DDx, Chlordane
GR-08	0-0.5 ft	Class A	
	0-3 ft	Class A	
	3-6 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx, Chlordane
	6-9 ft	Class B	Arsenic, Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	9-12 ft	Class B	PAH
	12-15 ft	Class A	
GR-09	0-0.5 ft	Class A	Arsenic, Cadmium, Copper, Lead, Mercury, Total TEQ
	0-3 ft	Class B	Cadmium, Copper, PAH
	3-6 ft	Class C	Cadmium
	6-9 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx
	9-12 ft	Class B	Cadmium, Copper, Lead, Mercury, PAH, Total DDx, Chlordane
	12-15 ft	Class B	Copper, Lead, Mercury, PAH, Total TEQ
GR-10	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium
	3-6 ft	Class B	Cadmium, Copper, Lead, Total ARO, Total DDx
	6-9 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total TEQ, Total DDx, Chlordane
GR-11	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Total TEQ, Total DDx
GR-12	0-0.5 ft	Class C	Cadmium
	0-3 ft	Class A	
	3-6 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx, Chlordane
	6-9 ft	Class B	Cadmium, Copper, Lead, Total ARO, Total DDx, Chlordane
	9-12 ft	Class A	
	12-15 ft	Class A	
	15-18 ft	Class A	

Table 3-24. Sediment Quality Guideline Quotients (Continued)

Station ID	Vertical Group	NTSDEC TOGS 5.1.9 Class	Chemical(s) Responsible for Class B or C Classification
GR-13	0-0.5 ft	Class B	Copper, Lead, Total TEQ
	0-3 ft	Class B	Cadmium, Copper, Lead, PAH, Total DDx, Chlordane
	3-6 ft	Class B	Cadmium, Copper, Lead, Total ARO, PAH, Total DDx, Chlordane
	6-9 ft	Class A	
	9-12 ft	Class A	
GR-14	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Total DDx
	3-6 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx, Chlordane
	6-9 ft	Class B	Arsenic, Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total TEQ, Total DDx, Chlordane
GR-15	0-0.5 ft	Class A	
	0-3 ft	Class A	
	3-6 ft	Class A	
	6-9 ft	Class C	Mirex
	9-12 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx, Chlordane, Mirex
	12-15 ft	Class B	Cadmium, PAH, Total TEQ, Total DDx
GR-16	0-0.5 ft	Class A	
	0-3 ft	Class A	
	3-6 ft	Class A	
	6-9 ft	Class B	Cadmium, Copper, Lead, Mercury, Total ARO, Total DDx
	9-12 ft	Class B	Arsenic, Cadmium, Copper, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	12-15 ft	Class B	Arsenic, Copper, Lead, Mercury, PAH, Total DDx, Chlordane
	15-18 ft	Class A	
	18+ ft	Class A	
GR-17	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Total TEQ
GR-18	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium
	3-6 ft	Class C	Total DDx

Table 3-24. Sediment Quality Guideline Quotients (Continued)

Station ID	Vertical Group	NTSDEC TOGS 5.1.9 Class	Chemical(s) Responsible for Class B or C Classification
	6-9 ft	Class C	Cadmium, Total DDx
	9-12 ft	Class C	Cadmium
GR-19	0-0.5 ft	Class A	
	0-3 ft	Class A	
	3-6 ft	Class B	Cadmium
	6-9 ft	Class B	Cadmium, Total DDx
	9-12 ft	Class B	Cadmium
	12-15 ft	Class B	Cadmium, Total DDx
	15-18 ft	Class B	Cadmium, Total TEQ, Total DDx, Chlordane
GR-20	0-0.5 ft	Class A	
	0-3 ft	Class C	Cadmium
	3-6 ft	Class C	Cadmium, Total DDx
	6-9 ft	Class C	Cadmium
	9-12 ft	Class C	Cadmium
	12-15 ft	Class C	Total TEQ
GR-21	0-0.5 ft	Class A	
	0-3 ft	Class A	
	3-6 ft	Class B	Cadmium, Total ARO, Total DDx, Chlordane
	6-9 ft	Class C	Cadmium
	9-12 ft	Class C	Cadmium
	12-15 ft	Class C	Total TEQ
GR-22	0-0.5 ft	Class A	
	0-3 ft	Class B	Cadmium, Copper, Total ARO, Total DDx
	3-6 ft	Class C	Total DDx
	6-9 ft	Class B	Cadmium, Total DDx, Chlordane
	9-12 ft	Class B	Cadmium, Lead, Mercury, Total ARO, PAH, Total DDx, Chlordane
	12-15 ft	Class C	Chlordane
	15-18 ft	Class B	Cadmium, Copper, Lead, Mercury, PAH, Total TEQ, Total DDx, Chlordane

Table 3-24. Sediment Quality Guideline Quotients (Continued)

Station ID	Vertical Group	NTSDEC TOGS 5.1.9 Class	Chemical(s) Responsible for Class B or C Classification
GR-23	0-0.5 ft	Class A	
	0-3 ft	Class A	
GR-23M	0-3 ft	Class A	
GR-24	0-0.5 ft	Class A	
	0-3 ft	Class A	
GR-25	0-0.5 ft	Class A	
GR-26	0-0.5 ft	Class A	
GR-27	0-0.5 ft	Class A	
GR-28	0-0.5 ft	Class C	Mercury
GR-29	0-0.5 ft	Class A	
GR-30	0-0.5 ft	Class A	
GR-31	0-0.5 ft	Class B	Lead, Mercury, PAH
GR-32	0-0.5 ft	Class A	
GR-33	0-0.5 ft	Class A	

3.3 Toxicology

3.3.1 10-Day Survival Test with the Amphipod *Hyalella azteca*. The USACE ERDC laboratory in Vicksburg, MS performed 10-day acute and chronic solid phase sediment toxicity tests on 40 samples utilizing a recommended benchmark benthic amphipod *Hyalella azteca* (U.S. EPA/USACE, 1998). The euryhaline (organism able to tolerate a wide range of salinity) amphipod *H. azteca* was obtained from ERDC in-house cultures. Among the factors considered in the selection of *H. azteca* is the species' documented sensitivity to metals coupled with silver being a primary COI within the study area. Only healthy organisms were used in testing. The *H. azteca* method (U.S. EPA, 2000; Method 100.1) was conducted using eight replicate 300 mL tall-form beakers containing 10 amphipods each. Water was renewed twice daily and a feeding ration of yeast, cerophyl, and trout chow was supplied daily. Assessment endpoints were acute (survival) and chronic (growth) at the end of the 10-day exposure period. Two growth endpoints were analyzed: total biomass/initial organism and individual biomass. Biomass was measured as ash-free dry weight (mg). For acceptable tests (tests passing test acceptance criteria), a one-way analysis of variance (SPSS, Inc., Chicago, Illinois) was conducted to determine if statistically significant reductions relative to the control existed. Survival data were arc-sine square root transformed prior to analysis. Toxicologically significant amphipod mortality is defined as a statistically significant 20% reduction in survival relative to reference sediment (U.S. EPA/USACE, 1998).

Due to laboratory capacity restrictions and the high number of test samples, toxicity tests were run in four phases. Ammonia concentrations in porewater exceeded the 20 mg/L guidance for freshwater organisms (U.S. EPA/USACE, 1998) for all toxicity test sediment samples with the exception of sediment LA-H1215. The high ammonia concentrations caused concern for confounding factors as a source of mortality and lowered growth rates. To assess the effects of ammonia, the first phase of five sediment samples was performed in conjunction with a toxicity reduction evaluation (TRE) focused only on ammonia. The five sediment samples represented a range of ammonia concentrations (low to high) as determined by bulk porewater measurements. In addition to the standard toxicity test of eight replicates per test sediment sample, four replicates of each test sediment were amended with SIR-600 (zeolite) resin prior to test initiation to reduce or eliminate porewater ammonia bioavailability. Porewater ammonia concentrations were measured in the unamended and amended sediments at test initiation to verify that ammonia was reduced. A sand and SIR-600 control were also included. Clean quartz sand was added to four replicates of each site sediment to evaluate the potential for a dilution effect from the SIR-600 addition. Four replicates of SIR-600 amended control sediment were included to ensure toxicity related to the SIR-600 did not occur.

The TRE tests (Phase 1) were run from November 27, 2011 to December 2, 2011; the test design and acute survival results are summarized in Table 3-25.

Table 3-25. Summary of TRE Study Results

Test Source	**No. of Samples**	**No. of Replicates**	**Average Survival** (%)	**Min Survival** (%)	**Max Survival** (%)	**Total Ash-free Biomass/Initial Organism** (mg) **% of Control**	**Individual Ash-free Dry Weight** (mg) **% of Control**
Control Sediment	1	8	89	80	100	NA	NA
Control/Zeolite	1	4	93	80	100	101	98
Control/Sand	1	4	98	90	100	86	78
Test Sediment	5	8	94	70	100	99	93
Test Sediment/Zeolite	5	4	92	70	100	110	107
Test Sediment/Sand	5	4	94	70	100	101	94

NA = not applicable

All of the TRE tests passed test protocol acceptance criteria. TRE results indicated no statistically significant differences for mortality, total growth, or individual growth between the control sediment and any of the five test sediments, the five test sediments treated with Zeolite, or the five test sediments treated with sand.

As a result of the TRE test (identified as TRE), the three subsequent phases of toxicity tests were performed without any ammonia treatment beyond standard water exchanges. Following is a summary of the test phase numbers of samples and dates:

Phase	# of Test Sediments	Start Date	End Date
TRE	5	22 Nov 2011	02 Dec 2011
Phase 1	10	27 Dec 2011	06 Jan 2012
Phase 2	13	17 Jan 2012	27 Jan 2012
Phase 3	12	17 Jan 2012	27 Jan 2012

For all 40 samples, there were no statistically significant differences between any of the test samples and control sediment for any of the three endpoints (mortality, total biomass, or individual biomass). Toxicity test sample result data are summarized in Table 3-26. These results suggest Genesee River sediments are not toxic to *H. azteca* based on the 10-day test for acute and chronic endpoints. While a few chemicals of concern had concentrations greater than PEC or other benchmark values that classify sediments as probably causing biological effects, the absence of toxicological effects is potentially due to (1) the low number of COIs that exceed probable effects benchmarks, and (2) combinations of factors such as TOC (both quantity and quality) and particle size reduced the bioavailability of the primary COIs. COI quotient calculations support factor #1 above; quotient levels are typically well below quotient probable effects ranges.

Table 3-26. Summary of Toxicity Testing Results

Test Sediment Group	No. of Samples	Average Survival (%)	Min Survival (%)	Max Survival (%)	Total Ash-free Biomass/Initial Organism (mg) % of Control	Individual Ash-free Dry Weight (mg) % of Control
Control Sediment	4	93	80	100	NA	NA
Test Sediment Interval Group (ft)						
All Intervals Combined	40	92	30	100	98	102
0-3	8	95	70	100	106	105
3-6	8	90	30	100	95	99
6-9	8	91	40	100	92	96
9-12	6	90	50	100	94	98
12-15	6	91	40	100	93	97
15-18	3	94	60	100	112	115
18-21	1	90	80	100	93	98

3.4 Habitat Assessment

A general assessment of the Genesee River nearshore riparian habitat was performed to identify the major habitat types present along the lower Genesee River and the extent of their coverage along the river. The riparian zone is defined as vegetated area along both sides of a river or stream and generally supports trees, shrubs and grasses. General land use and land cover along the lower Genesee River was evaluated using U.S. Geological Survey aerial photographs to determine the extent of habitat along the riparian corridor, National Wetland Inventory (NWI) maps to identify wetland resources, and geo-referenced photographs taken during field sampling to identify where habitat changes along the Genesee River shoreline occur. The habitat assessment did not include the delineation of the riparian corridor, which is defined by soil, vegetation and hydrology characteristics; collection of water quality/chemistry, fish, or macroinvertebrate samples; or data from plant and wildlife surveys.

This habitat assessment provides a general description of site conditions along the lower Genesee River in September 2011. It is not intended to be a detailed description of habitat and wildlife in the Genesee River riparian zone, as several other studies of the ecological resources have already been or are being conducted. Table 3-27 presents some of the studies that have been conducted along with a summary of their findings. Some of these documents provide detailed species lists for fish, wildlife, aquatic invertebrates, plankton, threatened and endangered species, and invasive species that are found in and around the lower Genesee River. No detailed lists of vegetation in the riparian zone were identified.

The reach of the lower Genesee River evaluated generally ranges from 200 to 500 feet in width and stretches five river miles upstream from the mouth of the river where it flows into Lake Ontario to the Veteran's Memorial Bridge (Route 104/Keeler State Expressway) (Figure 1-1). Within this reach of the river are Turning Point Park along the west bank and Seneca County Park along the east bank, both of which contribute to habitat within the riparian zone. The lower one-quarter to one-third of the lower Genesee River is almost fully developed, lined with marinas, boat slips, businesses, a U.S Coast Guard station, residences, and shoreline protection (rip rap and bulkheading). Boat slips line both shorelines up to river mile (RM) 1.1 along the east bank and RM 1.3 along the west bank. The width of the riparian zone along each side of the river (Figures 3-5a and 3-5b) ranges from 675 ft, along the lower Genesee River, to 2,550 ft and averages approximately 1,400 ft. Nearshore habitat along both banks consists of freshwater emergent marsh, deciduous forest habitat, and forest/shrub wetlands (Figures 3-5a and 3-5b). Representative habitat photographs are linked to specific locations in Figures 3-5a and 3-5b .

Deciduous forest habitat is found throughout the riparian zone (Figures 3-5a and 3-5b). NWI data also indicate patches of freshwater emergent wetland and freshwater forested/shrub wetland. Although emergent marsh occurs along the shoreline throughout much of the lower Genesee River, larger patches of emergent marsh within the riparian corridor range from approximately 3.2 to 16 acres in size (total ~ 54 acres). Forested/shrub wetland habitat patches in the riparian corridor range from approximately 1.5 to 23 acres in size (total ~ 39 acres). The shoreline habitat along both banks of the lower Genesee River varies between emergent marsh and rocky shoreline.

Shoreline habitat along the east bank of the Genesee River from RM 1 to RM 1.1 consists of emergent marsh. From RM 1.1 to 1.4, the shoreline becomes rocky and is characterized by a steep, eroded bank. From RM 1.4 to RM 2.5, shoreline habitat again consists of dense emergent marsh. The shoreline is rocky again from RM 2.5 to RM 3.2 and is characterized by a steep eroded bank between RM 2.6 and RM 2.9. Dense emergent marsh is present from RM 3.2 to RM 4.2, and the rest of the shoreline along the east bank of the lower Genesee River from RM 4.2 up to the Veterans Memorial Bridge is rocky and characterized by a steep eroded bank (Figures 3-5a and 3-5b).

Shoreline habitat along the west bank of the Genesee River from RM 1.3 to RM 3.3 consists of dense emergent marsh with small areas of steep eroded bank and rocky shoreline near RM 1.7 and between RM 2.1 and RM 2.2. The shoreline habitat between RM 2.4 and 2.5 consists of forested/shrub wetland. From RM 3.3 to RM 4.1, the shoreline is rocky and characterized by steep eroded bank from RM 3.3 to RM 3.5. Shoreline habitat from RM 4.1 to the Veterans Memorial Bridge predominantly consists of dense emergent marsh, with a disruption in this habitat at Kodak Park and between RM 4.7 and RM 4.9 where rocky shoreline is present.

Wildlife observed during the sampling event included a mallard duck (*Anas platyrhychos*) (omnivorous bird), king salmon (*Oncorhynchus tshawytscha*), a great blue heron (*Ardea herodias)* (piscivorous bird), herring gulls (*Larus argentatus*) (omnivorous bird), and a red-tail hawk (*Buteo jamaicensis*) (carnivorous bird). Although the resolution of habitat photos taken during field sampling was not sufficient to identify all deciduous forest species present, vegetation noted in habitat photographs includes oaks, weeping willow, maples, birch, some pine, and tree of heaven (invasive). Virginia creeper is also present. Emergent marsh vegetation includes cattail (*Typha sp.*) and some common reed (*Phragmites australis*) at locations further upstream. Recreational activities observed during sampling include angling and canoeing, indicating that the lower Genesee River is a valued recreational resource.

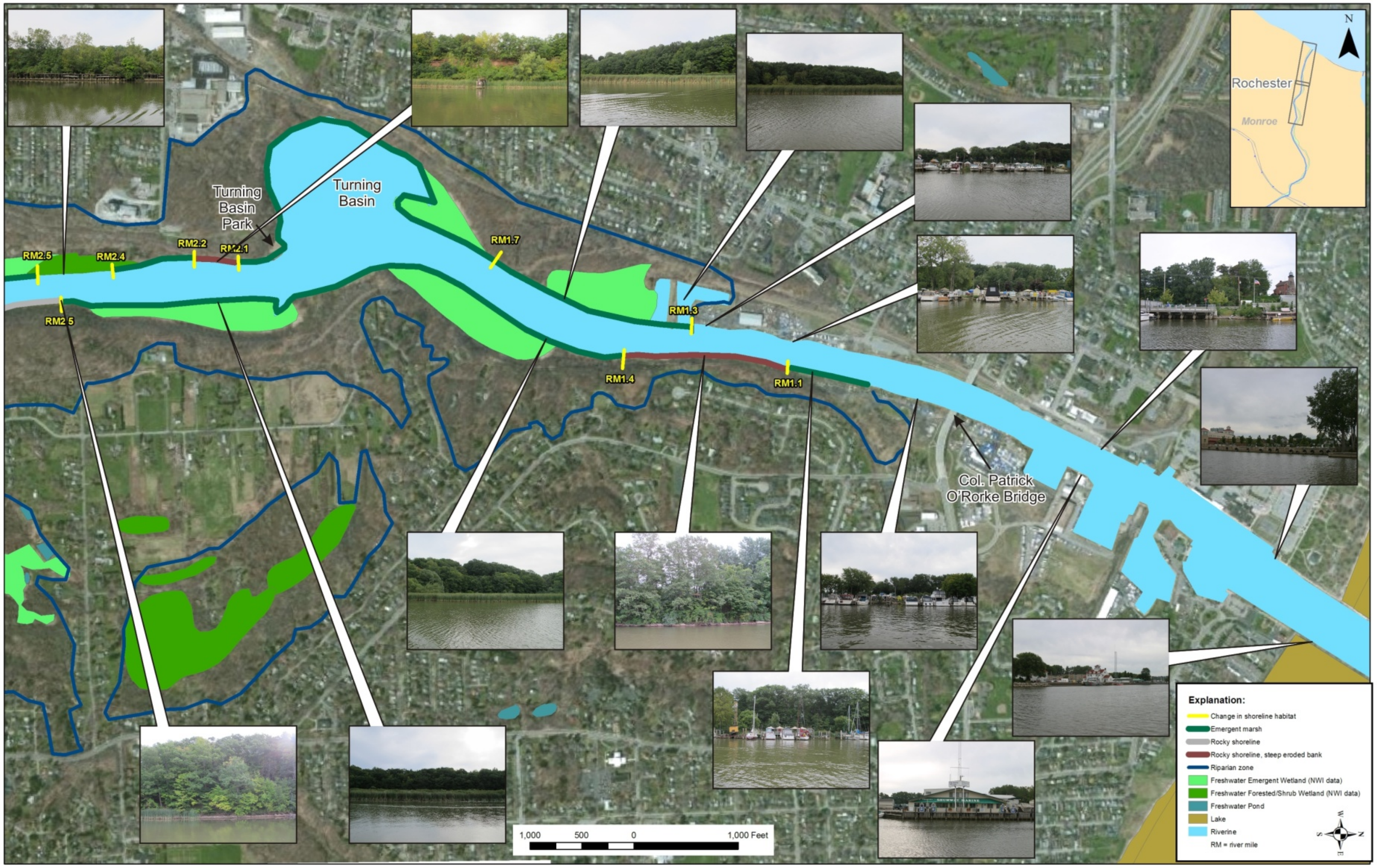

Figure 3-5a. Genesee River AOC Habitat Map

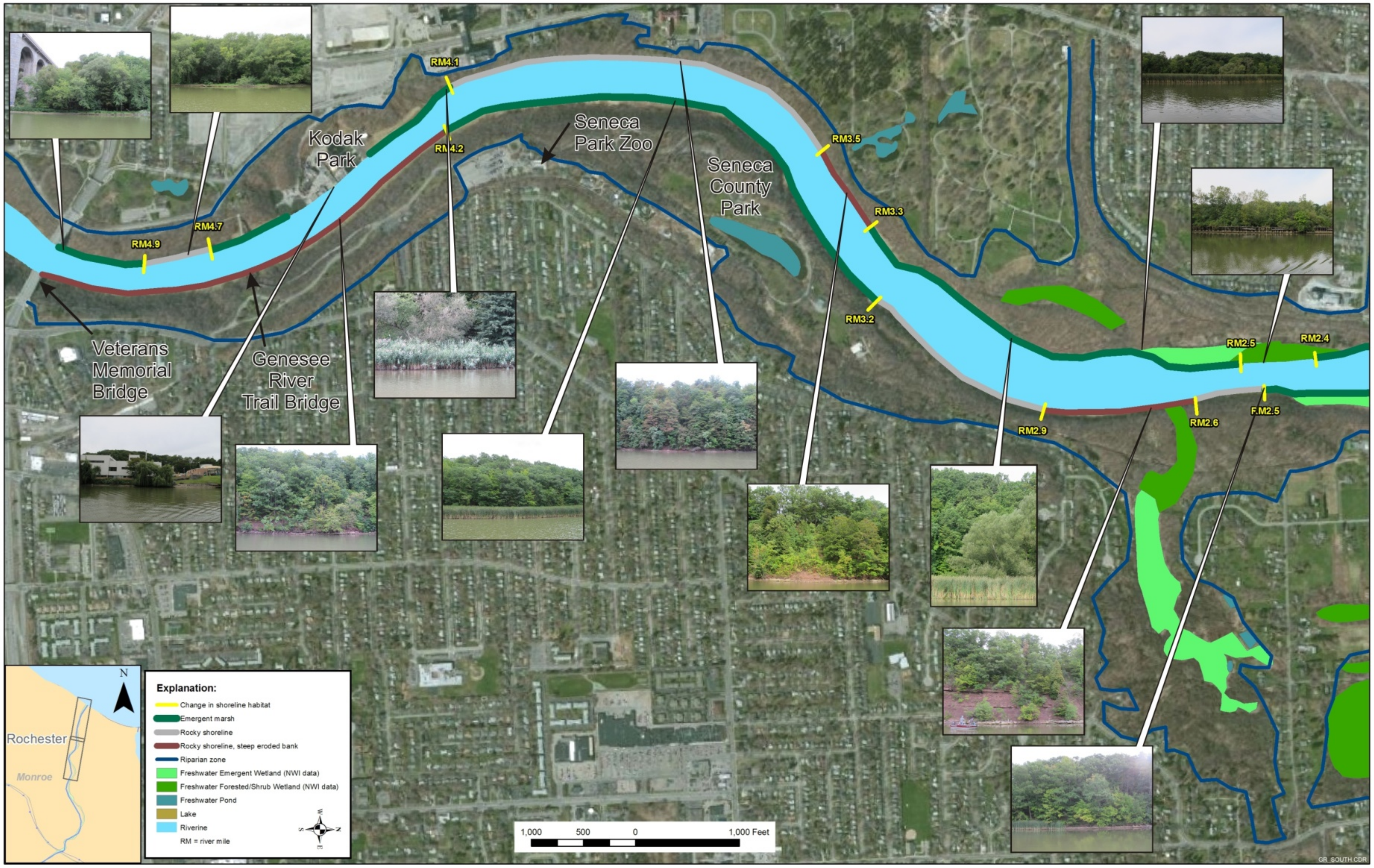

Figure 3-5b. Genesee River AOC Habitat Map

Table 3-27. Historical Genesee River Studies Characterizing Natural Resources

Document	Date	Summary of Content
U.S. Geological Survey. Final Report – Assessment of Habitat Use by Experimentally Stocked Juvenile Lake Sturgeon. Submitted to U.S. EPA Great Lakes National Program Office.	No date on report	Study determined that stocked juvenile sturgeon are successfully using nursery habitat within the Genesee River. Report presents results of a habitat quality assessment that includes list of benthic macroinvertebrate species present.
Interim Invasive Species Plant List. http://www.dec.ny.gov/animals/65408.html	Accessed October 2011	Provides a current list of invasive plant species to assist NYSDEC in incorporating invasive species management into funding, regulatory and other activities. It does not include all invasive or potentially invasive plant species.
http://www.dec.ny.gov/doc/wildlife_pdf/ontariosetbl.pdf	Accessed October 2011	Provides land cover for the Southeast Lake Ontario Basin, lists species of greatest conservation need and those that have been extirpated, provides species diversity and critical habitat information, and describes significant fish and wildlife habitats, including the Genesee River.
Comprehensive Wildlife Conservation Strategy Plan. New York State Department of Environmental Conservation, http://www.dec.ny.gov/animals/30483.html	Accessed October 2011	This document identifies data needs for determining the distribution and abundance of wildlife species and habitats, describes the problems that may impact species and their habitats, and describes conservation actions for preserving identified species and habitats. The chapter for the Southwest Lake Ontario Basin includes the lower Genesee River.
Jonahson, M. 2010. Movement of lake sturgeon (*Acipenser fulvescens*) in the lower Genesee River, New York. M.S. Thesis, State University of New York College at Brockport.	July 2010	Tracked movement of stocked lake sturgeon within the Genesee River and compared with behavior of naturally occurring lake sturgeon in other systems. Concluded that movement of stocked fish is similar to that of native fish.
Checklist of Amphibians, Reptiles, Birds and Mammals of New York State, Including Their Legal Status. New York State Department of Environmental Conservation, Division of Fish, Wildlife and Marine Resources.	April 2010	Provides a list of 32 amphibian, 39 reptile, 375 bird, and 92 mammal species believed to be a part of the fauna of New York and their present legal status.
Rochester Embayment Area of Concern Beneficial Use Impairment Delisting Criteria. Prepared by Ecology and Environment, Inc.	March 2009	Reports delisting criteria for the Rochester Embayment AOC. Currently, the Rochester Embayment, including the lower Genesee River, is listed as impaired, and there are fish consumption advisories, reproductive effects on mink, impacts to phytoplankton and zooplankton populations, the presence of zebra mussels, and loss of riparian and shoreline habitat.
Summary Report – Lower Genesee River Data Evaluation, Eastman Business Park, Rochester, New York. Prepared by Arcadis for Eastman Business Park.	February 2009	Summarizes available information on the status of the lower Genesee River to determine whether historic releases from Kodak Park may pose a threat to human health and the environment. Concluded that potential impacts from historic operations appear to be localized and are sediment-related, most studies reviewed show no apparent site effects,

Table 3-27. Historical Genesee River Studies Characterizing Natural Resources (Continued)

Document	Date	Summary of Content
		and screening criteria exceedances were low and do not support impact to human health and the environment.
Neuderfer, G.N. 2007. Contaminant Analysis in the Rochester Embayment Area of Concern, Final Report. USEPA-GLNPO, Project Number GL97582701.	May 18, 2007	Reports data on sediment chemistry, toxicity, benthic macroinvertebrate community condition, and bioaccumulation in lake sturgeon. Concludes benthic macroinvertebrate community is slightly to moderately impacted and lake sturgeon released to the river have elevated tissue concentrations of contaminants after one year.
The Genesee River Basin Action Strategy. Genesee/Finger Lakes Regional Planning Council and U.S. Army Corps of Engineers.	October 2004	Provides a compilation of currently available information about the state of the Genesee River watershed and ongoing assessment, outreach and implementation activities. Includes information on land use, impairment, listed species, and fish stocking, as well as other important information for developing an action strategy.
Final Report – Benthic Macroinvertebrate Survey of the Lower Genesee River in the Vicinity of the CSXT Derailment and Chemical Spill at Charlotte, New York. Prepared by IT Corporation for CSX Transportation.	April 1, 2002	Presents results of sediment sampling and benthic macroinvertebrate community assessment to evaluate potential impacts from a CSX train derailment on December 23, 2001 that spilled acetone and methylene chloride into the Genesee River. Concluded that the benthic macroinvertebrate community does not appear to have been impacted by the spill. A species list is provided.
NYSDEC. 1995. Phase II Final Report – Lower Genesee River Study, Summary of 1992, 1993 and 1994 Results. New York State Department of Environmental Conservation.	August 1995	Presents an assessment of aquatic condition based on toxicity tests, chemistry and fish, invertebrate and plankton populations. The lower Genesee River is listed as impaired for fishing and aesthetics, and there are low to high impacts to benthic populations throughout the lower river, as well as bioaccumulation of metals and pesticides in fish and invertebrate tissue and microbial and invertebrate toxicity near site 4 (near Kodak Park). The report contains lists of fish, invertebrate and zooplankton species observed and identified.
A Biological Survey of the Genesee River System. State of New York Conservation Department.	1926	Presents a survey of the Genesee River system to determine the most practical methods of increasing fish production. Provides species lists for fish, submerged aquatic vegetation, plankton and benthic macroinvertebrates.
Baker, Frank C. 1920. Animal Life and Sewage in the Genesee River, New York. *American Society of Naturalists,* 54(631): 152 – 161.	1920	Compares collections of species data before, during and after pollution, showing a decline in animal life populations resulting from pollution and recovery after pollution abatement.

Note: This list is not comprehensive.

4.0: DISCUSSION AND RECOMMENDATIONS

4.1 Discussion

The purpose of this site characterization project is to evaluate contamination in areas contiguous to the navigation channel and upstream of the navigation channel in the final approximately 6 miles of the Genesee River in Rochester, New York, to see if remedial action is necessary to delist the AOC or move forward in the process of determining measures necessary for delisting of the dredging beneficial use impairments. The specific goals of the study are to provide GLNPO with the tools to make rigorous, qualitative assessments based on quantitative data to support the design and performance of necessary remedial actions at this site as well as provide a baseline of conditions prior to any necessary remedial actions. To attain the objectives, the project collected sediment samples from 34 locations and analyzed a total of 126 sediment samples (140 samples including field duplicates).

SQGs were compiled from three sources to estimate the potential environmental effects of contamination levels. The primary source is the TEC/PEC and quotient approach provided in Macdonald et al. (2000). NYSDEC (2004) was not used as the primary source of benchmark data since it is not as comprehensive as is necessary for this broadly scoped study, in addition, many of the TEC/PEC values are more conservative compared to NYSEDC 2004 values. The MacDonald 2000 TEC/PEC calculations do not include silver as a metal or dioxins and furans. Therefore, the approach of using MacDonald et al. (2000) TEC/PEC benchmarks and adding the Long and Morgan (1990) ER-L/ER-M benchmark for silver and the NYSDEC (2004) dioxin TEQ benchmark was developed. This modified benchmark approach allows for some comparison to the NYSDEC 2004 system, with levels below the threshold benchmarks being analogous to Class A sediment, levels measured between threshold and probable quotients are analogous to Class B, and levels greater than the probable benchmark are analogous to Class C. The data suggest that average sediment contamination levels essentially fall within the definition of a Class B AOC as defined by the NYSDEC (2004).

The study confirmed that the primary COI in the study area is silver, with cadmium being a secondary COI. Other metal and organic compounds were typically measured well below probable effects benchmarks. Due to the reduced frequency that dioxins and furans were measured, their vertical and horizontal distribution is not as well documented.

Silver: Silver was measured at levels above the probable effects ER-M benchmark at the combined core/grab locations GR-01 to GR-22. Of those 22 sample locations within the northern portion of the study area, 14 of the 0-0.5’ intervals did not exceed the ER-M benchmark, with 11 of those 14 exceeding the ER-L threshold benchmark and three below the two benchmark levels. Only one 0-3’ core segment did not exceed the probable effects benchmark. At seven locations, one or more bottom intervals of the cores did not exceed the probable effects benchmark, suggesting the sediments at those elevations pre-date silver discharge into the Genesee River. Only one of the samples within stations GR-23 to GR-33 had a measured concentration exceeding the probable effects benchmark. These samples were from 0-0.5 surface sample grab (all 11 locations) or the first core interval (0-3’ or less; GR-23 and GR-24). These results agree with the northern sample pattern that in general, there is less silver contamination in the upper sediment intervals, suggesting that silver input may be reducing in the study area.

Cadmium: Cadmium is the second most prevalent COI, with 15 of the 22 cores from GR-01 to GR-22 having one or more intervals with Cd concentrations exceeding the probable effects benchmark (PEC). The cadmium concentration pattern was similar to silver, in that levels were, in general, higher in the middle intervals compared to the upper and lower intervals, and were reduced in upstream surface grab samples (all <TEC). Only one surface sediment grab sample (GR-12; >PEC) exceeded the TEC or PEC.

Dioxins furans: Dioxins and furans were measured in all the surface grabs, and the lowest interval of each core. Data for each sample was compared to the NYSDEC (2004) benchmark using the TEQ calculation. Dioxins were a primary COI within the workplan based on historical information. The total TEQ exceeded the NYSDEC Class C benchmark in only two of the 58 samples, suggesting that dioxins and furans are no longer a primary COI . However, the mean concentration at two depth intervals was significantly greater than their probable effects benchmark at two depth intervals. Conclusions regarding TEQ are difficult because of the limited number of samples analyzed. With only the surface and lowest interval of each core being analyzed, the concentrations in the middle remain unknown. Because other analytes such as silver and cadmium showed contaminant levels higher in the middle intervals compared to the upper and lower intervals, it cannot be assumed that the TEQ levels in the upper and lower intervals are indicative of the levels through the entire core.

Sediment Contamination Quotients: Contaminant quotients were calculated for each sample. The average PEC quotient was 0.35. Only one sample exceeded a quotient value of 1.0 for the probable effects quotient while 27% of the samples (24/125) exceeded a PEC quotient of 0.5. Sediment samples with quotient levels above 0.5 had an 85% capability to predict environmental effects based on MacDonald 2000. Assuming the 85% predictability, it follows that only 20 of the 24 samples measured above the quotient of 0.5 or 16% of the total samples (20/125) would cause toxicity. Therefore, quotient values indicate relatively low probability of negative biological effects from the sediment analyzed in the study.

Toxicity: There were no significant differences between the test samples and control samples for mortality, total biomass, or individual organism biomass from the 40 ten-day solid phase toxicity tests carried out using the amphipod *Hyalella azteca*. These results are not incompatible with the complete set of benchmark analyses, while they are not expected based on silver concentrations being generally above the ER-M, the quotient analyses confirm that a relative few number of contaminant are of high concern, thus the quotients are relatively low and in the region where biological effects are generally not encountered.

Habitat Restoration: Since contamination within study area sediments does not meet the current levels necessary for the site to be considered for restoration within the Legacy Act program, there are no further habitat restoration efforts planned under the GLLA.

4.2 Conclusions

Based on the results of this study, only two compounds, Ag and Cd, were considered to be primary COIs. While dioxins were historically considered to be primary COIs, results from the current evaluation indicate only minimal SQG exceedances, though the vertical and horizontal distribution is not well documented due to limited sampling. Low sediment contamination quotients indicate a low probability for negative biological impacts. This conclusion is supported by the lack of toxicity observed in the 10-day solid phase amphipod tests. Overall, the data suggest that the average sediment contamination levels fall within the definition of a Class B AOC as defined by the NYSDEC (2004).