**THIRD FIVE-YEAR REVIEW REPORT FOR
LAKE BOTTOM OU2 SUBSITE OF THE ONONDAGA LAKE SUPERFUND SITE
ONONDAGA COUNTY, NEW YORK**

Prepared by

**U.S. Environmental Protection Agency
Region 2
New York, New York**

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**Pat Evangelista, Director
Superfund and Emergency Management Division**

Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AWQS	Ambient Water Quality Standards
BERA	Baseline Ecological Risk Assessment
BSQV	bioaccumulation-based sediment quality value
BTEX	Benzene, toluene, ethylbenzene, xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	centimeter
COC	chemical of concern
CPOIs	chemical parameters of interest
CQA	construction quality assurance
CQAP	construction quality assurance plan
CQC	construction quality control
CY	cubic yard
DDT	Dichlorodiphenyltrichloroethane
DMU	Dredge Management Unit
EPA	United States Environmental Protection Agency
ESD	Explanation of Significant Difference
ft.	feet
FS	Feasibility study
FYR	Five-Year Review
GAC	granular activated carbon
$g/cm^2/yr$	grams per square centimeter per year
GWTP	Groundwater Treatment Plant
HHRA	Human Health Risk Assessment
ICs	Institutional Controls
ILD	in-lake waste deposit
ISS	In-Situ Stabilization
LMS	liquid management system
LOAELs	Lowest-Observed-Adverse-Effect Levels
MDL	method detection limit
MeHg	methylmercury
MERC	modified erosion-resistant cap
METRO	Metropolitan Syracuse Wastewater Treatment Plant
$\mu g/L$	micrograms per liter
$mg/m^2/day$	mg per square meter per day
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
mm	millimeter
MNR	monitored natural recovery
MPC	Modified protective cap
NAPL	non-aqueous-phase liquid

NAVD88	North American Vertical Datum of 1988
ng/L	nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NOAELs	no-observed-adverse-effect levels
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSOPRHP	New York State Office of Parks, Recreation and Historic Preservation
OLMMP	Onondaga Lake Monitoring and Maintenance Plan
O&M	Operation and Maintenance
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	Polychlorinated Biphenyl
PCDD/PCDF	polychlorinated dibenzo-p-dioxin/polychlorinated dibenzofuran
PDI	pre-design investigation
PEC	probable effect concentration
PECQ	probable effect concentration quotient
PRG	Preliminary Remediation Goal
RA	Remedial Area
RAO	Remedial Action Objective
RI	Remedial Investigation
RfD	reference dose
RG	Remedial Goal
ROD	Record of Decision
RPM	Remedial Project Manager
SCA	Sediment Consolidation Area
SEC	sediment effect concentration
SMS	Sediment Management System
SMU	Sediment Management Unit
SPA	Sediment Processing Area
SVOC	semi-volatile organic compound
SWQS	surface water quality standard
TBC	To-be-considered
TDS	total dissolved solids
TEQs	Toxic Equivalents
TLC	thin-layer cap
UCL	upper confidence limit
UFI	Upstate Freshwater Institute
USACE	United States Army Corps of Engineers
UU/UE	unlimited use and unrestricted exposure
VOC	volatile organic compound
WBB/HB	Wastebed B/Harbor Brook
WTP	Water Treatment Plant
ww	wet weight

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

The Onondaga Lake Superfund site currently includes eleven subsites (subsites are defined as any site that is situated on Onondaga Lake's shores or tributaries that has contributed contamination to or threatens to contribute contamination to Onondaga Lake) as shown in Figure 1 (see Attachment 1 for figures). Each subsite consists of one or more operable units (OUs). This FYR report evaluates the Lake Bottom OU2 subsite. The status of the other subsites is provided in Attachment 2.

This is the third FYR for this Subsite. The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared due to the fact hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Lake Bottom Subsite FYR was led by Victoria Rubino, EPA Remedial Project Manager. Participants included Debra Rosales (EPA-Ecological Risk Assessor), Marian Olsen (EPA-Human Health Risk Assessor), Tara Bhat (EPA- Human Health Risk Assessor), Sabrina Gonzalez (EPA-Hydrogeologist), Larisa Romanowski (EPA-Community Involvement Coordinator [CIC]), Joel Singerman (EPA-Section Supervisor), Michael Sivak (EPA-Branch Manager), Tracy Smith (NYSDEC-Project Manager), and Michael Spera (AECOM, Consultant to NYSDEC). Honeywell, a potentially responsible party for the Subsite, was notified of the initiation of the FYR. The Five Year Review began on 1/30/2025.

Site Background

Site Setting

Onondaga Lake is a 4.6-square-mile, 3,000-acre lake, approximately 4.5 miles long and 1 mile wide, with an average water depth of 36 feet, with two (northern and southern) deep basins. The city of Syracuse is located at the southern end of Onondaga Lake, and numerous towns, villages, and major roadways surround the lake (see Figure 2). The lake has three main tributaries--Ninemile Creek to the west; Onondaga Creek to the south; and Ley Creek to the southeast. In addition, several small tributaries flow into the lake, including Bloody Brook, Sawmill Creek, Tributary 5A and Harbor Brook. While Ninemile Creek and Onondaga Creek supply the vast majority of surface water to the lake, approximately 20 percent of the inflow comes from the Metropolitan Syracuse

Wastewater Treatment Plant (METRO). The lake drains into the Seneca River through a single outlet located at the northern tip of the lake.

The area around Onondaga Lake is the most urban in central New York State. The region experienced significant growth in the twentieth century, and in 2000, Onondaga County was the tenth most populous county in the State. There are approximately 320 acres of state-regulated wetlands and numerous smaller wetlands directly connected to Onondaga Lake or within its floodplains.

History of Contamination

Onondaga Lake has been the recipient of industrial and municipal sewage discharges for more than 100 years. Honeywell International, Inc.'s (Honeywell's) and its predecessor companies (*e.g.,* Solvay Process Company, Allied Chemical Corp. and AlliedSignal, Inc.) were historically industrial waste contributors; however, other industries in the area have contributed contamination as well. Other contaminant sources to the lake include the METRO facility, industrial facilities and landfills along Ley Creek, the Crucible Materials Corporation (via Tributary 5A), and the former giant bulk petroleum-products storage and transfer facility located north of the Barge Canal known as "Oil City."

Honeywell's predecessor companies operated three manufacturing facilities in Solvay, New York from 1881 until 1986. The product lines were collectively known as the "Syracuse Works." The major products manufactured during this period included soda ash (sodium carbonate) and related products; benzene, toluene, xylenes, and naphthalene at the Syracuse Works' Main Plant; chlorinated benzenes, chlor-alkali products, and hydrochloric acid at the Willis Avenue Plant, and chlor-alkali products and hydrogen peroxide at the Bridge Street Plant.[1] The manufacturing processes resulted in releases of primarily mercury, benzene, toluene, ethylbenzene, xylenes (BTEX), chlorinated benzenes, polycyclic aromatic hydrocarbons (PAHs) (especially naphthalene), polychlorinated biphenyls (PCBs), polychlorinated-di-benzo-p-dioxin/polychlorinated-dibenzofurans (PCDD/PCDFs), and calcite-related compounds.

Waste streams were discharged from the three facilities to at least four destinations--the Semet Residue Ponds (coke byproduct recovery only); Geddes Brook and Ninemile Creek (via the West Flume); the Solvay wastebeds, and directly to the lake (via the East Flume). The Solvay wastebeds are located in the towns of Camillus and Geddes, and in the city of Syracuse (see Figure 3). From approximately 1881 to 1986, the wastebeds were the primary means of disposal for the wastes produced by the Solvay operations. The wastebeds consist primarily of inorganic waste materials (Solvay waste) from the production of soda ash using the Solvay process. Initial Solvay waste disposal practices consisted of filling low-lying land adjacent to Onondaga Lake. Later, unlined wastebeds designed specifically for Solvay waste disposal were built using containment dikes constructed with native soils, Solvay waste, and cinders, or by using bulkheads made with timber along the lakeshore. The Solvay wastebeds and/or the East Flume also reportedly received chlorinated benzene still bottoms and portions of waste streams from the Willis Avenue and/or Bridge Street chlor-alkali plants.

[1] The Bridge Street Facility was sold to Linden Chemicals and Plastics (LCP) in 1979. LCP operated the facility until it closed in 1988.

The discharge of waste through the East Flume caused the formation of a large in-lake waste deposit (ILWD). The ILWD extends approximately 2,000 feet into the lake, approximately 4,000 feet along the lakeshore, and contains waste up to 45 feet thick. The majority of the ILWD is within the boundaries of Sediment Management Unit (SMU) 1 (see Figure 4), although some of the ILWD extends into the adjoining SMUs 2 and 7.[2] The ILWD contains waste from all of Honeywell's product lines. The discharges of waste to Geddes Brook and Ninemile Creek through the West Flume, as well as the overflow from Solvay Wastebeds 9 to 15, also caused the formation of deposits of Honeywell wastes and resulted in the development of the deposits in the Ninemile Creek delta in the lake in SMU 4. The overflow from Solvay Wastebeds 1 to 8 contributed to the formation of Honeywell wastes in the lake itself.

Appendix A, attached, provides a list of the documents utilized to prepare this FYR.

Appendix B, attached, summarizes the site's physical characteristics, geology/hydrogeology and land use. For more details related to background, physical characteristics, geology/hydrogeology, land/resource use, and history related to the site, please refer to www.epa.gov/superfund/onondaga-lake.

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[2] Onondaga Lake was divided into eight SMUs during the feasibility study (FS) based on water depth, sources of water entering the lake, physical and ecological characteristics, and chemical risk drivers. During the remedial design, the littoral areas were redefined into Remediation Areas (RAs) A through F so as to more accurately reflect the current understanding of in-Lake conditions. The SMU boundaries and RAs, as well as the extent of the ILWD based on additional data collected during design, are shown on Figure 5.

THIRD FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Onondaga Lake OU2 Lake Bottom Subsite		
EPA ID: NYD986913580		
Region: 2	**State:** NY	**City/County:** Syracuse/Onondaga County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** No	
REVIEW STATUS		
Lead agency: State		
Author name (Federal or State Project Manager): Victoria Rubino		
Author affiliation: EPA		
Review period: 1/30/2025 – 8/28/2025		
Date of site inspection: 6/2/2025		
Type of review: Statutory		
Review number: 3		
Triggering action date: 9/30/2020		
Due date ***(five years after triggering action date)*****:** 9/30/2025		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The Subsite includes the contaminated surface water and sediments in the 4.5-square mile lake. Mercury contamination is found throughout the lake, with the most elevated concentrations detected in the Ninemile Creek delta and in the sediments/wastes present in the southwestern portion of the lake. Mercury contamination was widespread in the upper 6.5 feet of the sediments in the lake, and it is even deeper in sediment in the Ninemile Creek delta and the ILWD. Other contaminants present within lake sediments include BTEX, chlorinated benzenes, PAHs, PCBs, and PCDD/PCDFs. Much of the contamination present in the southwestern portion of the lake is present in the ILWD, which comprises an area of approximately 100 acres. Elevated concentrations of some contaminants in certain locations of the ILWD extended to a depth of 25 feet or more in lake sediments. Elevated contaminant concentrations and visual evidence (*e.g.,* liquids, droplets, and sheens) indicated that chlorinated benzenes that were manufactured and released as a waste by Honeywell predecessor companies exist as nonaqueous-phase liquids (NAPLs) throughout the ILWD and in an area off the former Honeywell causeway.

Based on data collected during the Subsite's remedial investigation (RI), it was determined that the NAPLs and highly contaminated waste materials in these areas of the lake were highly mobile, at least when disturbed, have high concentrations of toxic compounds, and presented a significant risk to human health and the environment should exposure occur; therefore, they were characterized as principal threat wastes.

Concentrations of total mercury in the lake water were highest in the nearshore areas around both Ninemile Creek and the ILWD. In the deep basins, water column total mercury concentrations increased significantly in the hypolimnion during summer stratification, with a high fraction of this hypolimnetic total mercury occurring in the dissolved phase. Concentrations of chlorobenzene and dichlorobenzenes in lake water were highest near the Honeywell source areas in the vicinity of the East Flume and Harbor Brook and exceeded surface water quality standards.

Mercury, PCBs, hexachlorobenzene, and PCDD/PCDFs have bioaccumulated in Onondaga Lake fish and mercury has been found at elevated levels in benthic macroinvertebrates. It is likely that these contaminants have bioaccumulated in other biota (*e.g.,* birds, mammals), as well. Fish tissue concentrations of mercury and PCBs in excess of diet-based toxicity reference values suggest injury to piscivorous birds and mammals that consume fish from the lake. Chemicals of concern (COCs) in sediment shown to exhibit acute toxicity on a lake-wide basis include mercury, ethylbenzene, xylenes, certain chlorinated benzenes, PAHs and PCBs. COCs in surface water include mercury, chlorobenzene, and dichlorobenzenes.

The baseline human health risk assessment (HHRA) showed that cancer risks and noncancer health hazards associated with ingestion of chemicals in sport fish *(e.g.,* Largemouth bass [*Micropterus salmoides*]) from Onondaga Lake were above levels of concern. Fish ingestion is the primary pathway for exposure to COCs and for potential adverse health effects. The HHRA also evaluated risks associated with direct contact with contaminated sediments (inadvertently ingesting small amounts of sediment or having sediment contact the skin); this did not result in unacceptable risks.

Key results of the baseline ecological risk assessment (BERA) indicated that comparisons of measured tissue concentrations and modeled doses of chemicals to toxicity reference values showed exceedances of hazard quotients for site-related chemicals throughout the range of the point estimates of risk. Subsite-specific sediment toxicity data indicated that sediments are toxic to benthic macroinvertebrates on both an acute (short-term) and chronic (long-term) basis. Many of the contaminants in the lake were persistent and, therefore, the risks associated with these contaminants were unlikely to decrease significantly in the absence of remediation. On the basis of these comparisons, it was determined through the BERA that all ecological receptors of concern were at risk. Contaminants and stressors in the lake have either impacted or potentially impacted every trophic level examined in the BERA.

Response Actions

Site-specific sediment effect concentrations (SECs) and consensus-based probable effect concentrations (PECs) for COCs evaluated in the RI and the BERA were calculated using data from acute sediment toxicity testing using benthic macroinvertebrates. Benthic macroinvertebrates live in and around the sediments for most of their lives, and therefore experience the highest direct exposure to contamination in the lake. Because of the large number of COCs and the differences in sources, transport, and fate, a further refinement of the SEC/PEC approach was used to develop a single number, the mean PEC quotient (PECQ), which takes into account the presence and the concentrations of multiple chemicals in the sediments. The mean PECQ approach provides a consistent method of comparing the overall acute toxicity risk from the mixture of contaminants at various locations of the lake and to select a level of remediation that would address the risk of direct acute toxicity to the benthic macroinvertebrate community from the contamination in the lake sediments. The mean PECQ was used as a basis for delineating areas of the lake to be remediated. The areas of the lake in which COC concentrations in the littoral sediment exceed a mean PECQ of 1 generally coincide well with those areas where acute toxicity to benthic macroinvertebrates was observed in the sediment toxicity tests. Therefore, the mean PECQ of 1 was determined to be protective and was selected as a remediation goal to address direct acute toxicity to benthic invertebrates. Because mercury in the lake is a primary concern and elimination or reduction of mercury is part of all five Remedial Action Objectives (RAOs) discussed below, the mercury PEC of 2.2 milligrams per kilogram (mg/kg) was also selected as a remediation goal.

The selected remedy, which is presented in the Record of Decision (ROD) issued by NYSDEC and the EPA in July 2005, addressed surface sediments exceeding a mean PECQ of 1 or a mercury PEC of 2.2 mg/kg. The selected remedy would also attain a 0.8 mg/kg bioaccumulation-based sediment quality value (BSQV) for mercury on an area-wide basis for the lake and five subareas of the lake as determined during the remedial design. Another goal of the remedy was to achieve lake-wide fish tissue mercury concentrations ranging from 0.14 mg/kg for protection of ecological receptors to 0.3 mg/kg, which is based on the EPA's Methylmercury (MeHg) National Recommended Water Quality criterion for the protection of human health for the consumption of organisms. This range encompasses the goal for protection of human health based on the reasonable maximum exposure (RME) scenario of 0.2 mg/kg of mercury in fish tissue (fillets).

To accomplish the noted objectives, the major components of the selected remedy, as outlined in the ROD, include:

- Dredging up to an estimated 2,653,000 cubic yards (CY) of contaminated sediment from the littoral zone (the portion of the lake in which water depths range below 30 feet) in SMUs 1 through 7 to a depth that will prevent the loss of lake surface area, ensure cap effectiveness, remove NAPLs, reduce contaminant mass, allow for erosion protection, and reestablish the littoral zone habitat. Most of the dredging will be performed in the ILWD (which largely exists in SMU1) and in SMU 2.
- Dredging, as needed, in the ILWD to remove materials within hot spots and to ensure stability of the cap.
- Placement of an isolation cap over an estimated 425 acres within SMUs 1 through 7.

- Construction/operation of a hydraulic control system along the SMU 7 shoreline to maintain cap effectiveness. In addition, the remedy for SMUs 1 and 2 will rely upon the proper operation of the hydraulic control system, which is being designed to control the migration of contamination to the lake via groundwater from the adjacent upland areas.
- Placement of a thin-layer cap over an estimated 154 acres of the profundal zone (the portion of the lake in which water depths exceed 30 feet) within SMU 8.
- Treatment and/or off-site disposal of the most highly contaminated materials (*e.g.,* pure phase chemicals segregated during the dredging/handling process). The balance of the dredged sediment will be placed in a Sediment Consolidation Area (SCA), which will be constructed on one or more of Honeywell's Solvay wastebeds that historically received process wastes from Honeywell's former operations. The containment area will include, at a minimum, the installation of a liner, a cap, and a leachate collection and treatment system.
- Treatment of water generated by the dredging and sediment handling processes to meet NYSDEC discharge limits.
- Completion of a comprehensive lake-wide habitat restoration plan.
- Habitat reestablishment will be performed consistent with the lake-wide habitat restoration plan in areas of dredging/capping.
- Performance of an oxygenation pilot study to evaluate the effectiveness of oxygenation at reducing the formation of MeHg in the water column, fish tissue MeHg concentrations, and methane gas ebullition as well as to understand any other impacts. The pilot study would be followed by full-scale implementation (if supported by the pilot study) in SMU 8.
- Monitored natural recovery (MNR) in SMU 8.
- Institutional controls (ICs) consisting of notification of appropriate government agencies with authority for permitting potential future activities which could impact the implementation and effectiveness of the remedy.
- Implementation of a long-term operation, maintenance, and monitoring (O&M) program to monitor and maintain the effectiveness of the remedy (*e.g.,* cap repair).

The selected remedy also includes habitat enhancement, which is an improvement of habitat conditions in areas where CERCLA contaminants do not occur at levels that warrant active remediation, but where habitat impairment due to stressors has been identified as a concern. The ROD indicated that habitat enhancement would be performed along an estimated 1.5 miles of shoreline (SMU 3) and over approximately 23 acres (SMU 5) to stabilize calcite deposits and oncolites,[3] and promote submerged aquatic plant growth.

<u>Remedial Action Objectives/Remediation Goals</u>

The RAOs for Onondaga Lake were based on site-specific information, including the nature and extent of chemical parameters of interest (CPOIs),[4] the transport and fate of mercury and other

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[3] Oncolites are a form of calcite in littoral sediments of Onondaga Lake and are closely associated with discharges of calcium-laden wastes to the Lake by Honeywell.

[4] The CPOIs are those elements or compounds that were identified as contaminants of potential concern, chemicals of concern, or stressors of concern for the Onondaga Lake RI/FS. The major classes of CPOIs include mercury and other metals, BTEX, chlorinated benzenes, PAHs, PCBs, PCDD/PCDFs, and calcite.

CPOIs, and the baseline human health and ecological risk assessments. The RAOs were developed during the RI as goals for controlling CPOIs within the lake and protecting human health and the environment. The RAOs for Onondaga Lake are:

- RAO 1: To eliminate or reduce, to the extent practicable, methylation of mercury in the hypolimnion.
- RAO 2: To eliminate or reduce, to the extent practicable, releases of contaminants from the ILWD and other littoral areas around the lake.
- RAO 3: To eliminate or reduce, to the extent practicable, releases of mercury from profundal sediments.
- RAO 4: To be protective of fish and wildlife by eliminating or reducing, to the extent practicable, existing and potential future adverse ecological effects on fish and wildlife resources and to be protective of human health by eliminating or reducing, to the extent practicable, potential risks to humans.
- RAO 5: To achieve surface water quality standards, to the extent practicable, associated with CPOIs.

In order to achieve the RAOs, Preliminary Remediation Goals (PRGs) were established for the three primary media that have been impacted by CPOIs: sediments, biological tissue, and surface water. The following three PRGs were developed, each addressing one of the affected media:

- PRG 1: Achieve applicable and appropriate SECs for CPOIs and the BSQV of 0.8 mg/kg for mercury, to the extent practicable, by reducing, containing, or controlling CPOIs in profundal and littoral sediments.
- PRG 2: Achieve CPOI concentrations in fish tissue that are protective of humans and wildlife that consume fish. This includes a mercury concentration of 0.2 mg/kg in fish tissue (fillets) for protection of human health based on the RME scenario assumptions from the Onondaga Lake Baseline Human Health Risk Assessment and the EPA's MeHg National Recommended Water Quality criterion for the protection of human health for the consumption of organisms of 0.3 mg/kg in fish tissue. This also includes a mercury concentration of 0.14 mg/kg in fish[5] (whole fish) for protection of ecological receptors (wildlife) based on the exposure assumptions from the Onondaga Lake BERA. These human health and ecological goals represent the range of fish tissue PRGs.
- PRG 3: Achieve surface water quality standards, to the extent practicable, associated with CPOIs.

In addition to the remediation goals for mercury in fish tissue cited above, ecological target tissue concentrations for mercury based on the no-observed-adverse-effect levels (NOAELs), as well as target tissue concentrations for bioaccumulative organic contaminants, corresponding to various risk levels (including both the 10^{-4} and 10^{-5} cancer risk levels) for human health exposure and both the lowest-observed-adverse-effect levels (LOAELs) and NOAELs, were developed in the FS based on exposure parameters from the Onondaga Lake HHRA and BERA and were included in the ROD. These targets are not remediation goals, as presented in the ROD, but are points of reference for evaluations of reduction of risk for human and wildlife consumers of fish.

[5] This ecological goal was based on the LOAEL for the river otter.

As indicated in the ROD, contaminants other than mercury, including PCBs, hexachlorobenzene, and PCDD/PCDFs, are not as widespread in sediments in the lake and are found primarily in a few specific areas of the lake (*e.g.,* SMUs 1, 2, 6, and 7). These areas were remediated in accordance with the remedial design for lake dredging and capping.

As the areas of the lake with elevated concentrations of these bioaccumulative organic contaminants for which target tissue concentrations were developed are generally within the remedial areas based on exceedance of the cleanup criteria of the mean PECQ of 1 (which addresses multiple contaminants) plus the mercury PEC, the exposures to these compounds would be reduced to the same or greater extent as that of mercury. It was, therefore, expected that if the remediation goals for mercury in fish tissue are met in the future (*e.g.*, during the 10-year MNR period after completion of the dredging and capping), the future fish tissue concentrations for the contaminants listed in Table 7 of the ROD[6] would fall within the ranges shown in the table for each contaminant and receptor. If this assumption is proven not to be the case in the future, based on ongoing fish tissue monitoring, then an evaluation will take place to determine why this assumption may no longer be valid.

Target concentrations, PECs and/or remediation goals are further presented in Tables 1a, 1b, and 1c for fish, sediment, and surface water, respectively (see Attachment 1 for tables).

Explanations of Significant Difference

Three Explanations of Significant Difference (ESDs) have been issued since the issuance of the ROD to document modifications of the selected remedy.

Additional data were generated in 2005 and 2006 in SMU 2 as part of the pre-design investigation to more accurately define the extent of NAPLs in this area. These data showed that the site conditions and contaminant distribution were significantly different than were previously thought in SMU 2 along the causeway, and a small adjacent area in SMU 1. Based on the additional information, a revision to the portion of the remedy that pertains to the SMU 2 causeway area (and a small adjacent area in SMU 1) was evaluated. As a result of this evaluation, a modification to the remedy was made, including the placement of a portion of the lakeshore barrier wall in the southwest portion of the lake, backfilling behind the barrier wall with clean material, and collection of NAPLs present in the areas discussed above via wells with off-site treatment and/or disposal. The change was necessary to ensure the stability of the adjacent causeway and the adjacent area which includes a portion of I-690, and is supported by extensive sampling of the area which indicates that the areas containing NAPLs are significantly less extensive than estimated in the ROD (NYSDEC and EPA, 2006; Parsons, 2019a). This modification was documented in an ESD issued in December 2006 (the affected area is shown in Figure 6).

The second ESD, issued in August 2014, addressed two issues – a geotechnical concern in the eastern end of the lake and an alternative measure to address the release of methylmercury from sediment in the lake. This ESD allowed for the establishment of a buffer zone (approximately 10 acres) along the southeast shoreline where no dredging or capping would occur as the best means

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[6] The fish tissue concentration ranges in Table 7 of the ROD can be found in Table 1a except where modified as indicated in Note 6 in the table and discussed under V. Technical Assessment, Question B.

to prevent shoreline and rail line instability (see Figure 7). The ESD also identified nitrification of the hypolimnion by adding nitrate to the deep lake water instead of/in place of oxygenation. The change in approach was based on the success of a 3-year nitrate addition pilot study completed in 2013, which demonstrated that nitrate addition effectively inhibits the release of methylmercury from sediment in the deep water portions of the lake (NYSDEC and EPA, 2014; Parsons, 2019a).

A third ESD was issued in March 2018 to document the basis for the design and construction of modified protective caps (MPCs) in portions of RA-B, RA-C, and RA-D, as well as a modified erosion-resistant cap (MERC) in the vicinity of the METRO deep water outfall pipeline (see Figure 8). The MPCs were needed where geotechnical investigations completed subsequent to the Final Design (Parsons and Anchor QEA, 2012) identified soft (low strength) sediment on relatively steep slopes. In addition, small areas of disturbances of the cap occurred in RA-C during cap construction in September 2012 and in RA-D in November 2014. These MPCs have minimum thicknesses less than the minimum cap layer thicknesses specified in the ROD (*i.e.,* the original remedy required a minimum of 12 inches for the chemical isolation layer and minimum of 12 inches for the habitat layer, not including the underlying "mixing" layer). The sediments in the MPC areas were softer than what was identified during the pre-design investigation (PDI) and, therefore, design revisions were required in these and other areas (representing approximately 29 acres of the 418 acres of capped areas in the littoral zone[7]).

A subset of the MPCs (approximately 2 percent of the entire capped area) included areas where underlying soft sediments limited the cap thicknesses such that it was not feasible to construct separate chemical isolation and habitat/erosion protection layers. These areas, which include areas of direct application of granular activated carbon (GAC) with limited sand placement, are referred to as mono-layer caps. In addition, following the collection of data subsequent to the cap disturbances, thin-layer caps and amended caps were required in approximately 7.4 acres in the profundal zone (SMU 8) adjacent to RA-C (where a thin-layer cap was not included in the Final Design) and 16.8 acres adjacent to RA-D. The total area above and immediately adjacent to the METRO outfall pipeline that was not dredged or capped to protect the integrity of the pipeline is approximately 1.9 acres, and the area where the MERC was placed in the vicinity of the outfall pipeline is approximately 4.3 acres. The basis of the designs for the modified caps was to be protective consistent with the evaluation timeframe used in the Final Design and specified in the ROD. Given the relatively small size of these MPC areas relative to the remaining areas of the Lake with a full thickness cap, as well as the increased GAC dosages applied in these MPC and MERC areas to ensure cap effectiveness, it was concluded that the modifications will not affect remedial timeframes, degree of protectiveness of the overall remedy, remedial costs, or the extent of ICs needed. MPC design revisions were reviewed by NYSDEC and EPA and approved by NYSDEC prior to construction of the MPCs in 2015 and 2016 (NYSDEC and EPA, 2018; Parsons,

[7] The Final Design (Parsons and Anchor QEA, 2012) included an isolation cap in approximately 430 acres of the littoral zone of the Lake and select adjacent wetland areas as well as approximately 27 acres of thin-layer cap in SMU 8 (deep water area in the profundal zone). As discussed in the second ESD for the RA-E Shoreline Area and Nitrate Addition (NYSDEC and EPA, 2014), approximately 10 acres of the near-shore area along the RA-E shoreline were not dredged or capped because of stability concerns for the shoreline and active railroad lines. In addition, as noted above, a cap was not placed in approximately 1.9 acres above and immediately adjacent to the METRO outfall pipeline. Therefore, an estimate of the area capped in the littoral zone is 418 acres.

2018a; Parsons, 2019a). Post-construction physical and chemical monitoring is being conducted in all capped areas (starting in 2017), including the MERC and MPC areas addressed in the ESD, to ensure the effectiveness of the remedy in meeting the related goals specified in the 2005 ROD.

Status of Implementation

The Onondaga Lake Monitoring and Maintenance Plan (OLMMP)

The Onondaga Lake Monitoring and Maintenance Plan (OLMMP) (Parsons 2018b) presents the criteria, monitoring program, and decision-making framework for measuring progress toward, and attainment of, the remedial goals set forth in the ROD (NYSDEC and USEPA 2005). The monitoring program enables Honeywell, NYSDEC, and USEPA to track progress and ultimately verify remedy effectiveness in achieving the preliminary remedial goals (PRGs) and thereby the remedial action objectives (RAOs) specified in the ROD.

As detailed in the OLMMP, the lake monitoring program includes the following seven separate, but related, elements:

- Sediment Management Unit 8 (SMU 8) and Monitored Natural Recovery (MNR)
- Biota Tissue
- Surface Water
- Cap Maintenance and Monitoring
- Habitat Reestablishment and Biological Response
- Wastebeds 1-8 (WB 1-8) Shoreline Stabilization and Turbidity Monitoring[8]
- Institutional Controls

Dredging and Capping

There has not been any additional dredging since the work below was completed, although there has been minor repairs to cap material as described in the Operations and Maintenance section below. The cap and SCA continue to undergo monitoring and maintenance in accordance with the OLMMP and SCA Post-Closure Care Plan.

Sediments were dredged hydraulically from designated areas within the lake and select adjoining wetland areas between July 2012 and November 2014. Approximately 2.15 million CY of sediment were removed from the lake across 215 acres (Anchor QEA and Parsons, 2017) (dredging areas are denoted on Figure 9). Sediments were dredged hydraulically from designated areas within the lake and select adjoining wetland areas. Once a specific area of the lake was dredged, post-dredge surveys were conducted in accordance with a construction quality assurance plan (CQAP) to ensure that target elevations in the dredged area were achieved. Dredged material was

[8] The 2017 turbidity monitoring results adjacent to the shoreline of WB 1-8 verified a reduction in wind-driven turbidity along the WB 1-8 shoreline after stabilization was implemented. Therefore, consistent with the OLMMP and as documented in the 2017 Annual Report, no further routine turbidity monitoring is being performed. Annual physical inspections of this area are conducted as part of the long-term cap physical monitoring program. Additional turbidity monitoring, if required based on the annual inspections, would be developed in consultation with NYSDEC and subject to the agency's approval.

transported via a series of booster pumps and a double-walled pipeline through non-residential areas to a lined sediment processing area (SPA) adjacent to the SCA. The SPA and SCA were located on a former Solvay wastebed, Wastebed 13 (see Figure 10). At the SPA, the dredge slurry was passed through a screening process, which was designed to remove oversized material.

Oversized material was trucked to a Debris Management Area maintained at the SCA (see Figure 11) where the material was contained and covered. After screening, the slurry was conveyed to thickeners to reduce the volume of water that would need to be removed from the solid material by geotextile tubes (geotubes). The thickened slurry then underwent polymer injection to precondition the slurry prior to being conveyed to and discharged into the geotubes for dewatering and long-term isolation of the dredged material. The geotubes were managed within the lined SCA which collected and managed the geotube filtrate (water discharged from the geotubes). As part of the SCA construction, two basins were constructed adjacent to the eastern and western extents of the Phase II area (see Figure 11). These basins were considered part of the sediment management system (SMS) for the SCA.

The geotube filtrate and water coming into contact with filling tubes or dredged sediment (referred to as "contact water") was collected and routed to the Water Treatment Plant (WTP) constructed adjacent to the SCA for treatment of metals, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, and total suspended solids. The treated effluent was then conveyed to METRO where it underwent additional treatment for ammonia prior to discharge to the lake (EPA, 2015).[9] Mechanical dredging was used on a limited basis for a portion of the Wastebed B/Harbor Brook (WBB/HB) Outboard Area adjacent to RA-D (Anchor QEA and Parsons, 2017).

Capping operations commenced in August 2012 and were completed in December 2016. Cap material was placed on approximately 475 acres over six RAs of the lake, three adjacent lakeshore areas (*i.e.,* Wastebed B/Harbor Brook Outboard Area, Wastebeds 1-8 Connected Wetland, and the Ninemile Creek spits[10]), and portions of SMU 8 (see Figures 9 and 12). The littoral areas which received cap material included all areas which were dredged. Cap materials were placed both hydraulically, using a custom hydraulic spreader barge, and mechanically, using a variety of mechanical placement methods. The placement method depended on the grain size of the cap material being placed, the water depth at the placement location, and the proximity to obstructions such as the barrier wall located along the southwest lakeshore. Approximately 3.1 million CY of cap material was placed, including 1.6 million CY hydraulically, and 1.5 million CY mechanically.

The installed cap was designed for an effective life span of 1,000 years and was constructed of varying types of single-layer and multi-layer caps using sands, gravels, cobbles, topsoil and amendments. The amendments consisted of siderite (a naturally-occurring mineral consisting mostly of iron carbonate) to neutralize elevated pH and maintain conditions conducive to long-

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[9] Operational modifications were made in 2014 that provided the option for wastewater generated by the dredging/sediment handling processes at the SCA and treated at the SCA water treatment facility to be discharged directly to the Lake in accordance with a supplemental treatment/Lake discharge operations work plan and a State-approved wastewater discharge permit. The modifications provided operators with the capability to maximize operational up-time for dredging operations during wet weather conditions.
[10] The spits are depositional landforms caused by lake currents.

term biological decay of key contaminants within the cap, and GAC to improve sorption of contaminants within the cap and provide an added level of protectiveness. Amendments to the cap were used in Remediation Area (RA)-B, RA-C, RA-D, the Wastebed B/Harbor Brook Outboard Area, the Wastebeds 1-8 Connected Wetland, and in portions of RA-A (including the Ninemile Creek spits), RA-E, and SMU 8.

Both the dredging and the capping operations were subject to a robust construction quality control (CQC)/construction quality assurance (CQA) program designed to verify that the work was completed in accordance with the Final Design and subsequent NYSDEC-approved modifications. Dredging areas were divided into Dredge Management Units (DMUs) and completion was verified within each DMU using single-beam dual frequency bathymetric surveys. CQC bathymetric surveys were validated by performing duplicate CQA surveys across a minimum of 10% of each CQC survey area. The CQC/CQA program for the capping involved measurement of each individual cap layer in both single-layer and multi-layer caps. Layer thickness was verified using a variety of techniques, including core sampling, catch pans, and bathymetric surveys. Thermal processes were utilized to determine the presence of the necessary components for chemical isolation layers (siderite, GAC). Bathymetric survey data were collected across completed caps to verify that the installed cap was completed within the elevation tolerances specified by the design. Similar to the dredging program, CQA measurements were collected for a minimum of 10% of the CQC measurements. Additional details on capping and dredging operations are available in the September 2017 Capping and Dredging Construction Completion Report (Anchor QEA and Parsons, 2017).

Sediment Consolidation Area Cover

A multilayer cover system was constructed between 2015 and 2017 at the SCA consistent with requirements established in the approved design (Parsons and Beech & Bonaparte, 2016). The final closure cross-section layers were constructed as follows (from top to bottom):

- 2-inch thick (average) layer of compost; initially seeded with temporary and later with a permanent seed mix;
- 6-inch thick vegetative soil layer consisting of a mixture of 60 percent on-site borrow soil, 30 percent of imported sand, and 10 percent on-site topsoil;
- 18-inch thick protective soil layer;
- Geocomposite drainage layer consisting of a 200-mil thick geonet heat bonded to a singlesided non-woven geotextile on top deck and 250-mil thick geonet heat bonded with geotextile on both sides (*i.e.,* double-sided) on sideslopes;
- 40-mil thick linear low-density polyethylene geomembrane cap, smooth on top deck and textured on sideslopes;
- Landfill gas vent layer consisting of geonet composite strips, single-sided on top deck and double-sided on sideslopes;
- 8 ounces/square yard cushion geotextile; and
- Varying thickness of leveling layer material over sediment filled geotextile tubes.

Additional details on the construction and the imported backfill materials utilized at the SCA are provided in the SCA Closure Construction Quality Assurance Report (Geosyntec, 2018).

Habitat Restoration/Enhancement

The restoration of habitat is an integral component of the overall remedy for Onondaga Lake and was one of the important elements in the design for the dredging and capping activities specified for the lake. A goal of habitat restoration in these areas is to achieve ecological systems that function naturally, are self-sustaining, and are integrated with the surrounding habitats. One of the factors that was addressed during the design was the type and thickness of the habitat restoration layer that would be placed above the isolation layer in a given area based on specific habitat needs in that area. Another factor that was considered was the types of structure and aquatic plants that might be placed in various areas of the lake. Accordingly, the ROD called for the development of a comprehensive lake-wide habitat restoration plan and required that habitat re-establishment be performed in all areas of dredging and capping consistent with the plan. The ROD specified that the littoral zone in the vicinity of the dredging/capping should be restored to reestablish appropriate habitat and function following removal of contaminated sediments. Specific goals associated with this objective as set forth in the ROD can be found in the Onondaga Lake Capping, Dredging, Habitat and Profundal Zone Final Design Habitat Addendum (Parsons and Anchor QEA, 2018a).

Habitat re-establishment was performed in RA-A through RA-E within Onondaga Lake (see Figure 13). Habitat quality and diversity was achieved by planting and seeding more than 40 acres of naturalized shoreline and wetlands, which are primarily located in the Ninemile Creek spits, the adjacent in-lake area in RA-A, and in the WBB/HB Outboard Area. More than 450,000 plants representing over 125 native species were installed in accordance with design specifications detailed in the Habitat Design Addendum (Parsons, 2018b).

In addition to plantings and seeding, habitat enhancement was achieved by the placement of habitat “structures” throughout all of the RAs. Structures can be tree stumps, clusters of rock piles, submerged macrophytes, logs, or woody debris on the lake bottom or shoreline. Structural complexity is an important component to fisheries population dynamics and predator-prey relationships. Adding structures improves the quality of habitat for key species and increases angling opportunities by attracting sport fish to accessible locations near shore. The habitat restoration for the lake was designed to achieve these objectives through installation of more than 1,000 habitat structures, including rock piles, individual boulders and boulder clusters, basking logs, downed trees, and porcupine cribs (constructed wooden structures specifically designed to provide habitat for fish) (Parsons, 2018b). Habitat structure was also incorporated on the sediment cap adjacent to the Semet/Willis Sheetpile Wall. The habitat structures placed in this area include reef balls, which are custom designed and constructed structures. The access holes and hollow interior spaces of the reef balls provide ideal habitat and shelter for a variety of species and provide additional diversity with the other habitat structures placed throughout the lake (Parsons, 2019a).

Wetland optimization design revisions were incorporated into the WBB/HB Outboard Area wetlands to increase habitat diversity and wetland resilience to wind/wave action, and provide for cap surface elevations that would facilitate wetland vegetation establishment. These revisions did not impact the original cap design or protectiveness of the cap. These revisions provided for an increase in the cap thickness in some areas, and additional protection against erosion by placing protective berms adjacent to of the outboard area (see Figure 14) (Anchor QEA and Parsons, 2017).

As noted above, the selected remedy included habitat enhancement, which is improvement of habitat conditions in areas where CERCLA contaminants do not occur at levels that warrant active remediation, but where habitat impairment due to stressors has been identified as a concern. The ROD indicated that habitat enhancement would be performed along an estimated 1.5 miles of shoreline (SMU 3) and over approximately 23 acres (SMU 5) to stabilize calcite deposits and oncolites, and promote submerged aquatic plant growth. The intent of the habitat enhancement along the SMU 3 shoreline was to reduce near-shore turbidity associated with wind/wave events and to reduce shoreline erosion.

Implementation of habitat enhancement of the SMU 3 shoreline, which was integrated with the Wastebeds 1-8 interim remedial measure (IRM), included the placement of six inches, on average, of coarse gravel from elevation 360 feet North American Vertical Datum of 1988 (NAVD88) to 10 feet inland from elevation 362.5 feet NAVD88 to stabilize the substrate. From elevation 362.5 feet to 366.5 feet above mean sea level, the shoreline was stabilized with graded gravel material up to 18 inches. Shoreline stabilization was expanded to include much of the SMU 4 shoreline adjacent to Wastebeds 1-8. Shoreline stabilization along the SMUs 3 and 4 shorelines adjacent to Wastebeds 1-8 was implemented between January to April 2014 and September to November 2014. Morooka trucks were used to transport gravel to excavators that subsequently placed the gravel. Because portions of the shoreline stabilization area extended into the lake, the gravel was used to construct a temporary land bridge to access these portions of the placement area. The gravel from the land bridge was then side-cast into the placement area to complete the shoreline stabilization placement (Anchor QEA and Parsons, 2017).

As noted in the first FYR report for the Subsite, in a 2008 survey, significantly more acreage in SMU 5 was found to be naturally colonized by aquatic plants than would have resulted from implementation of habitat enhancement of the 23 acres in this part of the lake. Therefore, the goals outlined in the ROD for habitat enhancement in this area were already met without implementing active measures.

<u>Nitrate Addition</u>

A three-year nitrate addition pilot test was conducted from 2011 to 2013 to assess the effect of nitrate addition to the hypolimnion layer on methylmercury release and/or production in the lakes profundal zone (SMU 8). After a successful pilot study, an ESD was issued specifying continuation of nitrate addition to the hypolimnion of Onondaga Lake is warranted from late spring through fall to suppress methylmercury release and/or production.

A full-scale annual nitrate addition program began in 2014. As during the previous review, nitrate addition was performed between 2019 and 2023 in accordance with the approved O&M Plan (Parsons and UFI, 2014). During this period, liquid calcium nitrate solution was diluted with upper lake waters and added directly to the lower waters in the profundal zone at three locations in the lake. One application location was in the northern basin of Onondaga Lake, and the other two were in the southern basin of the lake (see Figure 15).[11] Equipment and procedures used to apply nitrate during this period were essentially the same as were used during the prior years (Parsons, 2024).

Adjacent Hydraulic Control Systems

Consistent with remedial actions and IRMs associated with adjacent contaminated subsites, shoreline subsurface barrier walls and/or groundwater collection systems have been installed directly adjacent to several capped areas within the lake and adjacent wetlands. Hydraulic containment by these systems limits groundwater upwelling in adjacent lake and wetland areas, and is, therefore, an important factor in ensuring that the caps achieve their established performance criteria. Groundwater flows through three zones in the aquifer—shallow; intermediate; and deep. A clay layer acts as a confining layer between the intermediate and deep zones. Thus, the only potential source of groundwater upwelling through the cap is from the deep zone through the underlying clay layer. This was the design basis used to generate the groundwater upwelling rates for cap modeling for the final design.

The hydraulic containment systems include:

- Shoreline barrier walls and groundwater collection systems that have been implemented as part of the remedial action for OU1 of the Semet Residue Ponds subsite, and the Willis/Semet and Wastebed B/Harbor Brook IRMs
- Shoreline groundwater collection systems that have been implemented as part of the Wastebeds 1-8 IRM

Infiltration of impacted groundwater to Onondaga Lake along the southwestern shoreline is being controlled as part of the Willis/Semet and WBB/HB hydraulic containment systems that include an epoxy-coated steel sheet pile barrier wall, which extends a minimum of three feet into the clay layer present at depths ranging from 35 to 70 feet below grade, and shallow and intermediate groundwater collection systems. The Wastebeds 1-8 IRM includes Eastern and RA-A shoreline groundwater collection systems to control shallow and intermediate groundwater discharges to Onondaga Lake. Collected groundwater from the hydraulic control systems is conveyed to the nearby Willis Avenue Groundwater Treatment Plant (GWTP) where it is treated for metals and organics prior to conveyance directly to Onondaga Lake or to METRO, where further treatment for ammonia is conducted prior to discharge to Onondaga Lake.

Monitored Natural Recovery

The selected remedy includes MNR to address mercury contamination in the profundal zone and hypolimnion of the lake. Natural recovery in SMU 8 (see Figure 5) has been ongoing and has progressed faster than anticipated (see discussion in the Status of Implementation and Data Analysis sections) through the burial of the contaminated sediments as new sediment enters the lake as inflows from tributaries and direct runoff to the lake.

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[11] Figure 15 shows the three 2023 liquid nitrate application locations. The application locations used in this five-year review period were the same locations where liquid nitrate has been applied since 2011.

Sediment remediation goals in the profundal zone include: achieving the mercury PEC of 2.2 mg/kg or lower on a point basis and the mercury BSQV of 0.8 mg/kg or lower on an area-wide basis within 10 years following the remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone. The remediation of upland sources, littoral sediments, and initial thin-layer capping in the profundal zone was completed in 2016. The mercury BSQV is applied over five subareas of the lake bottom that together cover the entire surface area of the lake. The five lake subareas from north to south are designated as: North Basin, Ninemile Creek Outlet, Saddle, South Basin, and South Corner (see Figure 16).

CSX Shoreline Area of Remediation Area E

A dredging and capping offset was developed in RA-E in the vicinity of the active rail lines along the southeastern shoreline based on rail line stability considerations. This offset ranges from approximately 130 to 200 feet (ft.) from the shoreline and impacts an area of approximately 10.1 acres.

Institutional Controls

ICs are included as part of the ROD remedy for the Subsite to protect the integrity of the cap and ensure long-term protectiveness of human health and the environment. Specifically, ICs are being implemented to prevent unacceptable exposure to residual contamination within the lake, prevent recreational boaters from accidently contacting any navigational hazards created by capping and restoration components of the remedy, and preventing damage to the cap from activities such as navigational dredging. The controls are being achieved through the NYSDEC and United States Army Corps of Engineers (USACE) permitting process to restrict actions that may disrupt the cap or SMU 8 sediment, the placement and maintenance of navigational buoys in the lake by the New York State Office of Parks, Recreation and Historic Preservation (NYSOPRHP), the provision of updated (post-capping) bathymetric survey results to the National Oceanic and Atmospheric Administration (NOAA) to facilitate updating of the Navigational Chart for Onondaga Lake, and the establishment of environmental easements or environmental notices. A summary of the ICs enacted and being applied is provided in the table below.

IC Summary Table

Table 1: Summary of Planned and/or Implemented IC's

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Soils, Sediments	Yes	Yes	Capped areas; SMU 8; CSX Dredging/ Capping Offset Area; SCA	Prevent future exposure to remaining contamination by controlling disturbances of the subsurface contamination; limit the use and development of the site	Environmental Easements or Environmental Notices (planned for 2026) Placement and maintenance of navigational buoys by NYSOPRHP (Ongoing)[12] NOAA navigational chart for Onondaga Lake (Chart # 14786 pg. 33 for the Small-Craft Book Chart for the New York State Barge Canal System, updated February 2020) NYSDEC and USACOE Permitting Process (Ongoing), interim SMP approved January 2024
Fish	Yes	Yes	Lake Wide	Provides recommended limits for consumption of fish caught from Onondaga Lake and its tributaries	Fish Consumption Advisories, NYSDOH (Ongoing)

Systems Operations/Operation & Maintenance

Adjacent Hydraulic Control Systems

Operational and monitoring data from the hydraulic containment systems discussed in the "Status of Implementation" section, above, are used to determine if groundwater from the shallow and intermediate zones is being successfully captured.

The WB 1-8 IRM includes the Eastern and RA-A shoreline groundwater collection systems to control shallow and intermediate groundwater discharges to Onondaga Lake. Similar to the prior

[12] Navigational Buoys are maintained by the NYS Office of Parks Recreations & Historic Preservation. Buoys are removed in winter and replaced in the spring. See https://extapps.dec.ny.gov/docs/regions_pdf/onondagalakebuoys.pdf for a map of buoy locations.

FYR, data indicates general achievement of hydraulic control for these systems, with periodic exceptions during scheduled maintenance, extreme weather conditions, and elevated lake levels.

Since the last review period, system upgrades and optimization activities have been implemented which have resulted in improved system performance, including a new redundant force main from the WB 1-8 system pump station to the Willis Avenue Water Treatment Plant and installation of an acid adjustment system in 2022. Updates are provided to NYSDEC regularly on the performance of and upgrades to these systems. Demonstration of consistent performance has been challenging along a portion of the system that is directly adjacent to the capped area in RA-A. Therefore, peeper porewater locations A-30 and A-31 (Figure 20.12) were added to the 2019 cap monitoring program to verify that the cap adjacent to this portion of the hydraulic containment system remains protective. Except for minor detections of benzene, toluene, and phenol (at less than 2 percent of the cap performance criteria) in 2022, all analytes were non-detect for these two peepers.

Habitat Restoration Monitoring and Wetland Mitigation

Habitat/Wetland Monitoring

Habitat-related monitoring was conducted to document habitat reestablishment and biological response within remediated areas and in lake-wide reference areas as indicated in the OLMMP (Parsons 2018b). Results show that restored habitats provide a diverse, functional habitat for a variety of species. Habitat monitoring included qualitative and quantitative surveys to evaluate vegetative areal percent cover and percent coverage for each species, including invasive species and cover type. Wildlife usage, aquatic macrophyte and benthic macroinvertebrate surveys, and fish community surveys were also conducted in this FYR period.

A wetland delineation was conducted in accordance with federal and state delineation methods in year five (2021 for the Ninemile Creek spits and 2022 for the Wastebed B/Harbor Brook Outboard Area) to quantify wetland mitigation acreage (Parsons, 2018a). The Wastebed B/Harbor Brook Outboard Area was the last mitigation area to be restored. Therefore, the year 5 wetland delineation completed in 2022 marked the final delineation needed to evaluate the overall achievement of wetland mitigation requirements for Onondaga Lake.

Table 3 (Attachment 1) summarizes the final year 5 delineated wetland acreage for each area compared to the mitigation requirement of 19.5 acres. The delineated wetland acreage across the restoration areas following their respective year 5 delineations show that 28.39 wetland acres have been created across all areas. The overall wetland mitigation acreage goal of 19.5 acres has therefore been met.

Table 3 (Attachment 1) also summarizes the open water acreage for the Wastebed B/Harbor Brook Outboard and the Wastebeds 1-8 Connected Wetland Areas compared to the mitigation requirement of 4.6 acres. The overall open water acreage calculated following year 5 formal delineations at each respective area totaled 6.4 acres. Therefore, the overall open water mitigation acreage goal of 4.6 acres has been met.

The mouth of Ninemile Creek was planted in 2016 and the WBB/HB Outboard Area was planted in 2017 following the completion of construction activities. Two qualitative reconnaissance surveys were conducted during this FYR period for both Ninemile Creek and WBB/HB Outboard Area. At the mouth of Ninemile Creek, 260 plant species were identified including Native broadleaf cattail *(Typha latifolia*), coontail (*Ceratophyllum demersum*), common water weed (*Elodea Canadensis*), sago pondweed *(Stuckenia pectinata)* etc. Quantitative vegetative monitoring was conducted on 50 square ft plots. Vegetation cover types and wetland acreages were estimated which included extensive areas of emergent wetland and aquatic bed. The overall cover of vegetation at the mouth of Ninemile Creek Spits was 97.1% which exceeded the 85% success criteria for the five-year monitoring program. The overall cover of the vegetation at the mouth of Ninemile Creek has steadily increased and overall coverage was 91.3% which exceeded the 75% success criteria goal for the five-year monitoring program. In the WBB/HB Outboard Area quantitative vegetative monitoring was conducted on 51 wetland plot locations, seven upland plots and 6 plots located within the 25 foot in lake planted buffer. A total of 292 plant species were identified in the WBB/HB Outboard Area, including Broadleaf cattail, sago pondweed, bladderwort etc. The average vegetation coverage in the WBB/HB Outboard upland areas was 100%, which exceeded the success criteria goal of 90%. Coverage in the planted wetland areas was 91% which exceeded the 85% success criteria goal. The average vegetation coverage in wetland plots from 2019 to 2022 ranged from 71.1 % to 91%. Invasive species coverage in both areas were less than 1%, meeting the success criteria of less than 5%. Additionally, the conditions of large trees were surveyed in the WBB/HB Outboard Area in the late summer of each monitoring year from 2018 to 2022. 102 of the 103 large trees planted during restoration survived and were generally in good condition. The one tree in the wetland area that was dead was replaced with three small black willows in November 2022. In the upland area a tree was noted as alive but in poor condition and it was supplemented by planting three additional large trees (two river birch and one northern white cedar).

The WBB/HB Outboard Area wetland habitat between 2017-2022 included persistent emergent wetlands, non-persistent/aquatic beds and scrub-shrub or young forested wetlands. Community composition consisted of Broadleaf cattail, swamp white oak, American burreed, pickerelweed, silver maple, and black willow, among others. Although there are no specific success criteria for wildlife usage in remediated areas, monitoring was conducted throughout this FYR period to assess functional wildlife use of the sites. Recorded observations indicate that the restored areas are attracting diverse wildlife including large numbers of migrating waterfowl during spring and fall including great blue heron, spotted sandpipers and ospreys. Overall, approximately 233 species were observed across all remediation areas from 2017-2022. As expected, most were found within the restored wetlands which included 112 bird species, 45 fish species, 53 macroinvertebrate species, 11 amphibian or reptile species and 12 mammal species. Common wildlife species included Herring Gull (*Larus argentatus*), Mallard (*Anas platyrhynchos*), and Double-crested Cormorant (*Phalacrocorax auratus*). Other notable species included Bald Eagle (*Haliaeetus leucocephalus*), Pied-billed Grebe (*Podilymbus Podiceps*), Black-Crowned Night Heron (*Nycticorax nycticorax*), Northern Leopard Frog (*Lithobates pipiens*), DeKay's Brown Snake (*Storeria dekayi*), Least Bittern (*Ixobrychus exilis*), American Mink (*Neovision vision*), Red Fox (*Vulpes vulpes*), and Paper Pondshell (*Utterbackia imbecillis*).

Surveying of aquatic macrophytes (vegetation) was conducted from 2017 to 2021 to document the natural recolonization by aquatic plants in remediation areas of the lake and the coverage in non-remediated areas (reference areas). Qualitative surveys included number of species observed, and Quantitative Surveys included species richness, density and percent cover. Species observed included Sago pondweed (*Stuckenia pectinata*), watermilfoil, (*Myriophyllum* spp.), coontail (*Ceratophyllum demersum),* curly pondweed (*Potamageton crispus*), common waterweed (*Elodea canadensis*), water stargrass (*Heteranthera dubia*) and stonewort (*Nitellopsis* sp.). The number of species observed during qualitative surveys increased from 11 (2017 and 2018) to 18 (2021). Similar increases in species richness were observed during quantitative surveys, increasing from nine (2017) to 17 (2020). Quantitative survey data from 2017 through 2021 show that lake wide macrophyte density ranged from 1.18 to 1.41. Macrophyte density within unremediated areas ranged from 1.46 to 1.69, and macrophyte density within remediated areas trended upward throughout the monitoring period, ranging from 0.61 in 2017 to 1.04 in 2021. The overall site vegetation cover is expected to remain stable. Although fluctuations in density are anticipated, success of vegetation in remediated areas is expected to continue.

Fish Community Monitoring

While there are no goals for the fish community, monitoring was conducted from 2008 to 2022 to qualitatively compare with the baseline community to gain a greater knowledge of community level changes. The relative abundance of the most common species during the post-construction monitoring period were Banded Killifish (*Fundulus diaphanous*), Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Round Goby (*Neogobius melanostomus*) and Gizzard Shad (*Dorosoma cepedianum*).

While there has been some annual variation, the relative abundance of most common species observed during the lake wide post-construction monitoring period (2017-2022) has remained comparable to the relative abundance of the most common species during the baseline monitoring. Largemouth Bass and Bluegill have remained as two of the most abundant species in the lake. The invasive round goby was first documented in Onondaga Lake in 2010 and has become increasingly abundant in subsequent years. This increase is not unexpected in freshwater bodies in New York state.

In accordance with the OLMMP, monitoring for evidence of spawning/reproduction of Northern Pike (*Esox lucius*) and other wetland species was conducted in the WBB/HB Outboard Area wetlands from 2018-2022. Annual monitoring was conducted during July and August when young of the year would likely be present in the wetlands. One adult Northern Pike was observed during this monitoring period in 2022. However, throughout all five years of monitoring 23 different species were observed including, Bowfin (*Amia calva*), Bluegill (*Lepomis macrochirus*), Pumpkinseed (*Lepomis gibbosus*) and Brown Bullhead (*Ameiurus nebulosus*), indicating that the newly established habitat is being used by fish. Northern Pike are uncommon in Onondaga Lake and it was not unexpected that only one adult Northern Pike was observed during the monitoring period. In accordance with the OLMPP, after there were no Northern Pike observations during four years of monitoring through 2021, field data were collected in 2022 to calculate a habitat suitability index to evaluate the suitability of the wetland for Northern Pike spawning. According to the Habitat Suitability Index, where values range between 0 (unsuitable habitat) and 1 (optimal habitat), the average score for Onondaga Lake over five years from 2018 to 2022 was 0.37 which was driven by the drop in water levels in the lake during Northern Pike embryo and early fry stages. Water levels in Onondaga Lake fluctuate due to the operation of the hydroelectric dam on the Seneca River. Although all other variables scored high, indicating that near ideal habitat and water quality exists for Northern Pike in this area, due to the limitation of the water level drop, successful pike spawning in this area is unlikely in most years. One adult Northern Pike was captured in the spring of 2022 during temperatures known to be conducive to spawning. Additionally, numerous wetland spawning fish species in this area were captured throughout the five-year monitoring period. This indicates that the WBB/HB Outboard Area is meeting the intended goal of providing suitable Northern Pike spawning habitat. The habitat restoration in this area has resulted in many of the wetland functions having been returned or created, therefore additional action to achieve better spawning conditions is not needed. While specific monitoring for Northern Pike is no longer necessary, the presence of Northern Pike will continue to be noted as part of Honeywell's overall fish collection activities. The results of the Habitat Suitability Index for Northern Pike conducted in 2022, can be found in the Honeywell Onondaga Lake 2022 Monitoring and Maintenance Report, Appendix 2E (Parsons, 2025c).

Benthic Macroinvertebrate Monitoring

Benthic Macroinvertebrates are also recolonizing the new cap substrate. Biological Assessment Profile (BAP) scores were used to characterize benthic communities and assess the recolonization of macroinvertebrates on the new cap. Scores were based on descriptive categories such as severely impacted (0.0-2.5), moderately impacted (2.5-5.0), slightly impacted (5.0 -7.5) and non-impacted (7.5-10.0) (Parsons, 2025). Based on the most recent benthic community survey in 2021, average BAP scores in remediated areas based on data from multiple locations in each of the cap types (sand, MPC with sand, fine gravel, coarse gravel, topsoil) ranged from 1.5 to 5.5, which is similar to the unremediated areas which ranged from 2.2 to 5.3. Overall, BAP scores are improving over time, suggesting the recolonization of benthic macroinvertebrates on the capped areas. In accordance with the OLMMP, two monitoring events were required and completed, and based on the results, no further monitoring of benthic macroinvertebrates is recommended at this time.

<u>Cap Monitoring</u>

Evaluations of cap effectiveness are conducted based on both physical and chemical monitoring as per the requirements of the OLMMP and associated Cap Monitoring Work Plan and subsequent annual scope documents. Physical monitoring of the capped areas has continued in RAs A through F, adjacent wetland areas, and thin layer and amended areas of SMU 8 to verify that the habitat/erosion protection layer and underlying chemical isolation layer for multi-layer caps and mono-layer caps are stable. Since the last review period, additional cap monitoring occurred in 2019, 2020, 2021, 2022, and 2023 consistent with the scope and schedule detailed in the OLMMP and subsequent annual scoping documents.

The cap chemical monitoring data are compared to the chemical-specific performance criteria for the lake, Outboard Area, and Wastebeds 1-8 connected wetlands which are the PECs for each of the 23 contaminants that have been shown to exhibit acute toxicity on a lake-wide basis (see Attachment 1, Table 1b), as well as the NYSDEC sediment screening criteria for benzene, toluene, and phenol. The chemical-specific performance criteria for the Ninemile Creek spits (which is monitored as part of the Onondaga Lake program) are consistent with the criteria set forth in the Ninemile Creek OU-2 ROD. The cap in the littoral zone has been designed to maintain chemical concentrations below the chemical-specific performance criteria specified above throughout the habitat/erosion protection layer for 1,000 years. In addition to the contaminant performance criteria, the cap is designed to maintain a pH less than 8 within the chemical isolation and habitat/erosion protection layers for 1,000 years. For the thin-layer caps in the profundal zone (SMU 8), the criteria are the mean PECQ criterion of 1 and the mercury PEC of 2.2 mg/kg within the top 4 cm, which is the compliance depth specified for SMU 8 in the Final Design.

Physical Monitoring

The physical monitoring of the cap includes both bathymetric surveys (including conventional survey methods in shallow areas) as well as coring and/or probing throughout the entire cap area, including thin-layer and amended cap areas in SMU 8. In areas where the cap consists entirely of sand-sized materials or a combination of sand and fine gravel, physical monitoring includes verification, via coring, that the thickness of both the habitat/erosion protection layer and chemical isolation layer is maintained. In areas where the sediment cap habitat/erosion protection layer consists of coarse gravel- and cobble-sized material that prevent coring, the monitoring program consists of verifying the presence of the overlaying habitat/erosion protection layer from the results of probing and bathymetric surveying (Parsons, 2018a).

Cap physical monitoring completed to-date has consisted of:

- 2017/2018: Comprehensive monitoring
- 2019: Comprehensive monitoring
- 2020: Comprehensive monitoring of MPCs, MERCs, SMU 8 TLCs and Direct Application Areas, plus physical probing, shoreline inspections and photographic documentation in other areas of the cap
- 2021: Probing and physical inspection, including shoreline inspection and drone photography
- 2022: Comprehensive monitoring
- 2023: Supplemental monitoring based on the 2022 monitoring results

Note: Supplemental monitoring has been done each year based on the results of prior monitoring.

A summary of the 2022/2023 physical monitoring is presented below. Comprehensive physical monitoring of the cap and visual inspection of the Wastebeds 1-8 shoreline stabilization area was implemented in 2022 consistent with the scope detailed in the OLMMP and the approved 2022 Onondaga Lake Scope Memorandum. No physical monitoring scope was anticipated for 2023 in the OLMMP. However, the 2022 bathymetric survey had significant data gaps because shallow water depth and heavy vegetation prevented collection of high-quality data in some areas. As a result, approximately one-third of the cap (approximately 150 acres) was resurveyed in spring of 2023, prior to the seasonal water level drop and vegetation growth. Physical monitoring of the cap was completed in 2023.

The 2022 Comprehensive Cap Monitoring activities included:

- Shoreline inspections and photographic documentation on foot, by boat, and by aerial drone
- Physical probing in a limited area
- Bathymetric surveys
- Measurement of cap thickness based on cores collected for chemical and/or supplemental physical monitoring
- Specific monitoring activities that were conducted in 2023 included:
    - Physical probing in a limited area
    - Bathymetric surveys
    - Measurement of cap thickness based on cores collected for supplemental chemical monitoring

The comprehensive 2022 monitoring program also included event-based monitoring if any of three extreme events occur:

- A 50-year or greater wind-generated wave event
- A 50-year or greater tributary flow event
- A seismic event measuring 5.5 or higher on the Richter scale within 30 miles of Onondaga Lake

None of these events have occurred since cap construction was completed. There is no indication of any human activities during this five-year review period that may have impacted the cap and/or other components of the remedy. Therefore, no event-based cap monitoring has been required.

Within topsoil areas in RA-A, the Ninemile Creek spits, Outboard Area wetlands (including lower Harbor Brook), and the WB 1-8 connected wetlands, the survey lines were modified as necessary to maximize data collection in and around wetland vegetation. However, similar to the previous FYR period, portions of these areas are too shallow and/or vegetated for a boat-based survey, and a comprehensive survey using manual methods could damage the wetland vegetation. Vegetation in these areas was inspected on a regular basis in 2022 and 2023 as part of the habitat restoration monitoring. This, combined with cores collected in these areas and observations from the shoreline visual inspection, provided verification that there has not been significant erosion of material in these areas. A small area (approximately 50 square feet) of vegetation and topsoil loss was noted in the Outboard Area wetlands in 2022. However, given the high energy nature of this shoreline, some loss of topsoil is expected and will not impact the overall restoration goals or cap protectiveness in this area.

The cap areas, conceptual cap types, and proposed bathymetry measurement areas for 2022/2023 are shown in Figures 20.1 to 20.11, and comparisons of 2019 to 2022/2023, 2019 to as-built, and 2022/2023 to as-built bathymetries for RAs A through F are shown in Figures 20.18 through 20.31. Due to gaps in bathymetry data in 2022 from dense vegetation, approximately one third of capped areas were re-surveyed in 2023. The 2022 and 2023 bathymetry data are combined for comparison with 2019 as-built figures. The 2022 multi- and mono-layer cap thickness measurements based on the cap coring are provided in Attachment 1 Tables 4.1a and 4.1b, respectively. The 2023 multiand mono-layer cap thickness measurements based on cap coring are provided in Attachment 1 Tables 4.2a and 4.2b. Based on a comprehensive review of bathymetry survey results, probing results, and coring results, the reductions in cap elevation seen in Figures 20.18 to 20.31 appear to result from consolidation and not loss of cap material. Similar to 2017 and 2018, bathymetry changes greater than 0.5 ft. shown on Figures 20.18 through 20.31 are generally attributable to settlement of the underlying sediment as a result of the weight of the cap and/or a result of loss of finer-grained habitat material overlying the coarser erosion protection layer. Such changes were anticipated in the final design (Parsons, 2020b).

In 2022, 344 cores were collected in multi-layer cap areas, and 161 cores were collected in mono-layer cap areas. During the supplemental 2023 monitoring, 22 cores were collected in multi-layer cap areas, and six cores were collected in mono-layer cap areas.

Based on results from the 2017 through 2021 cap monitoring, two small areas were recommended for additional cap material placement, which has been implemented. The areas are located in RA-C and RA-D where measured cap thicknesses were less than the target thickness goals. In a small portion of the cap in Model Area RA-C-2A (4 to 10 ft) it is believed that the fine gravel was not placed as intended during construction, likely due to caution related to over-placement of materials in this area that could have impacted the underlying sediment stability. Therefore, additional cap material was placed in this area in 2019 per a NYSDEC-approved work plan. The area for placement of additional cap material covered approximately 0.12 acres, as shown in Figure 20.32. The 2019 supplemental cap material placement in RA-C-2A had a target minimum placement thickness of two inches of fine gravel. Cores collected subsequent to placement verified that placement goals were achieved.

The second area where additional cap material was placed was along a small portion of the shoreline in RA-D in the area east of the crane pad area where visual observations in 2019 noted limited erosion of the topsoil and finer-grained habitat material. It was anticipated in the design that there would be some degree of movement and/or loss of the finer grained habitat material in this area. A focused bathymetry survey of this area was completed in May 2019. Based on the bathymetry comparison and physical observations, it was concluded that the bathymetry change was due in part to settlement or the loss of the finer grained habitat material. There was no or minimal loss of the underlying erosion protection material and therefore no impact to the isolation layer. To be conservative, since this is a high energy shoreline that experiences significant wind/wave energy and to minimize the potential for additional loss of cap material, it was recommended replacing the lost cap material in this small shoreline area with a coarser rounded cobble that would better resist erosion. Approximately 0.26 acres of new cap material was placed in 2019 consistent with a NYSDEC-approved work plan. Cap material was placed over the area shown in Figure 20.33 in a layer with a target average thickness of approximately 18 inches. Placement thickness was verified based on comparison of pre-placement and post-placement elevations, and has remained stable since its placement in 2019. To soften the shoreline, fine gravel was placed to fill the void spaces within the coarse cobble in the area above the water line.

Chemical Monitoring

Cap chemical monitoring completed to date has consisted of:

- 2017/2018: Comprehensive monitoring over two years
- 2019: Comprehensive monitoring
- 2022: Comprehensive monitoring
- 2023: Supplemental monitoring based on the 2022 monitoring results

The combined 2022 and 2023 chemical monitoring programs included over 12,000 chemical analyses from 167 sampling locations (see Figures 20.12 through 20.17), including multi-layer and mono-layer isolation caps in the littoral zone and thin layer capping and direct application areas in SMU 8.

Chemical monitoring is being conducted to verify that the chemical isolation in multi-layer caps and mono-layer caps is occurring consistent with design criteria. Chemical monitoring, which includes sampling within each of 17 primary cap modeling areas developed during the remedial design and within each MPC area, entails collection of porewater and/or cap material samples from the chemical isolation and habitat layers of the cap. All chemical monitoring includes "indicator chemicals," which were constituents determined during the design phase to represent the most significant potential for migration through the cap and which therefore dictated cap design, including GAC application rates. Indicator chemical groups are shown on Attachment 1 Table 2. Chemicals in addition to the indicator chemicals are included in the sampling program during "comprehensive" chemical monitoring events. The additional chemicals include all constituents that have chemical isolation performance criteria that are not already identified as indicator chemicals.

Comprehensive chemical monitoring was conducted in 2022 in accordance with the approved cap monitoring work plan and 2022 Onondaga Lake Scope document. This included collection and analysis of 530 porewater and solid-phase samples at 167 sampling locations. The methods for sample collection are dependent upon various factors, such as the grain size of the material being sampled, presence or absence of GAC in the material, and detection limits/sample volumes of certain constituents in porewater. Cap porewater concentrations for constituents included in the mean PECQ calculation are compared to the solid-phase performance criteria (see Table 1b for solid-phase criteria) by converting the porewater concentration to a solid-phase concentration based on partitioning calculations using the equilibrium partitioning coefficients. Similarly, cap solid-phase sample results for benzene, toluene, and phenol are compared to porewater screening criteria by converting the solid-phase concentration to porewater concentrations based on partitioning calculations using the equilibrium partitioning coefficients.

Supplemental chemical monitoring of the cap was completed in 2023 based on the results of 2022 monitoring activities, as documented in the 2023 Onondaga Lake Scope document. In addition to further evaluating sample locations with a concentration exceeding one or more of the cap performance criteria (i.e., an exceedance factor greater than 1) as per the requirements of the OLMMP, a criteria exceedance factor of 0.5 from the 2022 results was also conservatively used to identify 2023 resample locations as concentrations approach the criteria. The monitoring included resampling of nine locations to supplement analytical results collected during the 2022 annual monitoring. The specific sampling locations are shown on Figures 20.12 to 20.17 and summarized in the following table:

CHEMICAL MONITORING SAMPLE LOCATIONS AND ANALYTICAL PARAMETERS FOR 2023

Sample Location	Sample Medium (Method)	Analytical Parameters	Reason for Resampling (Based on 2022 results)
B-11	Porewater (Peeper)	Phenol	Phenol EF > 0.5
B-14	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 1 (CI layer)
B-15	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 0.5 (H layer)
C-14	Porewater (Direct Extraction)	VOCs, LPAHs (including phenol), pH	Porewater sample cores were retrieved from incorrect cap area. (Note: mercury was analyzed in solid phase sample, not porewater; the sediment sample was collected in the correct location and thus resampling for mercury was not needed)
D-13	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 1 (CI layer)
D-15	Porewater (Peeper)	Phenol	Phenol EF > 1 (CI layer)
D-21	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 1 (deep H & CI layers)
E-41	Porewater (Peeper)	Mercury	Mercury MDL > criteria
E-43	Porewater (Peeper)	Mercury	Mercury MDL > criteria

EF = exceedance factor (concentration/cap habitat layer criteria)
LPAH – low polycyclic aromatic hydrocarbon
MDL – method detection limit, H - habitat, CI - chemical isolation

Sampling intervals for all 2023 resample locations were consistent with the intervals sampled in 2022 for habitat/erosion protection, amended chemical isolation, and unamended chemical isolation layers. However, the 2023 sample volumes were revised based on the targeted analyte list to increase sample volumes and thus reduce MDLs. Samples from each location were submitted for laboratory analysis of the target parameters shown in the table above. Unfiltered samples were analyzed for VOCs; filtered samples were analyzed for LPAHs and phenol. Cores were collected to measure cap thickness prior to placement of the peepers.

In addition to the chemical analytical sampling, additional studies were completed in 2023 to aid in evaluating potential variability in pH results among three sampling methods: solid phase; direct extraction porewater; and peeper porewater. A review of the data from prior years through 2022 indicated that there may be a systematic difference in pH results between the different sampling methods. Therefore, testing was completed to further evaluate potential influences of sampling methods on measured pH results. Based on the results, it was recommended that pH measurements for future monitoring events be collected in the field from solid-phase cores.

A schedule of the physical and chemical monitoring activities through 2026 is available in the OLMMP. Additional work plans documenting the cap monitoring schedule after 2026 will be developed subject to NYSDEC review and approval. The post-remediation results for chemical monitoring of the cap focusing on 2022/2023 results are discussed in the “Data Review” section, below.

Nitrate Addition Program

Based on the success of the three-year pilot test from 2011-2013, nitrate addition has continued as part of the long-term remedy consistent with the 2014 ESD. Nitrate is applied after thermal stratification is established in summer and it has been applied at the same three locations in the lake, as necessary, since 2011 to maintain a concentration of 1.0 milligrams per liter (mg/L) in the hypolimnion. Although there were a few exceptions in the upper hypolimnion in 2021, none of the results triggered the need for supplemental mercury sampling during the 2019-2023 period. Water quality measurements are used to determine the density of nitrate solution, and there is frequent sampling of nitrate concentrations at depth and a submersible ultraviolet nitrate analyzer deployed to analyze nitrate conditions. The extent of nitrate needed in Onondaga Lake during summer months prior to fall turnover is anticipated to decline gradually over the coming years as mercury-contaminated sediment in SMU 8 is further isolated via MNR. Therefore, nitrate addition will be evaluated annually based on the prior year's results, the lake's fluctuating seasonal hydrologic and nitrate inputs, and other factors. Total dissolved gas, manganese and ferrous iron monitoring was eliminated in 2017 for the nitrate addition program and therefore these variables are not discussed in this FYR.

Zooplankton tissue analysis for both total mercury and methylmercury was conducted during this FYR period. Although there are no remedial performance criteria for zooplankton, analysis of mercury and methylmercury concentrations provides a measure of change in potential exposure to fish that eat zooplankton and aids in the understanding of mercury cycling. Observed reductions of methylmercury in surface water and in zooplankton are discussed in the "Data Review" section, below. Nitrate addition has been effective in inhibiting the release of methylmercury from sediment into the deep-water portions of the lake, resulting in lower concentrations of methylmercury in lake water and zooplankton.

Sediment Consolidation Area (SCA)

Monitoring and maintenance activities at the SCA during the 2019 to 2023 review period were performed consistent with the SCA Post-Closure Care Plan (Parsons and Beech & Bonaparte, 2017), with the objective of maintaining and verifying the integrity and effectiveness of the cover system, surface water management system, liquid management system (LMS), and the SCA perimeter berm. Monitoring activities have included quarterly visual inspections of the SCA final cover system and of the surface water management systems, monthly inspections of the LMS and stormwater management systems, quarterly odor monitoring, and additional inspections after major storm events and prior to mowing events.

Maintenance activities (*i.e.,* mowing, seeding, and invasive species control) were conducted, as needed, based on inspection findings. Conditions and operation of the SCA during the monitoring period were satisfactory. There were some minor areas of erosion at the northern end, adjacent to previously repaired areas but the area remains stable with active vegetation growth. Soil settling was observed at gas vents GV-3, GV-4, GV-14, GV-15, and GV-16 due to animal burrows, and these areas are being closely monitored. Repairs will be planned in the future as needed (Parsons, 2024).

LMS inspections found equipment to be in working order. There have been no issues with the LMS system, it continues to operate effectively managing leachate as designed. NYSDEC approved a change to the monitoring frequency on December 13, 2021. Beginning in 2024, LMS monitoring was reduced from monthly to quarterly.

Odor monitoring consisted of odor observations by a qualified individual who has experience with site-related odors at eight air monitoring stations along the SCA work zone perimeter road. No site-related odors were detected during inspections conducted during the 2019 to 2023 monitoring periods. Odor monitoring was recommended by Honeywell and approved by NYSDEC to be discontinued beginning in 2024 because there have been no odors since the closure of the SCA cover system (Parsons, 2024).

As further discussed in the "Data Review" section below, post-closure groundwater and surface water data collected as part of the SCA Environmental Monitoring Program indicate that the SCA cover and liner systems have remained effective at mitigating potential breaches affecting local groundwater and surface water quality.

Monitored Natural Recovery

The primary mechanism by which profundal zone surface sediment mercury concentrations are declining is burial by incoming clean sediments that are continually being deposited from overlying water. Collection and total mercury analysis of shallow sediment cores (0-4 cm and 4-10 cm) in SMU 8 is the primary method of determining attainment of MNR performance criteria.

The MNR monitoring scope included several components that aided in the assessment of the extent and rate of natural recovery in SMU 8:

- sampling and total mercury analysis of surface sediment samples and comparing these data with predicted concentrations obtained via site-specific natural recovery modeling;
- use of sediment traps deployed at a location in the South basin (South Deep) from May through October each year through 2022 to monitor sediment deposition rates of solids and total mercury in settling sediment;
- measurement over time of the depth of sediment above fluorescent sand-sized microbeads, which were placed in nine 1,400-square-foot plots in the deep-water zone of SMU 8 during 2009 to provide a vertical marker of the SMU 8 sediment, and which provide a quantitative demonstration of the extent of ongoing sediment burial;
- visual observations of varves/layers collected from profundal zone sediments (including 2021) and frozen cores to assess vertical mixing of sediment; and
- assessment of abundance and composition of benthic macroinvertebrates (*e.g.,* worms), which if present in significant numbers, can affect ongoing natural recovery by increasing the extent to which sediment is vertically mixed.

The 2017 compliance event indicated sedimentation was likely occurring faster than anticipated, indicating MNR goals were potentially being met. This triggered two consecutive compliance monitoring events in 2021 and 2022, which included an expanded number of cores from both the profundal and littoral zones for chemical analysis, per the OLMMP (Parsons, 2018). Shallow sediment cores were collected at 49 locations from the profundal zone (Figures 21 and 22) in both 2021 and 2022. Shallow sediment cores were also collected at 14 locations from the littoral zone (Figures 21 and 22) in 2021. These locations are a subset of the original locations used to calculate the surface-area weighted average concentration (SWAC) for each sub-area in the final design. Two of these littoral zone locations were resampled in 2022 based on the results from 2021. Monitoring also included the collection of cores from microbead plots for visual inspection to assess the depth of mixing of surface sediments and sedimentation rates, and sediment trap sampling and analysis for mercury and suspended solids analysis.

The MNR goal is to achieve a mercury PEC of 2.2 mg/kg or lower on a point-by-point basis in the profundal zone at 0-to-4-centimeter (cm) depth and a mercury BSQV of 0.8 mg/kg or lower on an area-wide basis in each of the five subareas. Due to faster than anticipated sedimentation rates, the MNR goal has been achieved. There was no MNR monitoring performed in 2023. See the "Data Review" section below for further compliance event details. While goals have been met, EPA and DEC may recommend measures for periodic sediment sampling events to ensure protectiveness of the remedy.

CSX Shoreline Area of Remediation Area E

As specified in the Design Addendum for this area (Parsons and Anchor QEA, 2014), the offset area where dredging and capping could not be conducted included baseline surface sediment sampling at approximately the same density as sampled during the PDI for the full list of mean PECQ parameters, plus benzene, toluene, and phenol; total organic carbon (TOC); grain size; and post-remedy surface sediment sampling at/near baseline locations to evaluate potential natural recovery.

Baseline surface sediment sampling in the offset area was completed in fall 2016. As specified in the OLMMP, post-remedy sampling and a bathymetric survey were implemented in this area in 2019. The 2019 sediment surface elevations were, with minor exception, consistent with pre-remediation elevations. The area at the mouth of Onondaga Creek was navigationally dredged subsequent to the pre-remediation and post-remediation bathymetric surveys and is also subject to periodic sediment deposition and erosion due to Onondaga Creek discharge, which accounts for the noted change in elevation in that area. The dredging was completed in 2018 by the New York State Canal Corporation and was coordinated with NYSDEC and Honeywell. No backfilling was completed following navigational dredging. Based on the documents reviewed by Honeywell, the navigational dredging did not impact the lake cap in this area.

As shown in Table 8 (Attachment 1), average contaminant concentrations in this area are on a consistent downward trend since the PDI sampling in this area although many locations continue to exceed the mean PECQ of 1. Consistent with the OLMMP, sampling and a bathymetric survey was implemented in this area again in 2024. The scope and timing for subsequent monitoring in this area will be determined based on the results of the 2024 sampling event.

Fish Tissue

Both Honeywell and NYSDEC have collected fish over the time frames prior to, during and subsequent to implementation of remedial activities, although they typically sample different species, with NYSDEC concentrating on Largemouth Bass, with other species being less consistently collected.

Contaminant data from fish tissue in Onondaga Lake are being used to assess the progress of the remediation in several contexts. These include the exposure of the public from consuming fish, and exposure experienced by two types of wildlife (those consuming smaller prey fish, and those consuming larger fish). In addition, the trends in the data are being considered to assess improvements (*i.e.,* declines) in the contaminant concentrations due to the remediation. Fish data were collected on an annual basis during the post-ROD baseline monitoring period (2008 to 2011) prior to commencement of remedial actions in the lake and during the remedial action period (2012 to 2016). Post remedial monitoring of fish tissue has been performed annually since 2017. Although data have been collected annually, 2019 and 2020 data experienced laboratory QA/QC issues, and are not able to be used for statistical analysis. At the time of this five-year review, new usable fish tissue results include Honeywell data collected in 2021 and 2022. The Honeywell 2023 fish tissue data report was not completed in time for this five-year review. In addition to fish tissue collected by Honeywell, NYSDEC fish tissue data for largemouth bass, a species not sampled by Honeywell, are available for all review years.

To statistically assess the direction and rate of change in fish concentrations post-remedy (*i.e.,* after 2016), additional fish tissue data collection will continue, as defined in the OLMMP. Fish tissue analysis is discussed further in the “Data Review” section below, in addition to Attachment 3. Since additional fish tissue data are needed to assess rates of change, the data review below focuses on a qualitative comparison of pre-remedy and post-remedy concentrations and comparisons to the fish tissue goals for mercury and the fish tissue target concentrations for the organics. An update to the last FYR regarding the recommendation of developing additional fish tissue metrics can be found in Appendix D.

Remedy Resiliency

Potential site impacts from severe weather have been assessed, and the performance of the remedy may be affected by weather-related events within the region and near the site. Specifically, the site may be impacted by extreme heat and increased precipitation from flooding. Potential effects include erosion of the lake and wetland sediment caps, and SCA cover due to severe storms/ weather events and associated flooding. However, the sediment cap has been designed to provide long-term physical isolation and stability, as well as chemical isolation with no anticipated cap maintenance or enhancement. The erosion protection layer of the cap was designed to be physically stable under conditions predicted to occur based on consideration of a 100-year return-interval wind-generated wave event and a 100-year tributary flood flow event. The cap includes over 40 different design profiles across the capping area, each of which was developed based on goals and input parameters specific to a given area, including sediment contaminant concentrations, water depth, wave erosive forces, and habitat substrate goals. EPA’s *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (2005) recommends that the physical cap integrity be monitored both routinely and after events with certain recurrence intervals. Therefore, in addition to routine monitoring of the cap, physical monitoring will be performed after extreme events to verify the integrity of the cap. The extreme event conditions that will be used to trigger a monitoring event include a 50-year or greater wind-generated wave event or a 50-year or greater tributary flow event.[13] This will also be included in the Site Management Plan once finalized.

[13] Consistent with the OLMMP, cap monitoring would also occur following a seismic event measuring 5.5 or larger within 30 miles of Onondaga Lake as measured by the US Geological Survey.

Stormwater calculations performed for the SCA as part of the Final Design Report showed the stormwater management system can handle a 100-year, 24-hour storm. Vulnerability assessments will be conducted for the SCA when deemed necessary and will address the vulnerability of the SCA and/or engineering controls to severe storms/weather events and associated flooding. Appendix C includes additional details and tools used for severe weather and remedy resilience assessment in line with regional practices.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the **last** FYR as well as the recommendations from the **last** FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2020 FYR

OU #	Protectiveness Determination	Protectiveness Statement
02	Protectiveness Deferred	A protectiveness determination of the remedy for the Lake Bottom Subsite cannot be made until additional post-construction fish tissue data are available to ascertain when the remedial goals identified in the ROD will be achieved. It is anticipated that at least four additional years of fish data will be needed to determine when the rates of decline can be estimated with statistical significance. Following the evaluation of the additional data, a protectiveness determination will be made. In the interim, remedial operation, maintenance and monitoring activities will continue to be implemented in accordance with existing plans and requirements. The construction components of the remedy, which includes in-lake dredging, capping, habitat restoration, capping/closure of the SCA located on Wastebed 13, which contains sediment and debris removed from the lake have been completed. Other components of the remedy, including nitrate addition in the hypolimnion and MNR are ongoing. The establishment of ICs is anticipated to be completed in 2026.

Table 3: Status of Recommendations from the 2020 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
02	Post-construction fish tissue data to be collected through 2022 should be statistically evaluated with prior post-construction data to ascertain when the RGs identified in the ROD will be achieved.	In four years, evaluate whether rates of decline in fish tissue contaminant levels can be estimated with statistical significance	Ongoing	Fish data through 2018 were presented in the 2020 FYR. Two years of data (2019 and 2020) are not usable for statistical purposes. At the time of this review, the only fish data from Honeywell available subsequent to the 2020 FYR are from 2021 and 2022, which is not enough to make a determination on whether rates of decline in fish tissue contaminant levels can be estimated with statistical significance. Additional fish tissue data are needed for statistical evaluation.	Click here to enter a date
02	Statistical metrics that would be utilized to evaluate attainment of fish tissue RGs and targets have, to date, not been formalized.	Statistical metrics that would be utilized to evaluate attainment of fish tissue RGs and targets should be developed. The metrics should characterize the population of the sample set, including an assessment of the significance of samples that exceed the RGs and targets.	Completed	Statistical metrics used to evaluate attainment of fish tissue RGs and targets have been developed and finalized by EPA and DEC (see details included in Appendix D). These metrics will be implemented as additional fish tissue data are collected.	8/26/2025
02	All institutional controls are not in place.	Institutional controls should be put into place.	Ongoing	ICs (*e.g.,* environmental notices and environmental easements) are still in progress. Fish consumption advisory signs and additional NYSDOH outreach has been implemented since the last FYR.	

Additional Information: While several environmental easements and environmental notices are complete, the completion of some of the ICs has taken longer than originally projected. This extended timeline is primarily the result of the coordination required among NYSDEC, Honeywell, and multiple property owners, which adds complexity to the process and necessitated additional time. The NYSDEC remains committed to completing the necessary steps as efficiently as possible and anticipates completing the easements in 2026.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On August 7, 2024, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, and Puerto Rico, including the Onondaga Lake – Lake Bottom subsite OU2 Superfund site. The announcement can be found at the following web address: https://www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, the EPA Community Involvement Coordinator (CIC) for the site, Larisa Romanowski, posted a public notice on the EPA site webpage https://www.epa.gov/superfund/onondaga-lake and provided the notice by email to the City of Syracuse; Towns of Camillus, Geddes and Salina; and Villages of Liverpool and Solvay on July 29, 2025 with a request that the notice be posted in municipal offices and on their respective webpages. In addition, on July 30, 2025, the notice was distributed via the NYSDEC's Onondaga Lake News email Listserv which includes approximately 11,000 subscribers. This notice indicated that a FYR would be conducted at the Onondaga Lake OU2 site to ensure that the cleanup at the site continues to be protective of human health and the environment. Once the FYR is completed, the results will be made available to the following repositories: NYSDEC Region 7 Office, 5786 Widewaters Parkway, Syracuse, New York; NYSDEC Central Office, 625 Broadway, Albany, New York; Onondaga County Public Library, Syracuse Branch at the Galleries, 447 South Salina Street, Syracuse, New York; Solvay Public Library, 615 Woods Road, Solvay, NY 13209; and Atlantic States Legal Foundation, 658 West Onondaga Street, Syracuse, New York. In addition, the final report will be posted on the following website: https://www.epa.gov/superfund/onondaga-lake. Efforts will be made to reach out to local public officials to inform them of the results.

Data Review

A discussion of the performance of the remedy based on data for all relevant media (*e.g.,* capped areas, surface water, SMU 8 sediment, fish tissue) is presented in this section. Figures and tables referenced in this section associated with cap monitoring, surface water/mercury methylation in the hypolimnion, and natural recovery can be found in Attachment 1. The tables and figures associated with monitoring of fish tissue and a general description of the fish tissue monitoring program since 2008 is presented in Attachment 3.

Cap Chemical Monitoring

Cap chemical monitoring completed to-date has consisted of:

- 2017/2018: Comprehensive monitoring over two years
- 2019: Comprehensive monitoring
- 2022: Comprehensive monitoring

- 2023: Supplemental monitoring based on the 2022 monitoring results

The 2022 comprehensive chemical monitoring program included over 9,200 chemical analyses from 167 cap sampling locations, including multi-layer and mono-layer isolation caps in the littoral zone and thin layer capping and direct application areas in SMU 8. Over 90 percent of the analytical results were non-detects or very low concentrations (*i.e.,* less than five percent of the performance criteria). Additional sampling was completed in 2023 at 9 locations to supplement the 2022 sampling results. The 2022 chemical monitoring results can be found in Tables 4.3a to 4.4 (Attachment 1). The 2022 chemical monitoring scope and exceedances of cap performance criteria are also summarized in the table below.

Table 2: 2022 Chemical Monitoring Scope and Exceedances of Cap Performance Criteria

Cap Type	Number of Sample Locations	Number of Samples	Number of Analyses	Number of Habitat Samples with Criteria Exceedances	Number of Sample Exceedances due to Chemical Migration
Multi-layer (Non-topsoil)	95	507	8,801	1	0[1]
Multi-layer (Topsoil)	27	66	2,342	8	0
Mono-layer	20	42	783	0	0
SMU 8 TLC	25	38	1,599	0	0
Total	**167**	**653**	**13,525**	**9**	**0**

Notes:

1. Potential impacts observed at D-21 are being further investigated as part of the 2024 cap monitoring scope.
2. TOC, total solids and pH are not included in counts.

Although there were no 2022 exceedances of cap criteria known to be attributable to chemical migration from the underlying chemical isolation layer, cap habitat layer criteria were exceeded at six locations (see Attachment 1, Table 4.4). In 2022, the cap performance criteria were exceeded at only one non-topsoil location (D-21), where phenol and toluene concentrations exceeded criteria in the deep habitat layer sample in the lower portion of the bioturbation zone. The cap criterion for phenol is based on the NYSDEC sediment screening criteria (SSC) which are in turn derived from surface water criteria based on taste and odor in fish tissue rather than aquatic toxicity. A mean PECQ value of 1 was used in the ROD to define areas of the lake that pose potential unacceptable risks to benthic organisms based on toxicity considerations. The mean PECQ of 1 was not exceeded. The source of the toluene and phenol is uncertain. The detected concentrations at D-21 were further evaluated through resampling in 2023.

Eight habitat layer samples, collected from five locations (D-42 through D-46) in cap areas with a topsoil habitat layer, exceeded cap criteria for PAHs. All of these locations are at the mouth of Harbor Brook. PAH concentrations were typically lower in the deepest habitat layer samples, indicating the exceedances are likely not a result of chemical migration from underlying sediments. The mean PECQ exceeded 1 at one of these locations (D-45). The PAH exceedances in the topsoil portion of the cap in this wetland and open water area at the mouth of Harbor Brook may be a result of PAHs migrating from portions of Harbor Brook, including reaches upstream of the areas remediated by Honeywell. Contaminants from onsite ditches likely contribute to a lesser extent than offsite sources due to lower flows and solids transport compared to Harbor Brook. Further monitoring and investigation into the elevated PAH concentrations in this area will be performed.

Results from the 2022 chemical monitoring programs verified that there is no evidence of significant chemical migration through any of the multi-layer or mono-layer capped areas, and the cap remains protective of human health and the environment. The infrequent exceedances of the cap criteria do not present an unacceptable risk to benthic organisms or other potential receptors given their infrequent and sporadic occurrence. See Figures 20.12 to 20.17 (Attachment 1) for the chemical and physical sampling locations for both 2022 and the supplemental 2023 event. Based on the 2022 monitoring results, supplemental chemical monitoring was completed at select locations in 2023, as detailed in Table 5 below:

Table 3: Chemical Monitoring Sample Locations and Analytical Parameters for 2023

Sample Location	Sample Medium (Method)	Analytical Parameters	Reason for Resampling	Results (2023)
B-11	Porewater (Peeper)	Phenol	Phenol EF > 0.5 (mono-layer)	All results below detection limits, detection limits below cap performance criteria
B-14	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 0.5 (H layer)	All results below detection limits, detection limits below cap performance criteria
B-15	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 0.5 (CI layer)	All results below detection limits, detection limits below cap performance criteria
C-14	Porewater (Direct Extraction)	VOCs, LPAHs, pH	Porewater sample cores were retrieved from incorrect cap area	All results below detection limits, detection limits below cap performance criteria
D-13	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 0.5 (CI layer)	Phenol and toluene concentrations significantly lower than those measured in 2022, all exceedance factors less than 0.5

Sample Location	Sample Medium (Method)	Analytical Parameters	Reason for Resampling	Results (2023)
D-15	Porewater (Peeper)	Phenol	Phenol EF > 0.5 (CI layer)	All results below detection limits, detection limits below cap performance criteria
D-21	Porewater (Peeper)	Phenol, VOCs	Phenol and toluene EF > 1 (deep H & CI layers)	Concentrations similar to those measured in 2022. Toluene detected below cap performance criteria in the upper compliance sample, and above cap performance criteria in the lower compliance and chemical isolation samples.
E-41	Porewater (Peeper)	Mercury	Mercury EF > 1 (CI layer), MDL > criteria in H layer	All results below detection limit, detection limits below cap performance criteria
E-43	Porewater (Peeper)	Mercury	Mercury MDL > criteria in H and CI layer	All results below detection limit, detection limits below cap performance criteria

Notes:
1. EF = exceedance factor (concentration/cap habitat layer criteria)
2. H=habitat, CI=chemical isolation, MDL= method detection limit
3. The 2023 peeper resampling results (Attachment 1, Table 7) confirmed the exceedances at location D-21 and are being further investigated as part of the 2024 cap monitoring scope.

The scope, results, and conclusions from the 2017/2018 and 2019 comprehensive monitoring events were similar to those from the 2022 monitoring events. The table below compares the 2022 comprehensive chemical monitoring results with the prior monitoring results focused on sample results with concentrations greater than the cap performance criteria in the habitat layer, and on concentrations greater than 50 percent (exceedance factor greater than 0.5) of the habitat layer performance criteria anywhere within the cap.

Table 4: Comparison of Results for Comprehensive Chemical Monitoring Events

Timeframe	Total Number of Sample Locations	Locations With Habitat Layer Exceedances	Additional Locations With Exceedance Factor Greater Than 0.5 in Habitat or Chemical Isolation Layers
2017/2018	140	6	9
2019	142	3	10
2022/2023	142	1	8

Notes:
1. Excludes PAHs in topsoil
2. 2017/2018 counts based on 2019 revised phenol Koc developed using the 2019 monitoring results

There is some variability between the results from the 2022/2023 sampling events and the prior sampling events, but overall, the results are relatively consistent, and no significant temporal trends were identified. A detailed evaluation was also completed to evaluate whether there were any locations where elevated concentrations were identified in multiple years. A performance criteria exceedance factor of 0.5 for habitat and chemical isolation layer samples was used as the basis for identifying elevated concentrations approaching the cap performance criteria. This evaluation identified two locations, as summarized below.

There was one location (D-21) in RA-D with an exceedance factor greater than 0.5 in multiple years. At this location, multiple VOCs had exceedance factors greater than 0.5 in 2019, 2022, and 2023. This location was re-sampled during the 2024 sampling event. Supplemental sampling at four new locations around location D-21 was also conducted in 2024. The 2024 sampling program was extended to include some additional sampling in 2025. Results from the 2024/2025 cap monitoring program are not available and will be presented in the next FYR.

There was one location (E-20) in RA-E where an exceedance factor greater than 0.5 was observed over multiple years. At this location, various PAHs had exceedance factors greater than 0.5 in the chemical isolation layer in solid phase samples in 2017, 2019, and 2022. Peeper porewater samples were collected from the habitat layer and analyzed for LPAHs (low molecular-weight PAHs) at this location. No LPAHs were detected. This is the only location throughout all lakewide capped areas with an exceedance factor greater than 0.2 in a chemical isolation layer sample for a PAH, and these PAHs have low mobility and are unlikely to migrate through the cap. Results indicate that the PAH concentrations are likely due to ambient sediment influences[14], not chemical migration from underlying sediments.

There is some variability between the sampling events, but overall, the results are relatively consistent, and no significant temporal trends were identified. During the combined 2022/2023

[14] Ambient sediment influences on material placed during cap construction (from 2012 to 2016) include potential impacts due to deposition of suspended sediments from adjacent unremediated areas (beyond the lake remedy footprint; including contributions from tributaries), areas pending remediation (within the lake remedy footprint), or partially remediated areas (within the lake remedy footprint where remedial action was in progress). These impacts are likely the result of resuspension of sediments due to wind and wave action and/or dredging and capping activities.

chemical monitoring event, there were no exceedances of the individual cap performance criteria in the habitat (compliance) layer with the exception of one location in Remediation Area D (station D-21) and five locations in topsoil/wetland areas near the mouth of Harbor Brook.

In addition, a detailed evaluation was completed to evaluate whether there were any locations where elevated concentrations were identified in multiple years, as detailed below, by remediation area. A performance criteria exceedance factor of 0.5 for habitat and chemical isolation layer samples was used as the basis for identifying elevated concentrations.

Remediation Area A

There were sporadic locations throughout the monitoring events in RA-A where various chemicals had concentrations resulting in exceedance factors greater than 0.5. However, the locations varied between sampling events and there were no locations where the exceedance factor was greater than 0.5 in multiple years. Concentrations are likely attributable primarily to impacts from ambient sediment influences, and not chemical migration from underlying sediments.

Remediation Area B

There were sporadic locations throughout the monitoring events in RA-B where various chemicals had concentrations resulting in exceedance factors greater than 0.5. However, the locations varied between sampling events and there were no locations where the exceedance factor was greater than 0.5 in multiple years. Concentrations are likely attributable primarily to impacts from ambient sediment influences, and not chemical migration from underlying sediments.

Remediation Area C

Chemical concentrations from RA-C locations did not result in exceedance factors greater than 0.5 in any monitoring event.

Remediation Area D

There were sporadic locations throughout the monitoring events in RA-D where various chemicals had concentrations resulting in exceedance factors greater than 0.5.

There was only location (D-21) with an exceedance factor greater than 0.5 in multiple years. At this location in 2019, chlorobenzene, dichlorobenzene, naphthalene, xylene, and various PAHs had exceedance factors greater than 0.5 in the chemical isolation layer based on direct extraction porewater results. This location was resampled with a peeper in 2019, and results were significantly lower, with no exceedance factors greater than 0.5. However, the 2022 sample and 2023 resample results both showed phenol and toluene exceedance factors greater than 0.5 in the chemical and/or habitat layers. To further evaluate this area, supplemental sampling at four new locations around location D-21 was recommended for 2024. As noted above, results from the 2024/2025 cap monitoring program will be presented in the next FYR.

Remediation Area E

As discussed above, there were sporadic locations throughout the monitoring events in RA-E where various chemicals had concentrations resulting in exceedance factors greater than 0.5. Concentrations are likely attributable primarily to impacts from ambient sediment influences, including tributaries, and not chemical migration from underlying sediments. As discussed above, only location E-20 had an exceedance factor greater than 0.5 in multiple years in RA-E, and this was limited to the chemical isolation layer and not the habitat layer.

Remediation Area F

Chemical concentrations from RA-F did not result in exceedance factors greater than 0.5 in any monitoring event.

SMU 8

Thirty-nine samples were collected from 25 locations in SMU 8 unamended and amended thin-layer cap (TLC) areas and direct GAC application areas in 2022. The long-term performance criteria for unamended and amended TLC and direct GAC application areas in SMU 8 is to meet the mean PECQ criterion of 1 and mercury PEC criterion of 2.2 mg/kg within the top 4 cm (approximately two inches), which is the compliance depth for SMU 8. Samples were collected from the top 4 cm of the sediment at each of the 25 sample locations to assess cap performance. A sample was also collected from the depth interval of 4 to 10 cm in unamended TLCs for potential future consideration if it is determined that the compliance depth should extend deeper than 4 cm. All samples collected from the SMU 8 TLC and direct GAC application areas in 2022 were less than the performance criteria. This is consistent with the results for these areas from the 2017/2018 and 2019 comprehensive monitoring events.

Although data were not available at the time of this review, an additional chemical monitoring event was conducted in 2024, which included:

- Sampling of all locations within MPCs and MERCs
- Sampling of all locations within SMU 8 amended TLCs and Direct Application Areas (these are the SMU 8 areas that were included in design revisions subsequent to the Final Design)
- Sampling of at least 50% of the comprehensive monitoring locations within full-thickness caps and SMU 8 unamended TLCs

Consistent with the OLMMP and also based on the recommendations of the revised draft 2023 Annual and Comprehensive Report (Parsons, 2025b), the 2024 supplemental monitoring was also recommended to facilitate detailed evaluation of cap conditions at and in the vicinity of location D-21:

- Addition of four supplemental locations adjacent to location D-21
- At all locations in Zone 1 of cap model area D-East, in which location D-21 is located, collection of solid phase and porewater samples and analysis for the full list of chemical groups throughout the cap profile as well as from the underlying sediments.

Additional monitoring in 2024 was conducted in Outboard Area East, where all five locations were sampled for the full list of chemical groups based on topsoil exceedances observed at the mouth of Harbor Brook, as discussed above. As noted above, the results from the 2024 cap monitoring program will be included in the next FYR.

<u>Surface Water Compliance Monitoring</u>

Surface water sampling was conducted in 2017 and 2018 and 2021-2022 for filtered (dissolved) and unfiltered (total) mercury, methylmercury, PCBs, and select VOCs/SVOCs (benzene, toluene, ethylbenzene, xylenes, chlorobenzenes, acenapthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, fluorene, naphthalene, phenanthrene, phenol, pyrene).

These results provide a basis for determining achievement of surface water performance goals which varies per chemical. For dissolved organic mercury, a value of 2.6 nanograms per liter (ng/L) or less is protective of wildlife and 0.7 ng/L or less is protective of human health via fish consumption. PCB concentrations in Onondaga Lake surface water samples that are protective of wildlife (0.12 ng/L or less) and of human health via fish consumption (0.001 ng/L or less) are also considered performance criteria. Consistent with the OLMMP, surface water samples were collected at ten littoral zone locations and two mid-lake locations (Attachment 1, Figures 25 to 27) at sample depths ranging from 0.33 to 6.6 feet prior to and after fall turnover each year.

As discussed in the previous FYR, 2017 and 2018 surface water sampling was conducted to assess compliance of performance goals. Benzene and chlorobenzene were detected at estimated concentrations of 0.2 micrograms per liter (µg/L) and 0.3 µg/L, respectively, at one location in RA- A in 2018. The surface water quality standard (SWQS) for benzene and chlorobenzene are 10 µg/L and 5 µg/L, respectively. Toluene was detected at one location in RAE in 2018 at an estimated concentration of 0.3 µg/L (SWQS of 100 µg/L). All of the other pre-turnover VOC/SVOC samples in 2017 and 2018 were nondetect. VOC and SVOC samples were not collected after fall turnover because all the pre-turnover results were below standards. As surface water criteria for SVOCs and VOCs were achieved in both 2017 and 2018, termination of further sampling and analysis was recommended, though further performance monitoring for mercury was requested by the NYSDEC due to the significance of mercury in the food chain.

Surface water samples for mercury were collected from 2017-2018 and 2021-2022. Detected levels of dissolved mercury at littoral and mid-lake locations were estimated from 0.08 to 0.37 ng/L in 2017 and from 0.12 to 0.40 ng/L in 2018. The levels were below dissolved mercury goals of 2.6 ng/L for the protection of wildlife and 0.7 ng/L for human health via fish consumption for both pre- and post- turnover events in 2017 and 2018. Total mercury concentrations in surface water ranged from 0.43 ng/L to 2.29 ng/L in 2017 and from 0.43 ng/L to 2.88 ng/L in 2018. Methylmercury concentrations ranged from “nondetect” to 0.21 ng/L in 2017 and from “nondetect” to 0.15 ng/L in 2018. Although the mercury surface water goals were met in 2017 and 2018, water samples were also collected in 2021 for total mercury, dissolved mercury and methylmercury analysis. In 2021, dissolved mercury concentrations at all locations were below the goal of 2.6 ng/L for the protection of wildlife for both pre- and post-turnover events. Additionally, all post-turnover dissolved mercury results were below the goal of 0.7 ng/L for human health via fish consumption. Pre-turnover dissolved mercury results ranged from 0.63 to 1.68 ng/L, with results from seven of 12 locations exceeding the 0.7 ng/L goal. However, accuracy of the results were in question due to mercury contamination in the laboratory and, therefore, mercury monitoring was conducted again in 2022. Results from 2022 pre-turnover sampling events showed that dissolved mercury concentrations in surface water were below the 0.7 ng/L goal, with results ranging from 0.15 to 0.53 ng/L. During post-turnover sampling conducted at the South Deep station as part of the Nitrate Addition Program, dissolved mercury concentrations were below the goal of 0.7 ng/L for human health via fish consumption, with results of 0.3 ng/L and 0.43 ng/L.

Additional lake mercury surface water monitoring was conducted as part of the nitrate addition program. Total mercury, dissolved mercury and methylmercury at water depths of 2 meters (epilimnion) and 16 meters (mid to lower hypolimnion) were analyzed in this FYR period. Concentrations of methylmercury in the hypolimnion were within barely detectable (e.g., typically less than 0.1 ng/L) ranges for all years. The sampling results through 2023 indicate that methylmercury was not significantly released from underlying sediment to lower hypolimnion waters during the summer when deep lake waters would be prone to methylmercury release in the absence of nitrate addition, which demonstrates that the nitrate addition continued to be effective through 2023.

From 2019 through 2023, the vast majority of dissolved mercury concentrations measured as part of the nitrate addition program were below the NYS SWQS. However, there have been sporadic low-level exceedances. In the 2-meter interval, dissolved mercury concentrations exceeded the NYS SWQS of 0.7 ng/L in two of ten samples in 2019 and five of 14 samples in 2020, and only one sample result exceeded the NYS SWQS of 2.6 ng/L in 2020. In the 16-meter interval, there were no exceedances of any performance criteria in 2019 and only one sample exceeded the NYS SWQS of 2.6 ng/L in 2020. Unusually elevated dissolved mercury concentrations in 2020 were accompanied by unacceptable field duplicate precision and other data validity concerns. As a result, it was determined that additional field duplicates will be collected in subsequent years and improvements in field procedures related to storage, cleaning, and pre-sample procedures were implemented in 2021 to reduce the potential for field contamination. Subsequent to these improvements, the following exceedances were observed from 2021 through 2023:

- In the 2-meter interval, dissolved mercury concentrations exceeded the NYS SWQS of 0.7 ng/L for protection of human health via fish consumption in four of 40 samples, and none exceeded the NYS SWQS of 2.6 ng/L for the protection of wildlife.
- In the 16-meter interval, dissolved mercury concentrations exceeded the NYS SWQS of 0.7 ng/L for protection of human health via fish consumption in two of 19 samples, and none exceeded the NYS SWQS of 2.6 ng/L for the protection of wildlife.

Surface water sampling for mercury (including dissolved mercury and methylmercury) will continue as part of the nitrate addition program.

During this FYR, PCB concentrations exceeded both the criteria for protection of wildlife (0.12 ng/L) and the protection of human health (0.001 ng/L). However, in-lake average PCB concentrations were generally lower than averages documented in tributaries. Total PCBs were evaluated during pre- and post-turnover events in both 2017 and 2018 at all specified littoral and mid-lake locations using a congener-based approach to achieve low detection limits. Total PCBs averaged 1.15 and 1.45 ng/L during pre- and post-turnover events in 2017. Similarly, total PCBs averaged 0.69 and 1.20 ng/L, respectively, during pre- and post-turnover events in 2018. Concentrations were generally lower in 2018 than those observed in 2017. The detected concentrations are above both the criteria for the protection of wildlife (0.12 ng/L) and the protection of human health via fish consumption (0.001 ng/L). The highest total PCB concentrations observed in the lake during the 2017 pre-turnover period and both the 2018 pre- and post-turnover periods occurred at the monitoring location that is closest to the Ley Creek outlet to the lake (SW-03). In 2021, grab samples were collected in the four major tributaries (Onondaga Creek, Ninemile Creek, Ley Creek and Harbor Brook) during low flow, standard flow, and high flow. Minor tributaries such as Bloody Brook, Sawmill Creek and Tributary 5A were only sampled during the first standard flow and high flow sampling events. Total PCBs were generally higher in Ley Creek than in other tributaries (see Attachment 1, Figure 28). Ley Creek is a current PCB source to surface water in Onondaga Lake. While some IRM and remedial actions addressing PCB sources located adjacent to Ley Creek have been conducted at two of the subsites and a portion of another subsite (see Attachment 2), remediation of the Creek itself has not yet been implemented. Ley Creek is the most significant current contributor of total PCBs to the Lake. It is anticipated that the concentrations in Ley Creek will be reduced after remediation.

Potential historic PCB impacts to Onondaga Lake from Honeywell-related sites have been previously addressed. As indicated in the Onondaga Lake ROD (NYSDEC and USEPA 2005), PCBs were not as widespread in sediments within the Lake compared to mercury, and were found primarily in a few specific areas (e.g., SMUs 1, 2, 6, and 7). These areas were remediated through dredging and capping operations. The ILWD, which was identified in the ROD as a source of PCBs to Onondaga Lake, has been addressed by dredging and capping in SMU 1 and SMU 2.

At least one additional surface water sampling event for select CPOI's is expected to be completed at the compliance surface water sampling locations during the next FYR period.

The Onondaga Lake ROD lists calcite and ionic waste constituents as CPOIs. Stressors of concern include calcium, chloride, salinity, ammonia, nitrite, phosphorus, sulfide, dissolved oxygen and transparency. These stressors were routinely monitored by Onondaga County in both the tributaries and deep portions of the lake as part of the Ambient Monitoring Program for a 20-year period ending in 2018. As noted in the AMP reports from 2017 through 2018, the high concentrations of total dissolved solids (TDS) in Onondaga Lake, which include concentrations of cations and anions (calcium, chloride, sodium, sulfate and others) are primarily associated with the natural hydrogeology of the lake and not with anthropogenic effects.

<u>Monitored Natural Recovery</u>

The 2017 routine monitoring results described in the previous FYR period indicated that the MNR goals were likely met, which triggered two consecutive years of compliance monitoring which occurred in 2021 and 2022. To assess the achievement of MNR goals and compliance with mercury PEC and BSQV criteria, shallow sediment cores were collected at 49 locations from the profundal zone during this FYR period in both 2021 and 2022 (see Attachment 1, Figures 21 and 22, and Tables 5.1 and 5.2). Shallow sediments were also collected from the littoral zone. Mercury data from 2021-2022 are summarized below. The MNR goal is to achieve a mercury PEC of 2.2 mg/kg or lower on a point-by-point basis in the profundal zone at 0-to-4-centimeter (cm) depth and a mercury BSQV of 0.8 mg/kg or lower on an area-wide basis in each of the five subareas (see Attachment 1, Figures 23 and 24). Mercury concentrations were measured in the surface (0 to 4 cm) and subsurface (4 to 10 cm) sediments throughout SMU 8. All mercury concentrations during this FYR period were below the mercury PEC of 2.2 mg/kg on a point-by-point basis in the profundal zone for the 0 to 4 cm sampling interval. Additionally, all mercury concentrations measured in 2021 and 2022 from SMU 8 were below the mercury PEC for the 4 to 10 cm interval.

During this FYR period, the sediment mercury SWACs were less than the mercury BSQV of 0.8 mg/kg in all five subareas of Onondaga Lake (Attachment 1, Table 6.1 for 2021 SWACs and Table 6.2 for 2022 SWACs). The lowest SWAC observed in 2021 was from the mouth of the Ninemile Creek subarea (0.32 mg/kg) and the highest was in the North Basin (0.64 mg/kg). The lowest SWAC in 2022 was in the South Corner subarea (0.39 mg/kg), and the highest was in the North Basin (0.67 mg/kg). In the littoral zone, sample locations that were used to calculate the SWACs in the Final Design were sampled in this FYR to verify that conditions have not changed significantly since the locations were previously sampled (during RI and PDI). Except for two locations, mercury concentrations measured in 2021 were consistent with or lower than previously measured concentrations. The two locations for which there were observed differences between the historical and 2021 data were S112 and S373, both of which are in the North Basin. These two locations were resampled in 2022. The data from this event were used for the 2022 SWAC calculations. The maximum mercury concentrations measured were at S112. These mercury concentrations were 1.9 mg/kg in 2021 and 2.6 mg/kg in 2022, which slightly exceeded the mercury PEC of 2.2 mg/kg. However, the resultant polygon for that station is only approximately 3% of the North Basin area, which has a calculated SWAC of 0.67 mg/kg, which is less than the BSQV. Mercury concentrations at S373 were 0.83 mg/kg in 2021 and 0.43 mg/kg in 2022, below the mercury PEC of 2.2 mg/kg. These mercury sampling results from the 2021 and 2022 compliance monitoring events confirmed that MNR-related remedial goals have been achieved. Therefore, no further MNR related monitoring was completed in 2023.

In addition to the collection of shallow cores and their analysis for mercury, monitoring to assess monitored natural recovery also included evaluations of the depth of mixing of surface sediments, sedimentation rates, and the concentrations of the settling particles. The performance criteria for MNR need to be met within the vertical interval of surface sediment that is relevant to potential exposures to benthic organisms. This vertical interval of sediment is referred to as the compliance depth. The appropriate compliance depth for the mean PECQ of 1, the mercury PEC, and the mercury BSQV in SMU 8 has been conservatively defined as the top 4 cm of sediment, which is consistent with results from the feasibility study (Parsons, 2004) and Appendix M of the Final Design Report (Parsons and Anchor QEA, 2012). Sediment traps were also used to evaluate sedimentation rates and mercury concentrations of the settling particles and were collected annually through 2022. Results from sediment trap monitoring conducted through 2022 indicate that sedimentation rates are higher than those assumed during the final design, and mercury concentrations on depositing particles are lower than the assumed value in the MNR modeling conducted during the final design. In 2022, the average deposition of suspended solids was 7,810 mg per square meter per day, which is higher than the 6,850 mg per square meter per day assumed in the Final Design (Parsons and Anchor QEA 2012). Additionally, mercury concentrations in sediment trap solids collected in 2022 ranged from 0.06 to 0.44 mg/kg, with a mean of 0.16 mg/kg, which is lower than the assumed post-remediation mercury concentration of 0.4 mg/kg used in the natural recovery modeling conducted during the Final Design. Average mercury concentrations in settling sediment since the completion of the remedy ranged from 0.16 mg/kg (2022) to 0.28 mg/kg (2020).

Mixing depth was monitored over the course of the MNR period. The sediment from 4 cm to 10 cm was also evaluated in order to provide further data in the event of mixing deeper than the 4 cm compliance depth. An estimate of the depth of mixing was determined from cores collected from the area of microbead placement during the oxygenated period. The most recent coring related to this was completed in 2021. The cores collected from the microbead plots were used to assess mixing depths. The presence of layers or laminations in the SMU 8 sediment is primary evidence that SMU 8 sediment is relatively undisturbed and not affected by bioturbation to depths greater than 4 cm or resuspension of lakebed sediment. Consistent with examinations completed in previous years, visual inspection of the cores collected in 2021 focused on the upper portion of the core. Based on the visual observations of laminations from the cores, mixing depths ranged from <0.1 cm to 3 cm in 17 of the 18 cores. There was one outlier with a mixing depth of 9.5 cm. The average mixing depth was approximately 2 cm, which is less than the mixing depth (4 cm) assumed in the MNR modeling conducted as part of the Final Design (Parsons and Anchor QEA, 2012). These results also verify that 4 cm is a conservative but appropriate compliance depth for evaluation of achievement of MNR goals.

Based on SMU 8 sediment sampling results from the 2021 and 2022 compliance monitoring events and an evaluation of the comprehensive data set through 2022, natural recovery of SMU 8 sediments is progressing faster than anticipated based on projections completed as part of the Final Design. SMU 8 sediments met the mercury PEC on a point-by-point basis and the mercury BSQV on a SWAC basis during both the 2021 and 2022 compliance monitoring events, verifying that MNR sediment-based remedial goals have been achieved and further routine sampling in SMU 8 is no longer needed. Therefore, routine monitoring related to MNR has ended. In the event that increased sediment mixing is observed in the future, consideration of additional data collection and/or analyses to confirm MNR goals continue to be met would be evaluated. Additionally, periodic sampling may be conducted in support of future Five-Year Reviews.

<u>Mercury Methylation in the Hypolimnion</u>

Full-scale nitrate addition has been conducted annually since 2014, following the completion of the three-year pilot study from 2011 through 2013. Nitrate addition was effective in maintaining nitrate concentrations in the hypolimnion at or above the goal of 1 mg/L from 2019 through 2023, thereby limiting accumulations of methylmercury in hypolimnion waters (Attachment 1, Figure 33). Surface water samples were collected each year during this FYR period and samples were analyzed for total mercury, methylmercury, and forms of nitrogen (i.e., nitrate, nitrite and ammonia).

During this FYR period, methylmercury release from underlying sediment to lower hypolimnion water has been mitigated. Maximum concentrations observed in the lower waters of the lake in 2023 were 0.16 ng/L for methylmercury and 2.00 ng/L for total mercury and relative to past years, total mercury concentrations were not elevated late in the season (*e.g.,* peaks of 11.4 ng/L in 2014, 5.9 ng/L in 2015, 5.09 ng/L in 2016, 3.34 ng/L in 2017, 3.58 in 2018, 5.11 in 2019, 10.8 ng/L in 2020, 3.08 in 2021, and 5.20 ng/L in 2022). Similar to what has been seen in previous years, higher mercury concentrations during fall may be caused by wind-driven resuspension of sediments. Methylmercury concentrations at the deepest water depth sampled (18 meters) remained low in 2023 ranging from 0.022 ng/L (which is the method reporting limit) to 0.12 ng/L (Attachment 1, Figure 32). Nitrate addition has been effective in inhibiting the release of methylmercury from sediment into the deep-water portions of the lake, resulting in lower concentrations of methylmercury in lake water and zooplankton.

To evaluate potential adverse effects of adding the calcium nitrate solution to the bottom waters of the lake, nitrite-nitrogen concentrations have been measured in Onondaga Lake from 2006 through 2023 and compared to the NYSDEC SWQS (100 µg/L as nitrogen, which equates to a level known to be protective of warm water fish from the effects of nitrite). Nitrite concentrations of all samples collected from the lower water depths of 12 m, 16 m, and 18 m during the period of nitrate addition in 2023 were below the SWQS of 100 µg/L. The only exceedance at these deeper depths in 2023 was at a depth of 12 m in early June prior to the start of nitrate addition. Exceedances of the SWQS for nitrite have occurred historically (prior to nitrate addition) in the lower waters of the lake during early summer. Elevated nitrite concentrations during these periods were caused by incomplete nitrification of ammonia. Therefore, the data do not indicate any adverse effects in the lower waters from nitrate addition. Although the nitrate solution is applied in the lower waters, samples have also been collected from near the surface at a depth of 2 m. With the exception of a period in late June/early July (with nitrite concentrations ranging from 108 to 161 µg/L), nitrite concentrations of all samples collected from the 2-m depth in 2023 were below the SWQS of 100 µg/L. Observations of elevated nitrite at the 2-m depth have not occurred since 2006. The epilimnion of Onondaga Lake is well-oxygenated and alkaline, precluding incomplete nitrification as a factor in the elevation of nitrite at the 2-m depth. This, coupled with a steady decline in nitrite concentrations as nitrate applications continued suggests an external source of nitrite (unrelated to the nitrate addition) during early summer of 2023. To date, significant adverse effects on water quality or growth of algae in the lake have not been observed as a result of the application of nitrate to Onondaga Lake.

Zooplankton samples have been collected from the south deep location and analyzed for total mercury and methylmercury (Figure 29). Although there are no remedial performance criteria for zooplankton, analysis of mercury and methylmercury concentrations provides a measure of change in potential exposure to fish that eat zooplankton and aids in the understanding of mercury cycling. During this review period, zooplankton samples were collected 17 times each year. Analysis of methylmercury was prioritized when zooplankton mass was insufficient to conduct both total mercury and methylmercury analyses, which was the case for nine of the samples in 2023. The zooplankton community was generally dominated by smaller taxa, including *Bosmina.* Large bodied *Daphnia* spp., an important fish prey species, were not observed in sufficient quantities to support targeted sampling during this review period and were not analyzed for mercury. Total mercury concentrations measured in all zooplankton collected from 2019 to 2023 ranged from 0.000174 mg/kg (non-detect) to 0.189 mg/kg. Methylmercury, a more bioaccumulative and toxic form of mercury, has consistently comprised a very low percentage of the total mercury present. Additionally, methylmercury concentrations observed in zooplankton from 2019 to 2023 ranged from 0.00001 mg/kg to 0.024 mg/kg. Peak methylmercury concentrations in zooplankton spiked when nitrate was depleted from the hypolimnion in 2009 and have remained relatively low since nitrate addition began (Figure 34). Despite the lack of sufficient zooplankton biomass, total mercury concentrations have primarily decreased in zooplankton since nitrate addition began in 2011. With the exception of a single anomalously high value in 2022, methylmercury concentrations in zooplankton have remained consistently low from the first year of nitrate addition through 2023 (Figure 35). The anomalously high methylmercury result observed in 2022 was determined to be an erroneous result because the reported methylmercury concentration was greater than the total mercury concentration, which is not possible. The next highest methylmercury concentration reported in 2022 was consistent with peak concentrations observed in previous years.

Nitrate addition has achieved the goal concentration of 1 mg/L nitrate in the hypolimnion since 2011 (see Figure 31). As illustrated in Figures 32 and 33, methylmercury concentrations and total methylmercury mass declined considerably in the lake's hypolimnion since 2011. Low methylmercury concentrations in Onondaga Lake since 2011 are consistent with the higher nitrate concentrations.

Sediment Consolidation Area (SCA)

Quarterly monitoring data is collected during post-closure operations and analyzed in accordance with the approved Revised Environmental Monitoring Plan (EMP). The EMP details the tailored statistical approach used to compare operational and closure phase data to baseline data using tracer constituents (constituents that show the greatest statistical difference between the surrounding Wastebed 13 groundwater and dredged material placed in the SCA). Tracer constituents include ethylbenzene, toulene, and total xylenes. Groundwater, surface water, and leachate samples were analyzed for baseline parameters including VOCs, metals, and other parameters listed in the 6 NYCRR Part 360-2 Baseline parameters. Tracer compound analytical results indicate that, since the SCA closure was completed, the cover and liner systems have remained effective at mitigating potential breaches affecting local groundwater and surface water quality.

Fish Tissue

Both Honeywell and NYSDEC have collected fish over the time frames prior to, during and subsequent to implementation of remedial activities, although they typically sample different species, with NYSDEC concentrating on Largemouth Bass, and other species being less consistently collected. For the fish tissue data reporting, both the Honeywell data sets from 2008 to 2022 (fillets of Smallmouth Bass [*Micropterus dolomieu*], Walleye [*Sander vitreus*], Common Carp [*Cyprinus carpio*] and Pumpkinseed [*Lepomis gibbosus*] and whole-body small and large prey fish) and NYSDEC data sets from 2008 to 2023 (Largemouth Bass, Carp, Yellow Perch [*Perca flavescens*], White Perch [*Morone americana*], and Channel Catfish [*Ictalurus punctatus*]) are used. Exceptions during this review period include: only Largemouth Bass were collected for NYSDEC fish tissue in Onondaga Lake from 2019 to 2023, and Honeywell fish tissue for 2019 and 2020 are not being used for graphical or statistical purposes due to laboratory QA/QC issues.

The discussion of fish tissue monitoring results below generally focuses on the 2019 to 2023 monitoring period for the NYSDEC data set and 2021 and 2022 for the Honeywell data set (due to unusable Honeywell data for 2019 and 2020 because of laboratory QA/QC issues). This period follows that which was covered in the second FYR report (data through 2018). Honeywell fish tissue data for 2023 were not available at the time of this review and will be included in future reviews. Fish tissue monitoring conducted by Honeywell from 2021 to 2022 was implemented consistent with the final version of the OLMMP (Parsons and Anchor QEA, 2018a). Data for the prior years, including the baseline monitoring period, are also discussed to some extent, particularly when considering potential trends in contaminant concentrations. The figures referenced in the discussion below can be found in Attachment 3 along with a general description of the fish tissue monitoring program since 2008 and a summary of the data sets used in this assessment.

Potential human health exposures associated with fish consumption are evaluated based on adult sport fish species selected to cover a range of trophic levels including top level piscivores (Smallmouth Bass, Walleye), invertivores (Pumpkinseed), and benthic herbivores (Common Carp)[15]. A total of 25 individual fish for each of the four adult sport fish species were targeted for collection each year during the 2021-2022 period for a total of up to 100 adult sport fish samples. The actual numbers of fish samples by species collected by Honeywell between 2008 and 2022 are presented in Table 1 of Attachment 3. Approximate Honeywell fish tissue sampling locations are provided on Figure 29 in Attachment 1.

For ecological exposure, the fish were grouped into two size classes: small (3 to 18 cm) and large (18 to 60 cm) consistent with the Onondaga Lake BERA (TAMS, 2002). Small prey fish composite samples collected by Honeywell, each consisting of a single species, were comprised of approximately 10 to 15 small prey fish per sample, depending on individual weights, consistent with prior sampling. The target species of small prey fish for composites were Banded Killifish and Round Goby, consistent with baseline monitoring, but may vary based on availability at the time of collection. For the small prey fish, three composite samples were targeted for collection at each of eight locations (Figure 29) for a total of 24 samples in 2021 and 2022.

Prior to 2020, only White Sucker were collected to represent the large prey fish. Due to fluctuations in relative abundance, Shorthead Redhorse *(Moxostoma macrolepidotum)* were added to the 2020 Scope Memorandum. A total of 24 large prey fish were collected in 2021, including 16 White Sucker and eight Shorthead Redhorse within eight locations (see Figure 29). In 2022, the 24 large prey fish consisted of 14 White Sucker and ten Shorthead Redhorse. The large prey fish were analyzed as individuals on a whole-body basis.

Sport and prey fish were collected using the same methods that were successfully used from 2008 through 2018, including nighttime electrofishing, gill netting, trap netting, and seining (Parsons, 2018a).

Due to laboratory fish homogenization issues in 2019 and 2020, it was mutually agreed by NYSDEC and Honeywell to perform analysis of all analytes as specified in the OLMMP for both 2021 and 2022. This included mercury, PCBs, hexachlorobenzene, dioxins/furans (12 samples/species), lipids, and percent moisture for sport fish and mercury, PCBs, hexachlorobenzene, DDT/metabolites, lipids, and moisture for all prey fish. Sport fish samples were analyzed as NYSDEC standard fillets, consistent with NYSDEC's fish preparation procedures for contaminant analysis (NYSDEC, 2014). The large and small prey fish were analyzed as whole body and whole body composites, respectively.

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[15] From 2008-2014, Brown Bullhead was one the four sport fish species included in the Honeywell monitoring program. In 2014, Common Carp, was also collected at the request of NYSDEC. In 2015, Brown Bullhead was dropped from the program and replaced by Common Carp.

To supplement the small and large prey fish data, site-specific whole-body concentrations were estimated based on the fillet samples from that size class and the fillet to whole-body conversion factors (0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) from the Onondaga Lake BERA (Section 8.2.6.4). These conversion factors may be reassessed with new data in the future, if appropriate.

During the 2019 to 2023 period, NYSDEC collected Largemouth Bass in Onondaga Lake: 2019 (50 samples), 2020 (38 samples), 2021 (40 samples), 2022 (33 samples), and 2023 (39 samples); additionally, this period did not include Yellow Perch (found in past years data sets). Analyses were conducted for mercury, PCBs, DDT, hexachlorobenzene, and lipids on all samples. The number of samples and species collected by NYSDEC between 2008 and 2023 is presented in Table 2 of Attachment 3.

The data in the figures for Sets 1, 2, and 3 (in Attachment 3) represent results for sport fish (both Honeywell and NYSDEC data), small prey fish (Honeywell data), and large prey fish (Honeywell data), respectively. These data are presented in the figures as box-and-whisker plots, which include the 95% upper confidence limit (UCL) values, as well as individual data points showing the full distribution of results. The results in these figures are compared with human health (fillet data in Set 1 figures) or ecological-based performance criteria or targets (whole-body concentrations for small prey fish in the Set 2 figures and for large prey fish in the Set 3 figures) for fish tissue as presented in Table 9 (Attachment 1), where applicable.

The discussion of the fish data presented below focuses on mean and 95% UCL values and the figures included in Attachment 3 present the full range of concentrations. For annual data sets for a contaminant where the 95% UCL value in a species is less than the goal (for mercury) or target concentration (for organics) but the maximum value (as presented in the box-and-whisker plots) is greater than the goal or target, the text below includes a discussion of the number (and percentage) of samples that exceed the goal or target.

Annual fish tissue arithmetic mean and 95% UCL contaminant concentrations for each species collected by Honeywell for the 2015-2022 (except 2019-2020) period for sport fish fillet data, prey fish whole-body data, and calculated whole-body concentrations based on the sport fish fillet data are presented in Attachment 3 Tables 3a, 3b, and 3c, respectively. Annual fish tissue mean and 95% UCL contaminant concentrations for the NYSDEC sport fish fillet data for Largemouth Bass for 2015-2023, and calculated whole-body concentrations based on the NYSDEC fillet data are presented in Attachment 3 Tables 4a and 4b, respectively.

For information on the potential impact of remediation on contaminant concentrations in fish tissue (as opposed to the risk to consumers of fish), the changes in concentration over time are reported. In these figures (Set 4 in Attachment 3), the data are presented in a way that controls factors which may influence the wet-weight concentrations but are independent of any exposure to the site-related contamination. This reduces the variability (*e.g.,* noise) in the data. For mercury, the variability due to fish age is corrected by using length as a surrogate for age. The wet-weight mercury concentration of each individual fish is adjusted by dividing the concentration (in mg/kg) by its length (in millimeters [mm]), providing a concentration as mg/kg per mm. For the organic contaminants, the amount of lipid in the fish has a major influence on the wet-weight concentrations (Sloan et al., 2002). For PCBs, dioxin/furans, DDTs, and hexachlorobenzene, the wet-weight concentrations for each individual fish are adjusted by dividing the concentration by its lipid content, providing a lipid-normalized concentration (*e.g.,* mg PCBs/kg lipid). The data in Set 4 are presented as means plus and minus two standard errors, which provide an estimate of upper and lower confidence limits.

The data for Sets 1, 2, 3 and 4 are discussed, below.

SPORT FISH (SET 1)

Honeywell Data

Mercury

Mercury concentrations in all sport fish species have generally declined since completion of dredging and capping in 2016. Smallmouth Bass, Walleye, Common Carp and Pumpkinseed concentrations for mercury on a wet-weight basis are depicted on Set 1, Figures 1 to 4.

Smallmouth Bass (arithmetic mean of 0.79 mg/kg wet weight [ww] in 2022 and 95% upper confidence limit [UCL][16] of 0.89 mg/kg ww in 2022) and Walleye (mean of 0.83 mg/kg ww in 2022 and 95% UCL of 0.96 mg/kg ww in 2022) mercury concentrations remain well above the human-health-based Remedial Goals (RGs) of 0.2 and 0.3 mg/kg ww. Smallmouth Bass and Walleye are longer-lived, higher trophic level species that take longer to respond to the effects of the remedy.

Mercury concentrations in Common Carp show a decline since initial sampling in 2014, with a 2022 arithmetic mean of 0.14 mg/kg ww and 95% UCL of 0.17 mg/kg ww, below the RGs. Mean concentrations in Common Carp have been below the human-health-based RG of 0.3 mg/kg ww since 2014, and below the human-health-based RG of 0.2 mg/kg ww in 2017-2022. In 2016 and 2017, the 95% UCL values were below the human-health-based RG of 0.3 mg/kg ww but above the human-health-based RG of 0.2 mg/kg ww. The 95% UCL values in 2018, 2021 and 2022 fell below the lower RG of 0.2 mg/kg. In 2021 and 2022, mercury concentrations in Common Carp were above the RG of 0.3 mg/kg ww in three of 25 (12%) and two of 25 (8%) samples, and above the RG of 0.2 mg/kg ww in five of 25 (20%) and eight of 25 (32%) samples, respectively.

Mean concentrations in Pumpkinseed on a wet-weight basis were elevated in 2015 relative to 2014, but have generally decreased from 2015 to 2022 with a 2022 mean of 0.13 mg/kg ww and a 95% UCL of 0.16 mg/kg ww. Mean mercury concentrations in Pumpkinseed have been below the 0.3 mg/kg ww RG since 2010 and below the 0.2 mg/kg ww RG since 2016. The 95% UCLs have been below the lower RG of 0.2 mg/kg since 2018. In 2021, the mercury 95% UCL was below the 0.2 mg/kg ww RG and there were five of 25 (20%) Pumpkinseed samples that were above the 0.2 mg/kg ww RG; none of the 2021 samples were above the 0.3 mg/kg ww RG. In 2022, the mercury 95% UCL was below the 0.3 mg/kg ww RG and the 0.2 mg/kg ww RG and there were two of 25 (8%) and three of 25 (12%) Pumpkinseed samples that were above the 0.3 mg/kg ww RG and the 0.2 mg/kg ww RG, respectively.

[16] The 95% UCL is an estimate of the upper bound for the true population mean.

PCBs

Sport fish PCB concentrations on a wet-weight basis are depicted on Set 1, Figures 5 to 8. PCB 2021 and 2022 arithmetic mean concentrations in Smallmouth Bass (0.23 mg/kg ww in 2021 and 0.20 mg/kg ww in 2022) are lower compared to mean PCB concentrations in 2014 (1.38 mg/kg ww), 2015 (1.91 mg/kg ww), 2016 (1.20 mg/kg ww), 2017 (0.50 mg/kg ww), and 2018 (0.47 mg/kg ww). Similarly, 2021 and 2022 mean PCB concentrations in Walleye (0.35 mg/kg ww in 2021 and 0.30 mg/kg ww in 2022) are lower compared to mean PCB concentrations in 2014 (2.21 mg/kg ww), 2015 (3.82 mg/kg ww), 2016 (2.51 mg/kg ww), 2017 (0.74 mg/kg ww), and 2018 (0.96 mg/kg ww). Although the 95% UCL PCB levels for the Smallmouth Bass and Walleye remained well above human-health-based targets (0.3 mg/kg ww cancer-based target and 0.04 mg/kg ww noncancer-based target) during the earlier portion of the 2014 to 2022 monitoring period, these concentrations have declined to levels well below the baseline (pre-remedy) period.

Although there were declines in the mean and 95% UCL values for PCBs in 2021/2022 Smallmouth Bass and Walleye compared to data through 2018, it should be noted that there was a change in lab and extraction procedures for the 2021/2022 analyses. As noted in the 2021 and 2022 annual reports, the fish data from 2021/2022 for all analytes were determined to be valid and usable during data validation. For some analytes such as PCBs, there were many samples qualified as "possibly biased low" due to low recovery in standard (certified) reference materials. In addition, NYSDEC has indicated that results for PCBs and lipids are potentially biased low based on split samples analyzed at NYSDEC labs. Therefore, NYSDEC and Honeywell are evaluating potential modifications of extraction/analytical methods for future PCB and lipids analysis. If modifications are determined to be necessary, updates to the QAPP will be prepared. In addition, NYSDEC and Honeywell are currently exploring options for applying estimation factors to the PCB and lipid results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the revised estimated concentrations (including statistics and figures) will be documented and discussed in an addendum to this FYR.

PCB concentrations in Common Carp (Set 1 Figure 7) were considerably lower in 2017 and 2018 relative to 2015 and 2016, and roughly the same in 2018, 2021, and 2022. The 2021 Common Carp 95% UCL (0.26 mg/kg ww) was below the 0.3 mg/kg ww cancer-based target, but above the 0.04 mg/kg ww noncancer-based target. However, the 95% UCL in Common Carp in 2022 (0.46 mg/kg ww) remained above the 0.3 mg/kg ww cancer-based target.

PCB concentrations in Pumpkinseed (Set 1 Figure 8) show no discernable trend on a wet-weight basis from 2014 through 2018, with lower concentrations in 2021 and 2022. In 2021 and 2022, the 95% UCL (0.021 mg/kg ww in 2021, 0.061 mg/kg ww in 2022) PCB levels for Pumpkinseed were below the 0.3 mg/kg ww cancer-based target and the 95% UCL in 2021 was below the 0.04 mg/kg ww noncancer-based target. PCB concentrations exceeded the 0.04 mg/kg ww noncancer-based target in one of 25 (4%) Pumpkinseed samples in 2021 and in four of 25 (16%) samples in 2022.

These comparisons to the PCB target concentrations will be reassessed, as needed, following potential application of estimation factors on the 2021 and 2022 data.

Dioxins/Furans

Wet-weight concentrations of dioxins and furans (evaluated as Toxic Equivalents [TEQs]) in sport fish are depicted on Set 1, Figures 9 to 12.

Dioxins and furans (evaluated as TEQs) in Smallmouth Bass and Walleye have, in general, declined in concentration since baseline. In 2022, the arithmetic mean and 95% UCL TEQs for Smallmouth Bass were 0.81 ng/kg ww and 1.0 ng/kg ww, respectively. In 2022, the mean and 95% UCL TEQs for Walleye were 0.64 ng/kg ww and 0.74 ng/kg ww, respectively. These levels for Smallmouth Bass and Walleye are below both the 4 ng/kg ww cancer-based target and the 1.3 ng/kg ww noncancer-based target. The 2021 mean and 95% UCL TEQs for Smallmouth Bass and Walleye were also below both targets. For Smallmouth Bass and Walleye, the 95% UCL values were below the 4 ng/kg ww cancer-based target but above the 1.3 ng/kg ww noncancer-based target from 2014 through 2018. In 2021, none of the 12 Smallmouth Bass samples exceeded the cancer and non-cancer based targets. In 2022, one of the 12 Smallmouth Bass samples (8%) exceeded the 1.3 ng/kg ww noncancer-based target. For Walleye, none of the 2021 or 2022 samples exceeded the cancer and non-cancer based targets.

Dioxin and furan TEQ concentrations in Common Carp (Set 1 Figure 11) have declined since 2014 (when this species was first sampled since the RI). In 2015 and 2017, the mean and 95% UCL TEQs in Common Carp were above the 4 ng/kg ww cancer-based target. In 2018, the mean and 95% UCL TEQs in Common Carp were 1.1 ng/kg ww and 3.2 ng/kg ww, respectively. In 2021, the mean and 95% UCL TEQs in Common Carp were 1.0 ng/kg ww and 1.4 ng/kg ww, respectively. In 2022, the mean and 95% UCL TEQs in Common Carp were 1.5 ng/kg ww and 5.3 ng/kg ww, respectively, with the 95% UCL exceeding the higher target. The 2018 and 2021 95% UCL TEQs in Carp are below the 4 ng/kg ww cancer-based target, but above the 1.3 ng/kg ww noncancer-based target. In 2021, there were four of 12 (33%) Common Carp samples at or above the 1.3 ng/kg ww noncancer-based target, though none exceeded the 4 ng/kg ww cancer-based target. In 2022, one of 12 (8%) Common Carp samples exceeded the 4 ng/kg ww cancer-based target and three of 12 (25%) Common Carp samples were at or above the 1.3 ng/kg ww noncancer-based target.

Dioxin and furan TEQ concentrations in Pumpkinseed have remained relatively unchanged since 2008, although significantly lower than other species. As shown in Set 1 Figure 12, TEQ concentrations in all Pumpkinseed samples have been below both human-health-based targets.

Hexachlorobenzene

Sport fish hexachlorobenzene concentrations on a wet-weight basis are depicted on Set 1, Figures 13 to 16. Detected mean and 95% UCL concentrations in all sport fish were lower in 2021 and 2022 relative to prior years. Hexachlorobenzene concentrations have a low frequency of detection in most samples analyzed since 2017 (see Attachment 3, Table 3a). No human health-based goals or targets for hexachlorobenzene were identified in the ROD.

NYSDEC Data

The discussion below focuses on Largemouth Bass sampled by NYSDEC in Onondaga Lake since 2015. The figures referenced below are included in Attachment 3.

Mercury

Mercury concentrations in Largemouth Bass fillet samples since 2015 are generally lower than pre-remediation (baseline) concentrations prior to 2012 (see Set 1, DEC Figure 1). Mean and 95% UCL values in Largemouth Bass have remained relatively constant since 2015 with no discernable trend. 95% UCL concentrations in the post-construction period through 2023 have ranged from about 0.7 mg/kg ww to 1.0 mg/kg ww, well above the human-health-based RGs of 0.2 and 0.3 mg/kg ww for Largemouth Bass. As noted above for Smallmouth Bass and Walleye, Largemouth Bass is also a longer-lived, higher trophic level species that takes longer to respond to the effects of the remedy.

PCBs

PCB concentrations in Largemouth Bass fillets are depicted in Set 1, DEC Figure 2. Although mean and 95% UCL PCB concentrations in Largemouth Bass in 2020 to 2023 are lower than in most years prior to commencement of remediation (with the exception of 2009 and 2010), there is no discernable trend since 2015. All PCB mean and 95% UCL concentrations in Largemouth Bass through 2023 continue to exceed both the 0.3 mg/kg ww cancer-based target and the 0.04 mg/kg ww noncancer-based target.

DDT

DDT concentrations in Largemouth Bass fillets are depicted in Set 1, DEC Figure 3. Similar to PCBs, although mean and 95% UCL DDT concentrations in Largemouth Bass in recent years are lower than in most years prior to commencement of remediation (with the exception of 2009 and 2010), there is no discernable trend since 2015, although concentrations typically remained below 0.05 mg/kg ww. No human-health-based targets for DDTs were identified in the ROD.

Hexachlorobenzene

Hexachlorobenzene concentrations in Largemouth Bass fillets are depicted in Set 1, DEC Figure 4. Mean and 95% UCL hexachlorobenzene concentrations in Largemouth Bass in recent years are lower than in the years prior to commencement of remediation, with only a limited number of detections in 2016 (8 of 55 samples) and no detections in 2017 to 2023 (33 to 50 samples each year). No human health-based targets for hexachlorobenzene were identified in the ROD.

SMALL PREY FISH (SET 2)

Honeywell Data

Contaminant concentrations in small prey fish (*e.g.,* Banded Killifish and Round Goby) were collected under the Honeywell monitoring program through 2022 and are summarized in Attachment 3 Table 3b and presented in Set 2 Figures 1 to 4. These data were evaluated via comparison to Ecological Performance Criteria and targets, which are presented in the Set 2 figures. In addition to the collected small prey fish, this category of samples also includes small Pumpkinseed (30-180 mm) from the Honeywell mercury, PCB, and hexachlorobenzene fillet data adjusted to provide an estimate of the whole-body concentrations (based on the site specific fillet to whole-body conversion factors used in the BERA) (Attachment 3 Table 3c).

Mercury

On a lake-wide basis, mercury wet-weight concentrations in small prey fish are generally lower for the 2021 to 2022 period relative to prior years. The 2021 mean (0.07 mg/kg ww) and 95% UCL (0.08 mg/kg ww), and the 2022 mean (0.06 mg/kg ww) and 95% UCL (0.07 mg/kg ww) were below the ecological-based RG of 0.14 mg/kg ww (see Set 2, Figure 1). Calculated mean and 95% UCL whole-body mercury concentrations in Small Pumpkinseed in 2021 and 2022 (Table 3c) were below the ecological-based RG.

PCBs

PCB wet-weight concentrations in small prey fish have generally declined since 2015 (see Set 2, Figure 2). In 2021, the small prey fish 95% UCL (0.20 mg/kg) was slightly above the ecological target of 0.19 mg/kg ww, whereas the mean (0.13 mg/kg ww) was below the target. In 2022, both the mean (0.051 mg/kg ww) and 95% UCL PCB levels (0.13 mg/kg ww) were below the ecological target. For each sampling year (2021 and 2022) the PCB concentrations exceeded the 0.19 mg/kg ww ecological target in three of 24 (12.5%) small prey fish samples that were all collected from the SMU 6 station near the mouth of Ley Creek. As shown on Set 2 Figure 2, concentrations in these samples from the SMU 6 station declined from 2021 to 2022. The elevated PCB concentrations in SMU 6 are likely attributed to ongoing PCB sources in Ley Creek, which enters Onondaga Lake at the north end of SMU 6 (Attachment 1, Figure 29). Calculated small Pumpkinseed whole-body mean and 95% UCL total PCB wet-weight concentrations are presented in Table 3c. Although the 95% UCL (0.06 mg/kg ww) was below the target (0.19 mg/kg) in 2021, the 95% UCL (0.20 mg/kg ww) in 2022 slightly exceeded the target. These comparisons to the PCB target concentrations will be reassessed, as needed, following potential application of estimation factors on the 2021 and 2022 data.

DDT and Metabolites

Concentrations of the sum of DDT and metabolites in small prey fish are generally low with respect to the ecological target and are relatively unchanged throughout the collection period (see Set 2, Figure 3). On a lake-wide basis, the mean and 95% UCL in 2021 and 2022 in small prey fish were less than 0.01 mg/kg ww, which is below the ecological target of 0.049 mg/kg ww for the sum of

DDT and metabolites. Maximum concentrations in each of these years were also less than the small prey fish target. The ecological target for small prey fish is based on protection of the belted kingfisher receptor at the LOAEL level.

<u>Hexachlorobenzene</u>

Mean and 95% UCL hexachlorobenzene concentrations in small prey fish (Set 2, Figure 4) and calculated Small Pumpkinseed whole-body hexachlorobenzene wet-weight concentrations (Table 3c) show no discernable trends over the collection period. Hexachlorobenzene was detected in 8 of 24 small prey fish samples each year during each sampling event in both 2021 and 2022 at concentrations near the method detection limit. There are no ecological targets for hexachlorobenzene in fish tissue.

LARGE PREY FISH (SET 3)

Larger prey fish collection was limited exclusively to White Sucker prior to 2020. Due to fluctuations in relative abundance, large prey fish collection in 2021 and 2022 consisted of a combination of White Sucker and Shorthead Redhorse. They were collected to assess exposure to larger wildlife which consume fish (*e.g.,* otter, great blue heron, osprey). Estimated or measured concentrations of whole fish in this size class (180 to 600 mm) are presented because they would also consume the entire fish. This category of samples includes multiple species to provide an assessment of this exposure, including whole-body samples of White Sucker and Shorthead Redhorse analyzed by Honeywell along with the four large sport fish (Smallmouth Bass, Walleye, Common Carp and Pumpkinseed) from the Honeywell data set and Largemouth Bass from the NYSDEC data set adjusted to provide an estimate of the whole-body concentrations (based on the site specific fillet to whole-body conversion factors used in the BERA). These data for the large prey fish (White Sucker and Shorthead Redhorse) are presented in Table 3b, and Set 3 Figures 1 to 4, and the calculated whole-body concentrations for the sport fish fillets are presented in Table 3c and discussed further below.

Honeywell Data

<u>Mercury</u>

For the large prey fish (Set 3, Figure 1), the mercury mean concentrations in 2021 (0.12 mg/kg ww) and 2022 (0.14 mg/kg ww) were either below or at the ecological-based RG (0.14 mg/kg). In 2021 and 2022, the 95% UCL values (0.16 mg/kg and 0.17 mg/kg, respectively) were above the ecological-based RG. In both 2021 and 2022, 8 of 24 (33.3%) samples were above the ecological RG of 0.14 mg/kg ww.

There are clear differences in the calculated whole-body mercury concentrations among species. The larger, higher trophic level, longer-lived fish (*e.g.,* Smallmouth Bass and Walleye) have higher concentrations than other species such as Pumpkinseed (Table 3c). Smallmouth Bass and Walleye calculated whole-body mercury concentrations (with 95% UCLs ranging from 0.54 to 0.67 mg/kg) during the 2021-2022 period are above the ecological goal of 0.14 mg/kg ww. The mercury 95% UCLs for calculated whole-body concentrations for Common Carp are at or below the RG in 2021 and 2022. The 95% UCL of the calculated whole-body mercury concentrations in large Pumpkinseed in 2022 (0.20 mg/kg ww) remained above the RG.

PCBs

Mean PCB wet-weight concentrations for large prey fish have declined since 2015 (Set 3, Figure 2) but increased in 2021 relative to 2018 and then declined in 2022. The 95% UCL values in 2021 (0.51 mg/kg ww) and 2022 (0.29 mg/kg ww) have also declined, although exceeded the ecological-based target (0.19 mg/kg ww). These comparisons to the PCB target concentrations will be reassessed, as needed, following potential application of estimation factors on the 2021 and 2022 data.

The larger, higher trophic level, longer-lived fish (*e.g.,* Smallmouth Bass and Walleye) have higher PCB concentrations than lower trophic level species. The calculated concentrations for both Smallmouth Bass and Walleye remained elevated relative to the ecological target of 0.19 mg/kg for PCBs (Table 3c). The calculated whole-body mean (0.26 mg/kg) and 95% UCL (0.35 mg/kg) PCB concentrations in Common Carp in 2021 are above the target of 0.19 mg/kg ww and consistent with the 2018 mean and UCL, though lower than the means and UCLs from 2015 to 2017. In 2022, the whole-body mean was higher at 0.68 mg/kg. No UCL could be calculated due to the small sample size.

DDT and Metabolites

Mean and 95% UCL concentrations of the sum of DDT and metabolites in large prey fish are relatively unchanged throughout the collection period through 2022 and are below the ecological target of 0.14 mg/kg ww (see Set 3, Figure 3). In 2021, the mean and 95% UCL concentrations for large prey were 0.03 mg/kg ww and 0.04 mg/kg ww, respectively. In 2022, the mean and 95% UCL concentrations for large prey were 0.02 mg/kg ww and 0.03 mg/kg ww, respectively. As DDT and metabolites are not analyzed in sport fish fillets, calculated whole-body concentrations are not included in Table 3c.

Hexachlorobenzene

Hexachlorobenzene concentrations in large prey samples are depicted in Set 3, Figure 4. There is no discernable pattern in hexachlorobenzene levels since monitoring for large prey commenced in 2014. Hexachlorobenzene was not detected in 14 of 24 and 23 of 24 White Sucker samples in 2017 and 2018, respectively. Concentrations in 2021 and 2022 were at or just above the method detection limit.

Whole-body hexachlorobenzene concentrations calculated from collected sport fish fillet data are summarized in Table 3c. The 2021 and 2022 levels are generally lower than previous years for Smallmouth Bass and Walleye. There is no discernable pattern in hexachlorobenzene levels in Common Carp and Pumpkinseed during the 2021-2022 monitoring period. The calculated concentrations of hexachlorobenzene in Common Carp were similar in both 2021 and 2022. All 2021 and 2022 large Pumpkinseed samples were non detect.

There are no ecological targets for hexachlorobenzene in fish tissue.

NYSDEC Data

As presented in Attachment 3 Table 4b, mean and 95% UCL calculated whole-body concentrations from the Largemouth Bass sport fish (fillet data) collected by NYSDEC through 2023 remain above the ecological-based goal for mercury in large prey fish (0.14 mg/kg) as well as the ecological-based target for PCBs (0.19 mg/kg), whereas concentrations of DDT and metabolites are below the ecological-based target (0.14 mg/kg). Hexachlorobenzene has not been detected since 2016.

ADDITIONAL REPORTING TO ASSESS POTENTIAL TRENDS AND LOCATION IMPACTS (SET 4)

The previous sections reported the concentrations in fish tissue as they would appear to the consumers of those fish as fillet or whole-body samples on a wet-weight basis. As discussed above and in Attachment 3, there are factors that will affect the concentrations of contaminants, causing increased variability that will make it more difficult to discern trends and understand the mechanisms influencing the results in the context of remedial success. These factors include the trophic level and age of fish for mercury, lipid content for organic contaminants, and location for species with limited home ranges. These factors are addressed in the data presented in the Set 4 figures in Attachment 3.

The first subset of figures presents mercury data normalized to fish length and organic contaminants (PCBs, dioxin/furan TEQs, DDTs, hexachlorobenzene) normalized to lipids for both sport fish and prey fish. As the normalized data are not compared to the goals (which are on a wet-weight basis) and all sport fish species for each contaminant are shown on one figure, the Honeywell data are presented as means plus and minus two standard errors rather than box-and-whisker plots to provide a simpler image.

The second subset of figures presents the data by sample location for localized small prey fish species collected by Honeywell (note, whole-body prey fish were not collected by NYSDEC). These figures show concentrations for the sediment management units (SMUs) from which the prey fish samples were collected. Note, Honeywell's fish sampling program did not include stations in SMU 1 prior to 2017.

Note, there are no SMU comparisons for Large Prey or Pumpkinseed in this FYR.

Honeywell Data

Mercury

Mercury concentrations in sport fish species have generally declined since baseline and completion of dredging and capping. The general trend is apparent in the length-normalized plots (Set 4, Subset 1, Figure 1). Mean length-normalized concentrations in Common Carp and Pumpkinseed were elevated in 2015 relative to 2014 but have generally decreased from 2015 to 2022. Mean length-normalized concentrations in Smallmouth Bass were also elevated in 2015 relative to 2014, and decreased from 2015 to 2017, with no discernable trend from 2017 to 2022. Mean length-normalized concentrations in Walleye have decreased from 2014 to 2018, with no discernable trend from 2018 to 2022.

Length-normalized mercury concentrations in small and large prey fish for all SMUs are depicted in Set 4, Subset 1, Figure 2. In small prey fish, length-normalized mercury concentrations were generally declining between 2014 and 2018 on a lake-wide basis. In large prey fish, length-normalized mercury concentrations declined from 2014 to 2016, and have remained low since then.

As shown in Set 4, Subset 2, Figure 1, mercury concentrations (as wet weight) in small prey fish have declined in all SMUs from the baseline period to during in-lake remediation to post remediation. In addition, mercury concentrations in the SMUs most impacted from historic Honeywell sources (SMUs 1 to 4 and SMU 7) have significantly declined such that concentrations in these SMUs in 2021 and 2022 are similar to the rest of the lake (SMUs 5 and 6).

PCBs

Lipid-normalized concentrations for total PCBs in sport fish are depicted on Set 4, Subset 1, Figures 3 and 4. Mean lipid-normalized PCB concentrations in Smallmouth Bass and Walleye are similar to each other and lower in 2021 and 2022 compared to prior years, and remained low in 2021 and 2022. Mean lipid-normalized PCB concentrations in Common Carp are similar to Pumpkinseed, and the lowest mean concentrations in both species were observed in the 2021 to 2022 period. Lipid-normalized concentrations for total PCBs in small and large prey fish are depicted on Set 4, Subset 1, Figures 5 and 6, respectively. Mean lipid-normalized concentrations for total PCBs in small prey fish were higher in 2015 relative to 2014 and declined from 2015 to 2018. The 2021 mean was higher than 2018 and similar to the 2016 mean, while the 2022 mean was lower and closer to the 2017 mean. These mean lipid-normalized PCB concentrations in small prey fish are impacted by the higher concentrations in the samples near Ley Creek. Lipid-normalized mean PCB concentrations for the large prey fish (White Sucker, with Shorthead Redhorse in 2021 and 2022) were elevated in 2015 and 2016 compared to 2014, but have declined since 2016 on a lipid-normalized basis. Mean lipid-normalized PCB concentrations in 2017 and 2018 were lower than the 2014 to 2016 levels, however, mean lipid-normalized PCB concentrations in 2021 and 2022 were closer to the 2014 levels. These higher lipid-normalized concentrations in 2021/2022, relative to 2017/2018, may be due to the inclusion of the Shorthead Redhorse in 2021/2022 which generally have higher concentrations than White Sucker. These analyses of the lipid-normalized PCBs data will be reassessed, as needed, following potential application of estimation factors on the 2021 and 2022 PCBs and lipids data.

As shown in Set 4, Subset 2, Figure 2, mean PCB concentrations (as wet weight) in small prey fish remain elevated in SMU 6 compared to other SMUs, as they have for most years. This condition may continue until remedial activities addressing PCBs in and adjacent to Ley Creek have been fully implemented since Ley Creek enters Onondaga Lake at the northern end of SMU 6. Concentrations in all other SMUs in recent years through 2022 are similar to one another and much lower than the baseline and remediation periods.

Dioxins/Furans

Lipid-normalized dioxins and furans (evaluated as TEQs) in sport fish on a lake-wide basis are depicted in Set 4, Subset 1, Figures 7 and 8. Lipid-normalized dioxins and furans (evaluated as TEQs) in Smallmouth Bass and Walleye have, in general, remained relatively unchanged during the 2014 to 2022 period, with concentrations significantly less than baseline (2008 to 2012). Lipid-normalized dioxins and furans (evaluated as TEQs) in Common Carp were higher in 2017 relative to 2014-2015 and 2018-2022. Lipid-normalized concentrations in Pumpkinseed were generally similar from 2014-2018 and slightly elevated in 2021-2022, although as discussed above in Set 1 were below the human-health target concentrations (on a wet weight basis). The slightly higher lipid-normalized values in 2021 and 2022 may be due to the potential low bias in the lipids results, as discussed above. The evaluations of lipid-normalized data will be reassessed, as needed, following potential application of estimation factors on the 2021 and 2022 lipids data.

DDT and Metabolites

Lipid-normalized concentrations for DDT and metabolites in small prey fish lake-wide are depicted in Set 4, Subset 1, Figure 9. Mean lipid-normalized DDT concentrations in small prey fish are variable over the 2014-2022 period, but remain at low levels. Mean concentrations in small prey fish are somewhat higher in 2017 and 2018 relative to the means observed in 2014-2015 and 2021-2022, although all lake-wide mean levels over this period are significantly less than the 2013 lake-wide mean. Mean lipid-normalized DDT concentrations in large prey fish are also variable with the highest lake-wide mean reported in 2018 due to an unusually high DDT concentration in one sample collected from SMU 4 (see Set 4, Subset 1, Figure 10). Mean lipid-normalized DDT concentrations in large prey fish were lower in 2021 and 2022 relative to 2018, though still higher than the 2014-2017 means.

As shown in Set 4, Subset 2, Figure 3, mean DDT concentrations (as wet weight) in small prey fish have declined in all SMUs from the baseline and remediation periods through 2022. Concentrations were comparable in all SMUs in 2022.

Hexachlorobenzene

Lipid-normalized hexachlorobenzene concentrations in Smallmouth Bass, Walleye, Common Carp and Pumpkinseed on a lake-wide basis are depicted in Set 4, Subset 1, Figures 11 and 12. Levels for Smallmouth Bass, Walleye and Pumpkinseed declined between 2014 and 2022. Lipid-normalized hexachlorobenzene concentrations for Walleye and Common Carp in 2018 were higher relative to 2017, while 2021-2022 levels were very low (*i.e.,* at/near detection limits) for both species. Hexachlorobenzene was not detected in Smallmouth Bass in 2018. Hexachlorobenzene was not detected in Pumpkinseed in 2017-2018 and was detected at levels closer to zero in 2021-2022. Lipid-normalized hexachlorobenzene levels in small prey fish on a lake-wide basis were lower in 2015-2017 and 2021-2022 relative to 2014, and were non-detect in 2018.

As shown in Set 4, Subset 2, Figure 4, hexachlorobenzene in small prey fish has been mostly non-detect or detected near low detection limits in recent years across all SMUs.

NYSDEC Data

Mercury

Mean length-normalized mercury concentrations in Largemouth Bass since 2015 are generally lower than pre-remediation (baseline) concentrations prior to 2012, although there has been no discernable trend since 2015 (Set 4, DEC Figure 1). Mean length-normalized concentrations have declined from 2021 to 2023.

PCBs

Although mean lipid-normalized PCB concentrations in Largemouth Bass in 2016-2023 are lower than in most years prior to commencement of remediation (with the exception of 2009 and 2010), there is no discernable trend since 2015 (Set 4, DEC Figure 2).

DDT and Metabolites

Similar to PCBs, there is no discernable trend in lipid-normalized DDT concentrations in Largemouth Bass since 2015 through 2023 (Set 4, DEC Figure 3), although concentrations remain low.

Hexachlorobenzene

Although lipid-normalized hexachlorobenzene concentrations in Largemouth Bass slightly increased from 2014 to 2015, concentrations decreased significantly in 2016 and hexachlorobenzene was not detected from 2016 through 2023 (Set 4, DEC Figure 4).

Mercury, Pre-and Post-Remedy

In addition, as NYSDEC's largemouth bass data from Onondaga Lake are available for each year through 2023 (with typically at least 30 samples per year), this represents the most extensive data set for a specific species. Plots of mercury vs fish length for the baseline period prior to dredging/capping (2008 to 2012) and post-remedy period (2017 to 2023) are presented in Set 4 DEC Figure 5 as individual data points for each of the two groupings of data. Set 4 DEC Figure 6 presents box-and-whisker graphs for mercury concentrations in each of these two groupings. Combining the data into these two multi-year groupings shows the decreases in mercury resulting from the lake remedy.

A statistical comparison of these two groupings of data was conducted using the Wilcoxon Mann Whitney comparison test. This type of test was selected for the comparison because the baseline period and post-remedy period data are both non-normally distributed. The Wilcoxon Mann Whitney test was used to evaluate the null hypothesis that baseline period data were less than or equal to post-remedy period. The probability associated with the test was 0 and it was concluded that mercury concentrations in largemouth bass from the post-remedy period data were less than the baseline period data.

Site Inspection

The inspection of the Site was conducted on 6/2/2025. In attendance were Victoria Rubino, Sabrina Gonzalez, and Tara Bhat (USEPA), Tracy Smith, Jessica LaClair, Adam Haines and Kristin Granzen (NYSDEC), Shane Blauvelt with Honeywell, Mark Arrigo with Parsons, Hazel Powless with Onondaga Nation, and Elizabeth Bough Martin, the Onondaga County environmental director. The purpose of the inspection was to assess the protectiveness of the remedy. The inspection did not identify anomalies or concerns.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Cap Evaluation

Based on a comprehensive review of the bathymetry survey results, probing results, and originally planned and additional coring results, there has been no significant loss of cap material in any capped area during this review period and, following a period of consolidation after cap placement, the cap appears to be physically stable. The monitoring results did indicate that there were very small areas in Model Area RA-C-2A where fine gravel was not observed or where the total cap thickness was less than the target thickness in the last FYR. Based on comprehensive follow-up investigations, it was determined that cap materials for the erosion protection/habitat layer were not fully placed here as intended during construction (most likely as a result of caution related to over placement of materials that could have adversely impacted the underlying sediment stability in an area identified as being very sensitive to the thickness of cap material). Accordingly, additional cap material in a portion of this area (approximately 0.12 acres) was placed here in November 2019. In addition, due to limited erosion of the topsoil and finer-grained habitat material along a small portion of the shoreline in RA-D in the area east of the crane pad area, additional erosion protection material consisting of cobble and fine gravel was placed in this area (approximately 0.26 acres) in 2019.

Results from the 2022/2023 chemical monitoring programs verified that there is no evidence of significant chemical migration through any of the multi-layer or mono-layer capped areas, and the cap continues to be functioning consistent with the design. The 2022 comprehensive sampling program included over 8,800 chemical analyses[17] from 95 sampling locations for multi-layer caps with sand or gravel habitat layer, including both habitat layer (compliance) and chemical isolation layer sampling. Over 97 percent of the analytical results were non-detects or very low concentrations (*i.e.,* less than five percent of the performance criteria). Detected concentrations in the habitat layer are primarily attributable to factors other than chemical migration from the underlying sediment.

In 2022, the cap performance criteria were exceeded at only one non-topsoil location (D-21), where phenol and toluene concentrations exceeded criteria in the deep habitat layer sample in the lower

[17] Excludes TOC, total solids, and pH.

portion of the bioturbation zone. However, the cap criterion for phenol is based on the NYSDEC SSC derived from taste and odor in fish tissue surface water criteria rather than aquatic toxicity and potential impacts to benthic organisms are unlikely, considering that the criteria exceedances at this location are observed below the depth of the majority of the bioturbation and that the mean PECQ of 1 was not exceeded in 2022 (a PECQ value of 1 was used in the ROD to define areas of the lake that pose potential unacceptable risks to benthic organisms based on toxicity considerations). The detected concentrations at D-21 were further evaluated through resampling in 2023. The source of these exceedances of phenol and toluene is uncertain, and supplemental sampling was performed in 2024, although those results were not available for this FYR.

Phenol concentrations measured during the 2023 resampling were less than those measured in 2022 at this location, though the highest concentration was measured in the deepest sample. Toluene concentrations measured during the 2023 resampling were greater than those measured in 2022 at this location and the vertical distribution pattern was similar (*i.e.,* highest concentration was measured in the middle sample interval). Criteria exceedances were observed in the deep habitat and shallow chemical isolation layer samples collected in 2023.

Eight habitat layer samples, collected from five locations in cap areas with a topsoil habitat layer, exceeded cap criteria for PAHs. All of these locations are at the mouth of Harbor Brook. PAH concentrations were typically lower in the deepest habitat layer samples, indicating the exceedances are likely not a result of chemical migration from underlying sediments. The mean PECQ exceeded 1 at one of these locations (D-45). The PAH exceedances in the topsoil portion of the cap in this wetland and open water area at the mouth of Harbor Brook may be a result of PAHs migrating from portions of Harbor Brook, including reaches upstream of the areas remediated by Honeywell, as well as potentially ditches within the Wastebed B/Harbor Brook subsite. Further monitoring and investigation into the elevated PAH concentrations in this area is being conducted.

As noted above, an extensive cap monitoring event was completed in 2024 with some additional sampling performed in 2025. This also included supplemental monitoring to facilitate detailed evaluation of cap conditions at and in the vicinity of location D-21, including addition of four supplemental locations adjacent to location D-21. In addition, at all locations in Zone 1 of cap model area D-East, in which location D-21 is located, the 2024/2025 monitoring included collection of solid phase and porewater samples and analysis for the full list of chemical groups throughout the cap profile as well as from the underlying sediments. Additional monitoring in 2024 also included Outboard Area East, where all five locations were sampled for the full list of chemical groups based on topsoil exceedances observed at the mouth of Harbor Brook, as discussed above. Results from the 2024/2025 cap monitoring program are not yet available and will be presented in the next FYR.

Surface Water and Sediment Monitoring

In 2017-2018 as well as 2021 (post fall turnover) and 2022 (prior to fall turnover), surface water sampling results for dissolved mercury indicated that the levels are below goals for the protection of human health via fish consumption and for protection of wildlife. Benzene, chlorobenzene and toluene were detected at concentrations below criteria or not detected. All other VOC/SVOC samples were nondetect. During this FYR, PCB concentrations exceeded both the criteria for protection of wildlife (0.12 ng/L) and the protection of human health (0.001 ng/L). However, in general, in-lake average PCB concentrations were lower than averages documented in background tributaries. Total PCBs were generally higher in Ley Creek than in other tributaries. Ley Creek is a current PCB source to surface water in Onondaga Lake. Four subsites located on Ley Creek (two of the subsites include portions of the Creek itself) are current or former PCB sources. While some IRM and remedial actions addressing PCB sources located adjacent to Ley Creek have been conducted at two of the subsites and a portion of another subsite, remediation of the Creek itself has not yet been implemented. Surface water sampling in Onondaga Lake for mercury and PCBs should continue at least once during future FYR periods.

Within surface sediment, all mercury concentrations in the profundal zone (SMU 8) during this FYR period in both 2021 and 2022 were below the mercury PEC of 2.2 mg/kg on a point-by-point basis for the 0 to 4 cm sampling interval. Additionally, all mercury concentrations measured in 2021 and 2022 from SMU 8 were below the mercury PEC for the 4 to 10 cm interval. Mercury sampling results from the 2021 and 2022 compliance monitoring events confirm that MNR-related remedial goals have been achieved. Therefore, no further MNR related monitoring was completed in 2023.

Wetland Mitigation

Wetland mitigation requirements have been attained for wetland acreage and open water. Habitat reestablishment and biological response were also monitored for this FYR. Observations indicate that the restored habitats are providing a diverse, functional habitat for a variety of species, including the fish community. Benthic community data collected during this FYR demonstrated the recolonization of benthic macroinvertebrates in Onondaga Lake.

Aquatic Vegetation

Qualitative and quantitative surveys of aquatic macrophytes conducted in 2017 through 2021 to document the natural recolonization by aquatic plants in remediation areas and the coverage in non-remediated areas (reference areas) indicate that significant natural recolonization of capped areas has occurred since cap placement such that remediated and non-remediated areas were characterized as having moderate to dense macrophyte coverage. The continued colonization and growth of submerged aquatic macrophytes in remediated areas is expected to continue.

Nitrate Treatment

The addition of nitrate to Onondaga Lake during this FYR period has successfully met objectives and resulted in methylmercury concentrations in lake water remaining near background levels. Monitoring results show that methylmercury was effectively controlled during summer lake stratification. Diluted calcium nitrate solution addition will continue to be implemented in future years as needed. Although there are no remedial performance criteria for zooplankton, analysis of total mercury and methylmercury in zooplankton have remained consistently low from the first year of nitrate addition through 2023. Zooplankton can be used as a measurement of change in the mercury and methylmercury concentrations in potential exposure to fish that consume zooplankton. As zooplankton are critical for the base of the food chain for upper level sport fish (*e.g.,* walleye, bass), the lower methylmercury concentrations in zooplankton are expected to result in lower exposure of fish to methylmercury. Similarly, reductions in methylmercury exposures from the water column and through the food chain are anticipated over time to result in lower concentrations of methylmercury in fish in Onondaga Lake which in turn will reduce potential risks to humans and wildlife that consume fish. Therefore, the nitrate addition remedy is functioning as intended to protect the environment and ecological receptors.

Fish Tissue Monitoring

Mercury concentrations in fish collected in Onondaga Lake were evaluated to assess the progress of the remediation towards meeting human health and ecological based RGs established in the ROD. There are no RGs in the ROD for organic compounds in fish tissue, however, detected concentrations of organic compounds in fish tissue were compared to points of reference (*i.e.,* targets) for evaluations of risk reduction for human and wildlife consumers of fish. These compounds include PCBs in sport fish and prey fish, dioxins/furans in sport fish, and DDT and metabolites in prey fish. Contaminant concentrations for these compounds as well as for hexachlorobenzene were also evaluated.

The fish tissue results generally indicate lower contaminant concentrations in the current FYR period relative to prior years. While mean and 95% UCL contaminant concentrations are below or near RGs or targets for some fish species (e.g., mercury in Common Carp and Pumpkinseed, PCBs in Pumpkinseed, dioxin/furan TEQs in Smallmouth Bass, Walleye, and Pumpkinseed) in 2021/2022 (see Set 1 figures), for other species, particularly longer-lived, higher trophic level species (*e.g.,* Smallmouth Bass, Walleye, and large prey fish), contaminant concentrations for mercury and PCBs remain at levels that are above RGs or targets. This condition is not unexpected, however, as it is anticipated that longer-lived, higher trophic level species will take longer to respond to reduced contaminant concentrations in other media as a result of remedy implementation. In addition, variabilities in small and large prey fish concentrations may be due to fish size, which can play a role in mercury accumulation. Thus, a longer period of time to observe a decreasing trend in mercury levels, particularly in the large prey fish, may be required. PCB contributions from Ley Creek could also be an ongoing source that may be influencing the PCB concentrations observed in small prey fish and potentially other species. Mercury concentrations in small prey fish have decreased post remediation, and concentrations of DDT and metabolites remain below the ecological-based target. PCB concentrations in large prey fish have also decreased. While PCB concentrations in small prey fish remain elevated within the lake in the vicinity of Ley Creek, overall lake-wide concentrations in small prey fish have significantly decreased post remediation. Fish monitoring will continue as per the requirements of the OLMMP and annual scoping documents submitted by Honeywell and approved by NYSDEC.

It is noted in the OLMMP that "*to account for natural variability, performance criteria [for fish tissue] will be considered to have been met after multiple years of data indicate attainment. Performance criteria should be met at least three years in a row or four years out of five to verify achievement of goals. Fish monitoring will continue until NYSDEC/EPA determine that the relevant RAOs and PRGs in the ROD have been achieved. The data will be provided to NYSDOH for consideration in setting fish consumption advisories, as changes to the advisories can denote* *trends toward meeting the PRG and RAO*." As there are some fish tissue data sets where the 95% UCL was below goals or targets for at least three years in a row based on data from 2015-2022 (*e.g.,* dioxins/furan TEQs in Pumpkinseed, mercury in small prey fish on a lake-wide basis and DDT and metabolites in small and large prey fish), modifications to the Honeywell fish tissue monitoring program will be evaluated by EPA and NYSDEC, if appropriate, following the approach in the additional fish tissue metrics summary (Appendix D) during the next review period. Additional fish tissue data are required to determine trends with statistical significance.

Sediment Consolidation Area

The results of monitoring and maintenance activities at the SCA, from closure through 2023, of the cover and liner systems, surface water management system, liquid management system, and the SCA perimeter berm indicate that these systems and features are functioning as intended. Odor monitoring inspections conducted at eight air monitoring stations along the SCA work zone perimeter road indicated that no site-related odors were detected during the 2019 through 2023 monitoring periods. Groundwater data collected under the EMP indicate that the SCA cover and liner systems have remained effective at mitigating potential breaches affecting local groundwater and surface water quality.

Institutional Controls

ICs are being implemented to prevent unacceptable exposure to residual contamination within the lake, prevent recreational boaters from accidently contacting any navigational hazards created by capping and restoration components of the remedy, and prevent damage to the cap from activities, such as navigational dredging. The controls achieved to date include use of the NYSDEC and USACE permitting process to restrict actions that may disrupt the cap or SMU 8 sediment, the placement and maintenance of navigational buoys in the lake by the NYSOPRHP, and the provision of updated (post-capping) bathymetric survey results to NOAA to facilitate updating of the Navigational Chart for Onondaga Lake. In addition, fish consumption advisories issued by NYSDOH and related public communication activities have been implemented to educate the public about the risks associated with consuming fish. Since 2017, the City of Syracuse, Onondaga County and NYSDEC posted signs in numerous locations along the shore of Onondaga Lake (*e.g.,* at public fishing access points) regarding the presence of consumption advisories and where to find additional information. In addition, since 2021 NYSDOH has hosted focus groups and worked on developing regional fish advisory guides with input from Burmese and Karen speaking anglers to increase awareness amongst these populations about fish consumption advisories. The guides have been published by NYSDOH and made available to the public as of November 2025 (see Appendix A: References).

These ICs are functioning as intended. The establishment of additional ICs (*i.e.,* environmental easements and environmental notices) is currently underway and will be included in the Site Management Plan.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Human Health

The exposure assumptions and toxicity values that were used in the HHRA to estimate the potential risk and hazards to human health from exposure to the contaminants followed the general practice at the time that the risk assessment was performed. Although specific parameters and toxicity values (*e.g.,* PCDD/PCDF and benzo(a)pyrene, as discussed in the previous FYR) may have changed, the risk assessment process that was used is still consistent with current practices, and the conclusions remain valid.

The RAOs identified in the ROD include reducing or eliminating potential risks to humans and ecological receptors. Currently, there are advisories in place that recommend that consumption of fish be limited to certain types and specific meal frequencies. The actions taken through the implementation of the remedy to date include reducing methylation rates of mercury, completion of dredging, capping, and habitat enhancement/reestablishment. The State's fish consumption advisories that are currently in place are intended to reduce exposure through ingestion. Fish tissue monitoring will continue, and it is expected that concentrations will continue to decrease.

Sediment-based cleanup levels identified at the time of the remedy incorporated site-specific criteria established during the RI/FS and were developed consistent with published scientific literature. Fish-based remediation goals include fish tissue mercury concentrations ranging from 0.14 mg/kg, which is for protection of ecological receptors, to 0.3 mg/kg, which is based on the EPA's Methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms. This range encompasses the goal for protection of human health based on the reasonable maximum exposure scenario of 0.2 mg/kg of mercury in fish tissue (fillets).

Ecological

The exposure assumptions, toxicity data, cleanup levels and RAOs used at the time of the selection of the remedy are still valid. The risk assessment methodology used to complete the 2002 BERA was consistent with both EPA and NYSDEC guidance. Assessment and measurement endpoints encompassed the sustainability (survival, growth, and reproduction) of organisms at the base of the food web (aquatic macrophytes, phytoplankton, zooplankton, benthic invertebrates, and terrestrial plants) and up the food chain (fish, amphibians and reptiles, insectivorous birds, benthivorous waterfowl, piscivorous birds, carnivorous birds, insectivorous mammals, and piscivorous mammals). Measurement endpoints included measured or modeled concentrations of chemicals and stressors in water, sediment, fish, birds, and mammals, laboratory toxicity studies, and field observations. Toxicity Reference Values were selected based on LOAELs and/or NOAELs from laboratory and/or field-based studies reported in the scientific literature. Reproductive effects (e.g., egg maturation, egg hatchability, and survival of juveniles) were generally the most sensitive exposure endpoints and were selected when available and appropriate. Site-specific SECs using toxicity and chemistry data were derived to allow assessment of whether the sediment chemical concentrations found at various locations in the lake would result in adverse biological effects. These SECs were then used to derive consensus-based PECs for use in determining areas of the lake bottom that potentially pose a risk to the benthic community. Based on the comprehensive analysis of measurement endpoints for ecological receptors, these assumptions remain valid.

QUESTION C: Has any **other** information come to light that could call into question the protectiveness of the remedy?

No other information has come to light that would call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review: *None*

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 2	**Issue Category:** **Remedy Performance**			
	Issue: There are not enough sets of annual fish tissue data available since the completion of the remedy to establish rates of decline in fish with statistical confidence.			
	Recommendation: A minimum of two additional years of fish tissue data are needed to determine rates of contaminant decline with statistical significance.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State	6/30/2028

OU(s): 2	**Issue Category:** **Monitoring**			
	Issue: Increasing PAH concentrations have been detected in surface sediments near Harbor Brook.			
	Recommendation: Identify the source of the PAHs and determine next steps.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	State	9/30/2027

OU(s): 2	Issue Category: Institutional Controls			
	Issue: Some Environmental Easements and Environmental Notices have not been completed.			
	Recommendation: NYSDEC to complete the remaining environmental easements and environmental notices.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	State	State	12/31/2026

OTHER FINDINGS

In addition, the following are suggestions that were identified during the FYR and may improve performance of the remedy and O&M, but do not affect current and/or future protectiveness.

- While fish consumption advisory signs have been installed at many fishing access points and there has been recent outreach by NYSDOH, including fish consumption guides for the Karen and Burmese communities, an ongoing effort should be made to continue outreach and further increase awareness of the fish consumption advisory and associated risks.

- Given historic issues with QA/QC for fish tissue, ensure close oversight of the laboratory by continuing to evaluate QA/QC procedures. As noted above, NYSDEC and Honeywell are evaluating potential modifications of extraction/analytical methods for future PCB and lipids analysis. If modifications are determined to be necessary, updates to the QAPP will be prepared. In addition, NYSDEC and Honeywell are currently exploring options for applying estimation factors to the PCB and lipid results from fish tissue samples collected since 2021 due to a low bias in those results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022 (and potentially 2023 and 2024), then the revised estimated concentrations (including statistics and figures) will be documented and discussed in an addendum to this FYR.

- The OLMMP or other site management documents should be updated, including future sampling duration and frequency for media such as surface water, sediment, cap material, and fish tissue.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit: 2	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 6/30/2028
Protectiveness Statement: A protectiveness determination of the remedy for the Lake Bottom Subsite cannot be made until additional post-construction fish tissue data are available to ascertain when the remedial goals identified in the ROD will be achieved. It is anticipated that at least two additional years of fish data, and as many as four, will be needed to determine when the rates of decline can be estimated with statistical significance. Following the evaluation of the additional data incorporating the approach documented in the Fish Tissue Metrics summary included in Appendix D herein, a protectiveness determination will be made. In the interim, remedial operation, maintenance and monitoring activities will continue to be implemented in accordance with existing plans and requirements. Additionally, fish consumption advisories are in place and additional outreach activities are being implemented. The construction components of the remedy, which include in-lake dredging, capping, habitat restoration, capping/closure of the SCA located on Wastebed 13, which contains sediment and debris removed from the lake, have been completed. MNR goals have been achieved. Other components of the remedy, including nitrate addition in the hypolimnion and cap monitoring are ongoing.		

VIII. NEXT REVIEW

The next FYR report for the Lake Bottom subsite (OU2) of the Onondaga Lake Superfund Site is required five years from the completion date of this review. However, EPA is committed to completing the next FYR by September 30, 2030 to maintain adherence to the schedule leading into this review period.

APPENDIX A – REFERENCE LIST

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APPENDIX B - PHYSICAL CHARACTERISTICS, GEOLOGY/HYDROGEOLOGY, AND LAND USE

Physical Characteristics

Onondaga Lake is a 4.6-square-mile, 3,000-acre lake, approximately 4.5 miles long and 1 mile wide, with an average water depth of 36 feet, with two (northern and southern) deep basins. The city of Syracuse is located at the southern end of Onondaga Lake, and numerous towns, villages, and major roadways surround the lake (see Attachment 1, Figure 2). The lake has three main tributaries--Ninemile Creek to the west; Onondaga Creek to the south; and Ley Creek to the southeast. In addition, several small tributaries flow into the lake, including Bloody Brook, Sawmill Creek, Tributary 5A, and Harbor Brook. While Ninemile Creek and Onondaga Creek supply the vast majority of surface water to the lake, approximately 20 percent of the inflow comes from the Metropolitan Syracuse Wastewater Treatment Plant (METRO). The lake drains into the Seneca River through a single outlet located at the northern tip of the lake.

The area around Onondaga Lake is the most urban in central New York State. The region experienced significant growth in the twentieth century, and in 2000, Onondaga County was the tenth most populous county in the State. There are approximately 320 acres of state-regulated wetlands and numerous smaller wetlands directly connected to Onondaga Lake or within its floodplains.

Site Geology/Hydrogeology

Onondaga Lake is underlain by a thick layer of soft, unconsolidated sediments ranging from approximately 80 feet to over 300 feet thick beneath the mouth of Onondaga Creek at the south end of the lake. These unconsolidated deposits consist (from top to bottom) of layers of fill, marl, silt and clay, silt and fine sand, sand and gravel, and till. The bedrock geology beneath the lake consists of 500 to 600 feet of sedimentary rocks of the Vernon Shale Formation, which are comprised of soft and erodible mudstones with some localized, discontinuous gypsum seams.

Two primary hydrogeologic units exist at the lake--unconsolidated deposits and underlying bedrock shale. Groundwater in the unconsolidated deposits, which overlies the silt and clay layer, comprises an unconfined groundwater zone that provides most of the discharge of groundwater to the lake. There is limited groundwater discharge from the deeper bedrock to the lake. Total quantities of groundwater discharged to the lake are small compared to discharges of surface water to the lake.

Land and Resource Use

From 1970 to 1985, fishing on the lake was banned due to contamination. From 1986 to 1999, the fish consumption advisory for Onondaga Lake was “Don’t eat any fish” from the lake. In 1999, the advisory was updated to “Don’t eat any Walleye [*Sander vitreus*] and eat up to one meal a month of all other species.” In 2007, the advisory was updated to “Don’t eat Largemouth Bass [*Micropterus salmoides*] and Smallmouth Bass [*Micropterus dolomieu*] over 15 inches, and

Walleye. Eat up to one meal a month of Smallmouth Bass and Largemouth Bass less than 15 inches, Carp [*Cyprinus carpio*], Channel Catfish [*Ictalurus punctatus*], White Perch [*Morone americana*] and all other species." In 2010, the advisory was updated to "For men over 15 and women over 50: Don't eat Largemouth Bass and Smallmouth Bass greater than 15 inches, Walleye, Carp, Channel Catfish and White Perch. Eat up to four meals a month of Brown Bullhead [*Ameiurus nebulosus*] and Pumpkinseed [*Lepomis gibbosus*]. Eat up to one meal a month of all other fish (including Largemouth Bass and Smallmouth Bass less than 15 inches). For women under 50 and children under 15: Don't eat any fish." This advisory is currently in effect. The fish consumption advisory is based on the presence of mercury, dioxin, polychlorinated biphenyls (PCBs), and PFAS[18] in fish tissues.

In general, the eastern shore of Onondaga Lake is mainly urban and residential, and the northern shore is dominated by parkland, wooded areas, and wetlands. The northwest upland is primarily residential, with interspersed urban structures and several undeveloped areas. The southern and western shorelines are dominated by industrial wastebeds, consisting mainly of ionic wastes, many of which have been remediated and/or revegetated. Urban centers and industrial zones dominate the landscape surrounding the south end of Onondaga Lake from approximately the New York State Fairgrounds to Ley Creek. Land around the southwest corner and southern portion of the lake is generally industrial and has been significantly modified as part of long-term development of the Syracuse area. Land around much of the lake is recreational, providing hiking and biking trails, fishing access and other recreational activities.

The Onondaga Nation has a unique cultural, spiritual, and historic relationship with Onondaga Lake. Nation leaders are mandated to act as stewards of the Lake and its surrounding ecosystems (Heath, 2020).

References

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[18] PFAS was added to the NYSDOH fish advisory in 2021 and is not associated with the OU2 Onondaga Lake Bottom Site.

APPENDIX C – REMEDY RESILIENCY

In line with regional practice, three tools were utilized to assess the Onondaga Lake OU2 Lake Bottom Superfund subsite.

The first tool used to assess the site was the Climate Mapping for Resilience & Adaptation (CMRA). The tool examined five hazards for Onondaga County, where the site falls within. According to this tool, the National Risk Index Rating for extreme heat is "Relatively Moderate". There is a projected increase of days per year with maximum temperatures >100 degrees F and >105 degrees F (Figure C-1). The National Risk Index Rating for Flooding is "Relatively Moderate", with an increase in average total precipitation, and a decrease in days with maximum temperature below 32 degrees F (Figure C-2). For the last three index values: The National Risk Index rates Wildfire "Very Low" (Figure C-3), there is no rating for Drought (see Figure C-4), and Coastal Flooding is Not Applicable (Figure C-5).

The second tool utilized is called National Oceanic and Atmospheric Administration (NOAA) Sea Level Rise Viewer. Onondaga Lake is located in central New York, in Onondaga County. There is not risk to Sea Level Rise due to the inland geographic location, see Figure C-6 for details.

The third tool utilized is called the United States Geological Survey (USGS) U.S. Landslide Inventory & Susceptibility Map. As shown in Figure C-7 and C-8, there have been two landslides recorded in the vicinity of the site, and Onondaga County varies from low to high landslide susceptibility based on the different topographical conditions.

Based on this information, potential site impacts from severe weather events have been assessed and the performance of the remedy may be impacted by extreme heat and increased precipitation from flooding. Potential effects include erosion of the lake and wetland sediment caps, and Sediment Consolidation Area (SCA) cover due to severe storms /weather events and associated flooding. However, the sediment cap has been designed to provide long-term physical isolation and stability, as well as chemical isolation with no anticipated cap maintenance or enhancement. The erosion protection layer of the cap was designed to be physically stable under conditions predicted to occur based on consideration of a 100-year return-interval wind-generated wave event and a 100-year tributary flood flow event. The cap includes over 40 different design profiles across the capping area, each of which was developed based on goals and input parameters specific to a given area, including sediment contaminant concentrations, water depth, wave erosive forces, and habitat substrate goals. EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites* (2005) recommends that the physical cap integrity be monitored both routinely and after events with certain recurrence intervals. Therefore, in addition to routine monitoring of the cap, physical monitoring will be performed after extreme events to verify the integrity of the cap. The extreme event conditions that will be used to trigger a monitoring event include a 50-year or greater wind-generated wave event or a 50-year or greater tributary flow event.[19] This will also be included in the Site Management Plan once finalized. Stormwater calculations performed for the

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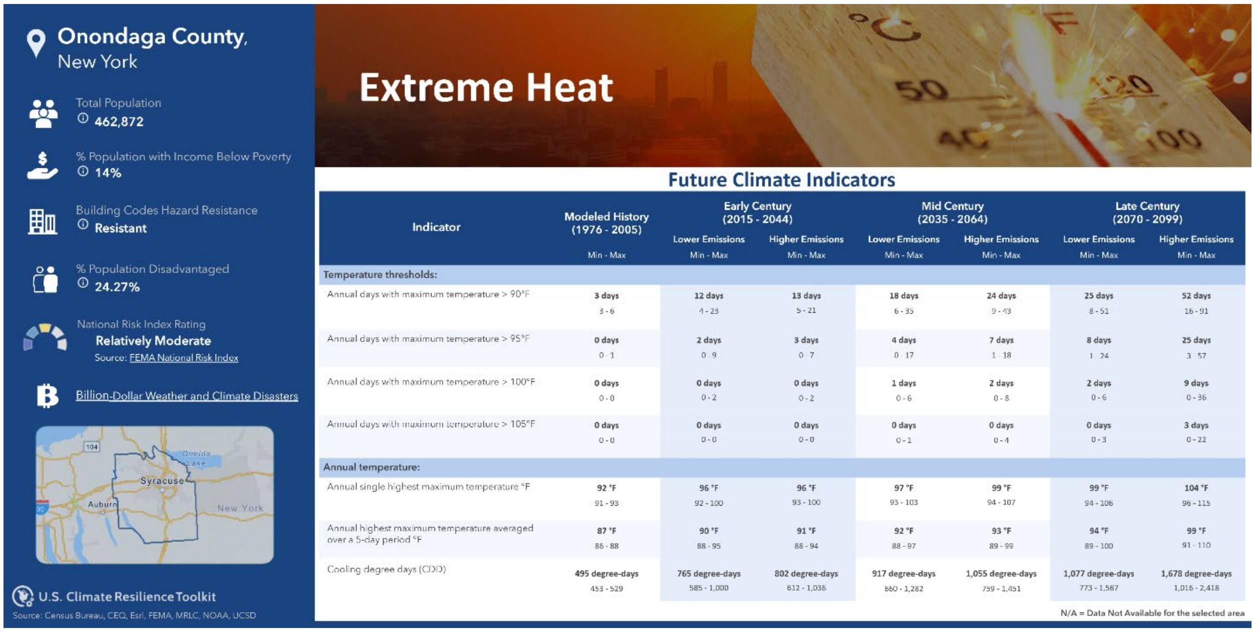
[19] Consistent with the OLMMP, cap monitoring would also occur following a seismic event measuring 5.5 or larger within 30 miles of Onondaga Lake as measured by the US Geological Survey.

SCA as part of the Final Design Report showed the stormwater management system can handle a 100-year, 24-hour storm. Vulnerability assessments will be conducted for the SCA when deemed necessary and will address the vulnerability of the SCA and/or engineering controls to severe storms/weather events and associated flooding.

Figure C-1

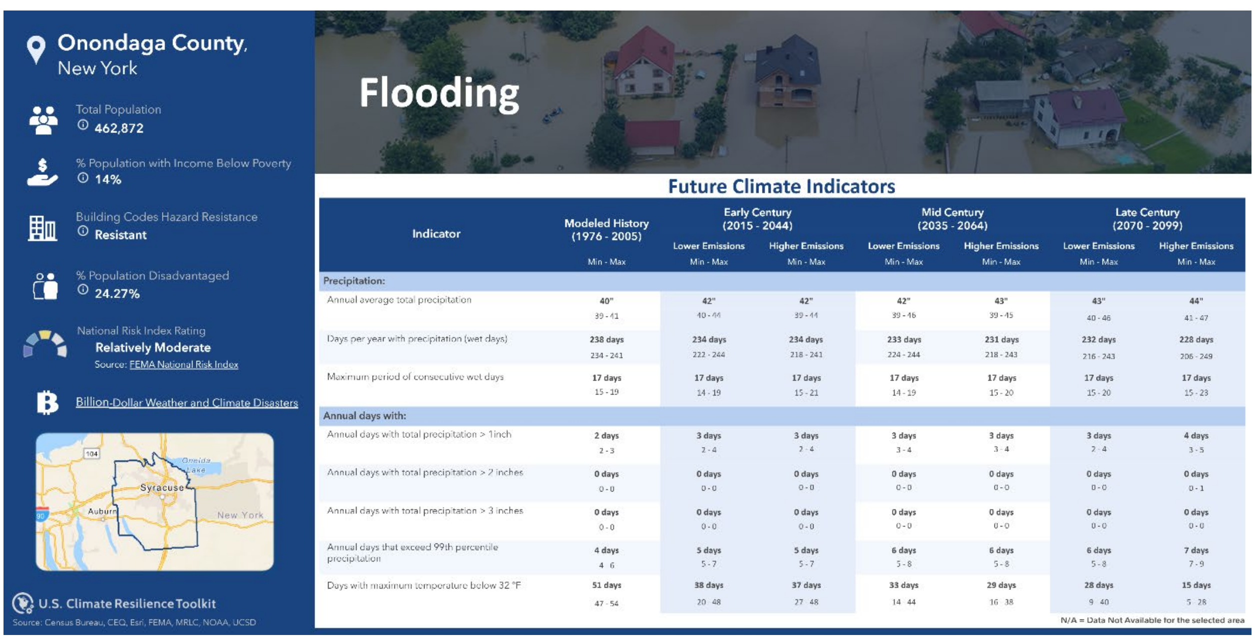


Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Temperature thresholds:							
Annual days with maximum temperature > 90°F	3 days 3 - 6	12 days 4 - 23	13 days 5 - 21	18 days 6 - 35	24 days 9 - 43	25 days 8 - 51	52 days 16 - 91
Annual days with maximum temperature > 95°F	0 days 0 - 1	2 days 0 - 9	3 days 0 - 7	4 days 0 - 17	7 days 1 - 18	8 days 1 - 24	25 days 3 - 57
Annual days with maximum temperature > 100°F	0 days 0 - 0	0 days 0 - 2	0 days 0 - 2	1 days 0 - 6	2 days 0 - 8	2 days 0 - 6	9 days 0 - 36
Annual days with maximum temperature > 105°F	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 1	0 days 0 - 4	0 days 0 - 3	3 days 0 - 22
Annual temperature:							
Annual single highest maximum temperature °F	92 °F 91 - 93	96 °F 92 - 100	96 °F 93 - 100	97 °F 93 - 103	99 °F 94 - 107	99 °F 94 - 106	104 °F 96 - 115
Annual highest maximum temperature averaged over a 5-day period °F	87 °F 86 - 88	90 °F 88 - 95	91 °F 88 - 94	92 °F 88 - 97	93 °F 89 - 99	94 °F 89 - 100	99 °F 91 - 110
Cooling degree days (CDD)	495 degree-days 453 - 529	765 degree-days 585 - 1,000	802 degree-days 612 - 1,036	917 degree-days 660 - 1,282	1,055 degree-days 759 - 1,451	1,077 degree-days 773 - 1,567	1,678 degree-days 1,016 - 2,418

N/A = Data Not Available for the selected area

Figure C-2



Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Annual average total precipitation	40" 39 - 41	42" 40 - 44	42" 39 - 44	42" 39 - 46	43" 39 - 45	43" 40 - 46	44" 41 - 47
Days per year with precipitation (wet days)	238 days 234 - 241	234 days 222 - 244	234 days 218 - 241	233 days 224 - 244	231 days 218 - 243	232 days 216 - 243	228 days 206 - 249
Maximum period of consecutive wet days	17 days 15 - 19	17 days 14 - 19	17 days 15 - 21	17 days 14 - 19	17 days 15 - 20	17 days 15 - 20	17 days 15 - 23
Annual days with:							
Annual days with total precipitation > 1inch	2 days 2 - 3	3 days 2 - 4	3 days 2 - 4	3 days 3 - 4	3 days 3 - 4	3 days 2 - 4	4 days 3 - 5
Annual days with total precipitation > 2 inches	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 1
Annual days with total precipitation > 3 inches	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0	0 days 0 - 0
Annual days that exceed 99th percentile precipitation	4 days 4 - 6	5 days 5 - 7	5 days 5 - 7	6 days 5 - 8	6 days 5 - 8	6 days 5 - 8	7 days 7 - 9
Days with maximum temperature below 32 °F	51 days 47 - 54	38 days 20 - 48	37 days 27 - 48	33 days 14 - 44	29 days 16 - 38	28 days 9 - 40	15 days 5 - 28

N/A = Data Not Available for the selected area

Figure C-3

Onondaga County,
New York

Total Population
462,872

% Population with Income Below Poverty
14%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
24.27%

National Risk Index Rating
Very Low
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

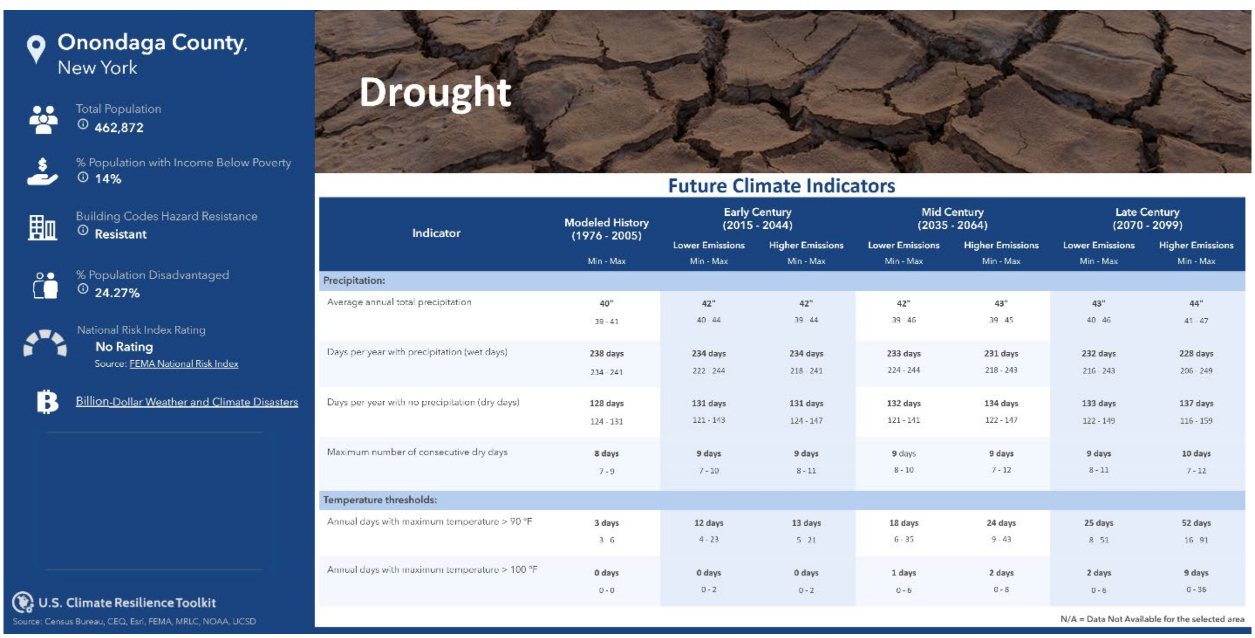
Wildfire

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Days per year with no precipitation (dry days)	**128 days** 124 - 131	**131 days** 121 - 143	**131 days** 124 - 147	**132 days** 121 - 141	**134 days** 122 - 147	**133 days** 122 - 149	**137 days** 116 - 159
Maximum number of consecutive dry days	**8 days** 7 - 9	**9 days** 7 - 10	**9 days** 8 - 11	**9 days** 8 - 10	**9 days** 7 - 12	**9 days** 8 - 11	**10 days** 7 - 12
Days per year with precipitation (wet days)	**238 days** 234 - 241	**234 days** 222 - 244	**234 days** 218 - 241	**233 days** 224 - 244	**231 days** 218 - 243	**232 days** 216 - 243	**228 days** 206 - 249
Temperature thresholds:							
Annual days with maximum temperature > 90°F	**3 days** 3 - 6	**12 days** 4 - 23	**13 days** 5 - 21	**18 days** 6 - 35	**24 days** 9 - 43	**25 days** 8 - 51	**52 days** 16 - 91
Annual days with maximum temperature > 100°F	**0 days** 0 - 0	**0 days** 0 - 2	**0 days** 0 - 2	**1 days** 0 - 6	**2 days** 0 - 8	**2 days** 0 - 6	**9 days** 0 - 36

N/A = Data Not Available for the selected area

Figure C-4



Onondaga County,
New York

Total Population
462,872

% Population with Income Below Poverty
14%

Building Codes Hazard Resistance
Resistant

% Population Disadvantaged
24.27%

National Risk Index Rating
No Rating
Source: FEMA National Risk Index

Billion-Dollar Weather and Climate Disasters

U.S. Climate Resilience Toolkit
Source: Census Bureau, CEQ, Esri, FEMA, MRLC, NOAA, UCSD

Drought

Future Climate Indicators

Indicator	Modeled History (1976 - 2005)	Early Century (2015 - 2044)		Mid Century (2035 - 2064)		Late Century (2070 - 2099)	
		Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions	Lower Emissions	Higher Emissions
	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max	Min - Max
Precipitation:							
Average annual total precipitation	**40"** 39 - 41	**42"** 40 - 44	**42"** 39 - 44	**42"** 39 - 46	**43"** 39 - 45	**43"** 40 - 46	**44"** 41 - 47
Days per year with precipitation (wet days)	**238 days** 234 - 241	**234 days** 222 - 244	**234 days** 218 - 241	**233 days** 224 - 244	**231 days** 218 - 243	**232 days** 216 - 243	**228 days** 206 - 249
Days per year with no precipitation (dry days)	**128 days** 124 - 131	**131 days** 121 - 143	**131 days** 124 - 147	**132 days** 121 - 141	**134 days** 122 - 147	**133 days** 122 - 149	**137 days** 116 - 159
Maximum number of consecutive dry days	**8 days** 7 - 9	**9 days** 7 - 10	**9 days** 8 - 11	**9 days** 8 - 10	**9 days** 7 - 12	**9 days** 8 - 11	**10 days** 7 - 12
Temperature thresholds:							
Annual days with maximum temperature > 90 °F	**3 days** 3 - 6	**12 days** 4 - 23	**13 days** 5 - 21	**18 days** 6 - 35	**24 days** 9 - 43	**25 days** 8 - 51	**52 days** 16 - 91
Annual days with maximum temperature > 100 °F	**0 days** 0 - 0	**0 days** 0 - 2	**0 days** 0 - 2	**1 days** 0 - 6	**2 days** 0 - 8	**2 days** 0 - 6	**9 days** 0 - 36

N/A = Data Not Available for the selected area

Figure C-5

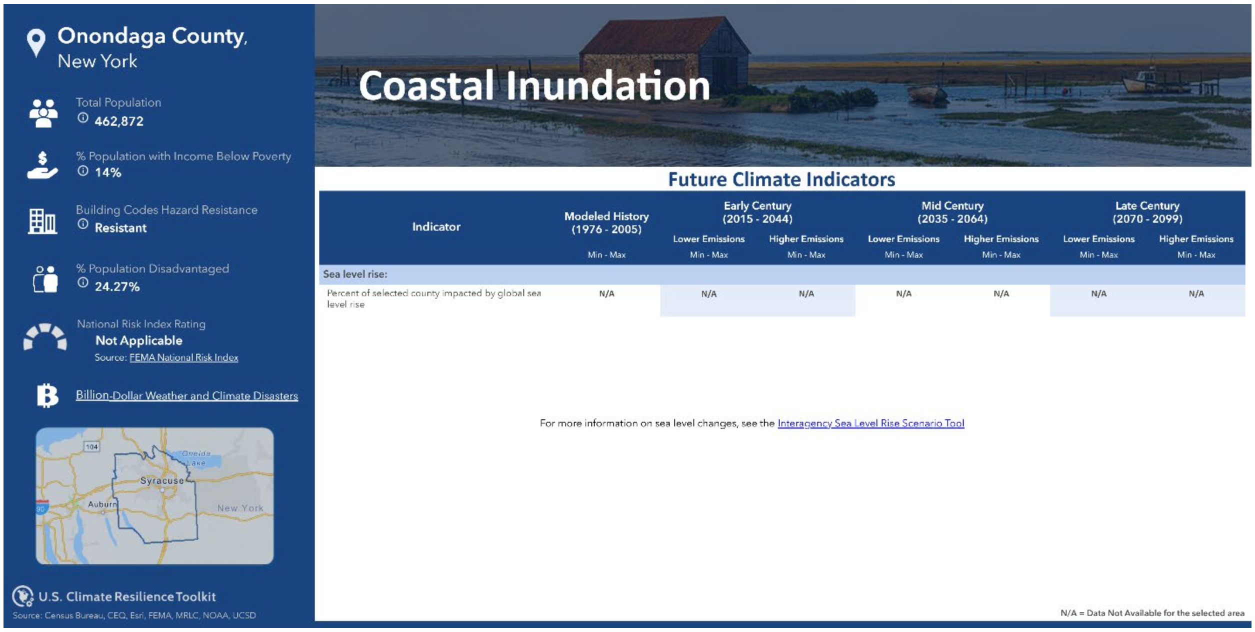


Figure C-6

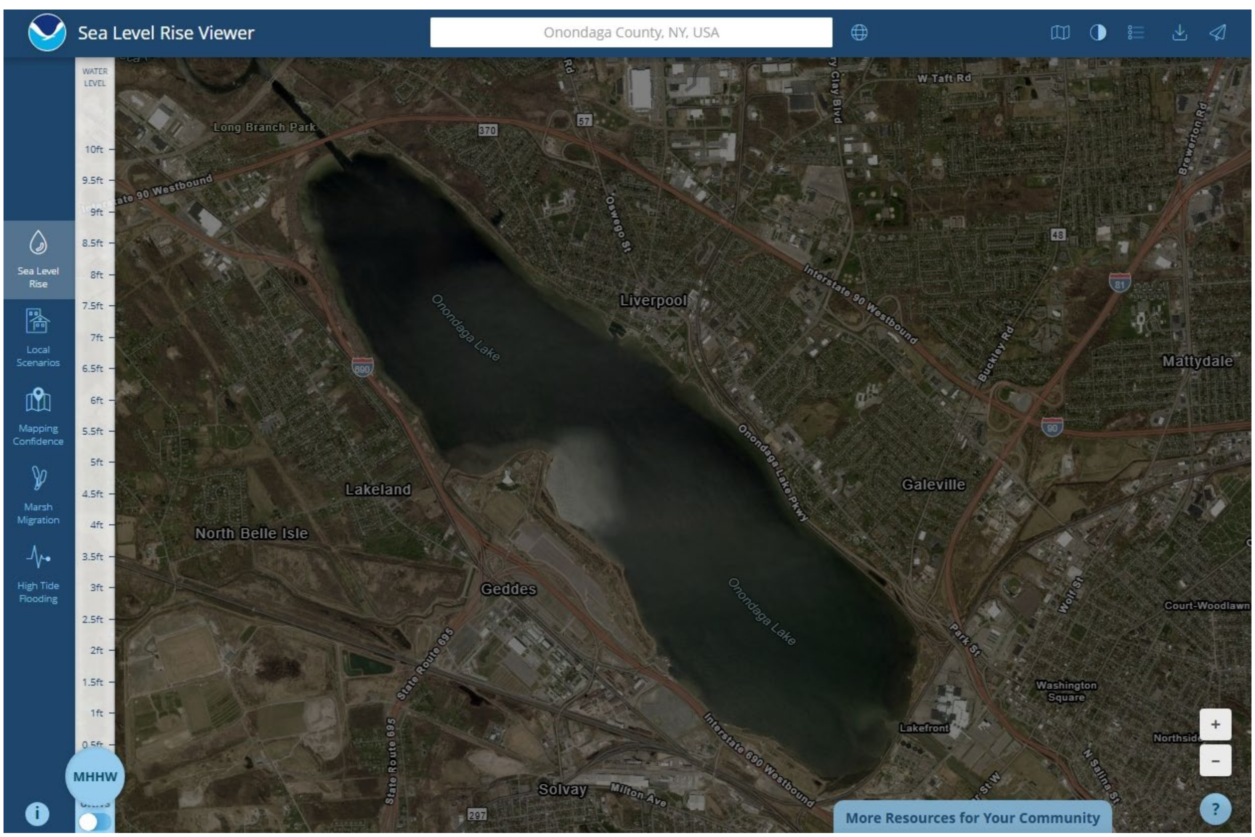


Figure C-7

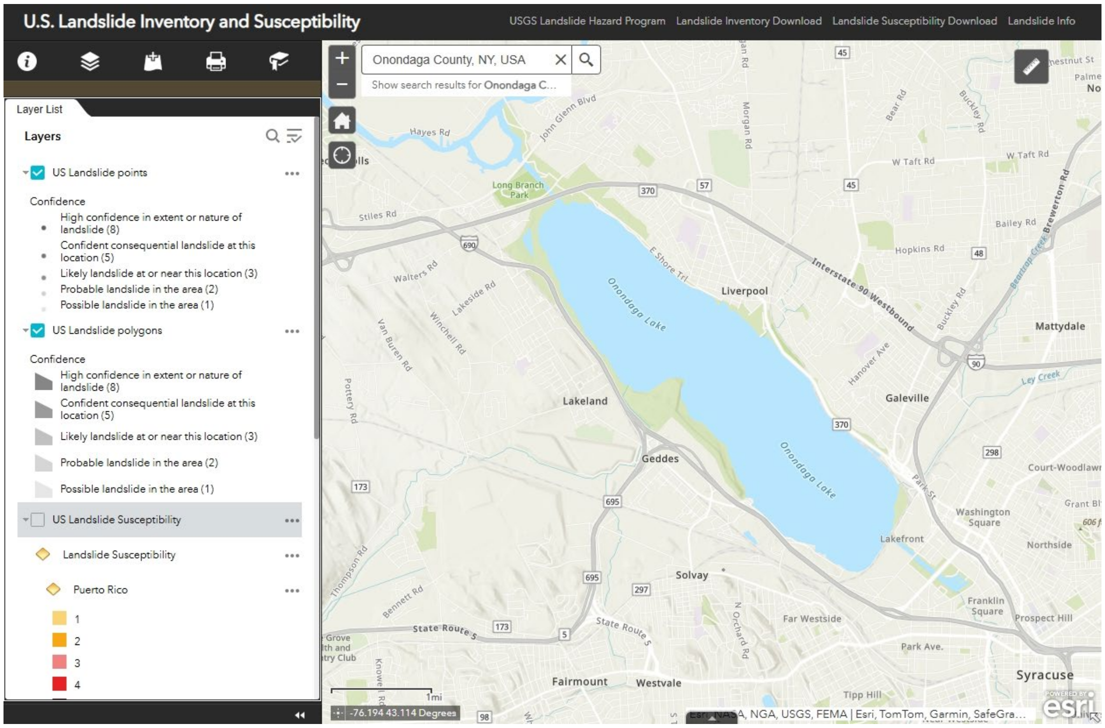
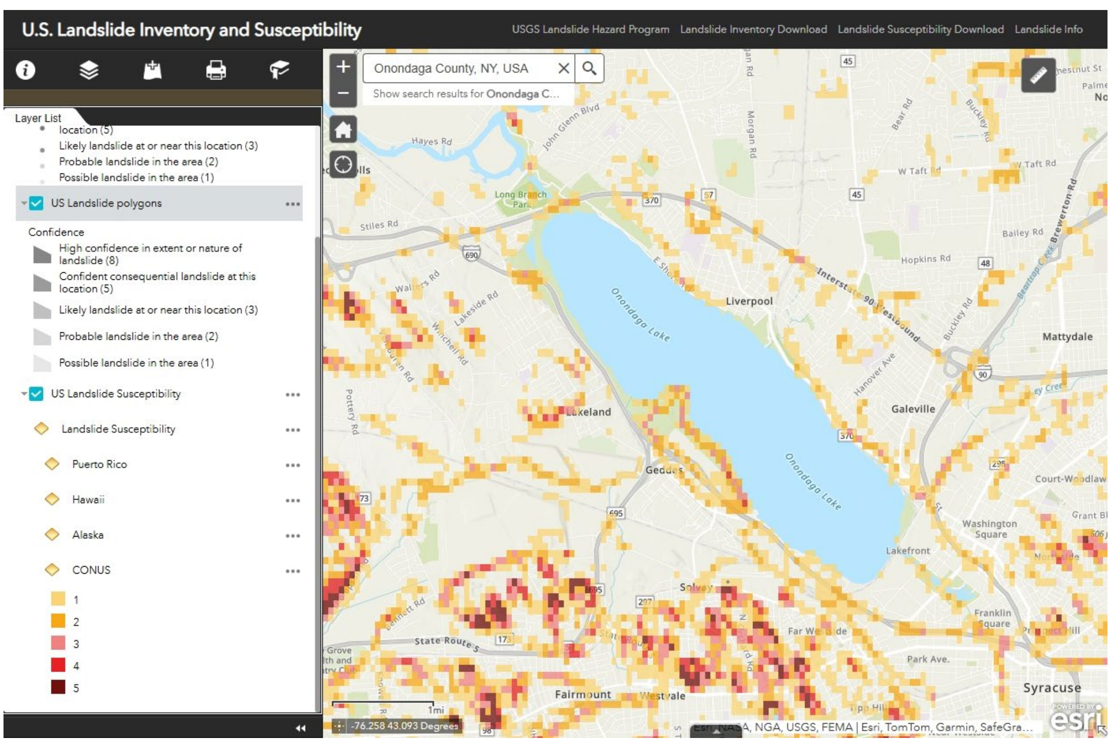


Figure C-8



APPENDIX D: FISH TISSUE METRICS UPDATE

Onondaga Lake OU2 Fish Tissue Metrics

Objective: The primary objective in the development of the fish tissue metrics for the Onondaga Lake Bottom subsite is when determining that fish tissue goals (for mercury) and target concentrations (for organics) have been met, it can be stated with a high level of confidence that ecological consumers and human consumers of fish, throughout all areas of Onondaga Lake, are typically consuming fish at a concentration at or below the fish tissue goals and target concentrations.

Summary of Approach: While the 95% UCL (using all valid sample results, including potential outliers) will be the main statistical approach to determine if remedial goals/targets in fish are being met for protection of human health and ecological receptors on a lake-wide level in Onondaga Lake, additional measures to confirm compliance or possibly trigger further investigation are necessary for evaluating fish tissue from Onondaga Lake, even when the 95% UCL falls below the goals/targets for each fish species. EPA and DEC recommend performing data visualizations for each species on both Honeywell and DEC fish samples (DEC samples are from a different fish species than Honeywell's samples) with each new fish data set. This would help to identify distribution patterns to provide a closer examination of the data, such as identifying potential outliers often represented by samples above the interquartile range (on standard box-and whisker plots) that continue to exceed goals/targets. Statistical programs such as EPA's ProUCL can assist in this process. This would include, but is not limited to, using the goodness of fit (GOF) test to indicate non-parametric data sets[20] to capture potential distributional issues in the data. Documentation of the statistical distribution supporting the selection of the 95% UCL will be included (e.g., ProUCL output files). Information that could be looked at more closely include spatial patterns, fish size/age, and any other potential reasons for outliers.

The ROD estimated that concentrations of contaminants in fish will be reduced within ten years following completion of remedial activities, which would be by 2026. While the OLMMP states "Performance criteria should be met for three consecutive years in a row or, 4 years out of 5 to verify achievement of goals", EPA and DEC may require further evaluations of potential distributional patterns to confirm that goals/targets have been met. Fish tissue monitoring will continue to be performed as documented in the OLMMP (Parsons, 2018) and any future addenda. However, further sampling, including potential modifications to the sampling program, may be required based on these evaluations.

[20] Selection of underlying distribution in ProUCL uses the following decision rule: a normal distribution is selected if data pass the GOF tests for normality at the 1% level of significance; a gamma distribution is selected if data fail the tests for normality above but pass the GOF test for a gamma distribution at a 5% level of significance; a lognormal distribution is selected if data fail both of the tests above but pass the GOF tests for lognormality at a 10% level of significance; and if a data set fails all three sets of GOF tests, no underlying statistical distribution is identified and non-parametric methods are recommended for calculation of 95% UCLs.

If EPA/DEC determine that there continue to be persistent exceedances of the goals/targets (i.e., 95% UCL remains above the threshold or is below the threshold, but multiple samples of a given species continue to exceed the threshold which could suggest that the objective noted above may not be achieved), then additional assessment may be needed. This assessment could include:

- An examination of fish contaminant results from baseline and after implementation of the remedy for factors that may be influencing the distribution or variability of the results. The factors could be related to localized exposure to residual contamination, continuing contaminant sources, different rates of recovery, unanticipated changes, or changes in trophic transfer of contaminants, among others.
- Collection of background data to determine whether significant further reductions in fish concentrations are practicable, with or without further remedial action.
- Additional analyses or data collection (potentially including other media) may be needed depending on the suspected causes of persistent exceedances in fish.

These analyses may indicate causative factors preventing fish tissue from meeting the goals/targets. Findings of these analyses may be used to adjust fish monitoring requirements, change expectations of fish tissue recovery, or evaluate if adjustments to remedial controls (e.g., nitrate addition, additional thin-layer capping) are necessary. If necessary, prior to implementing any additional remedial actions, an evaluation of the potential effectiveness of those actions in further reducing fish tissue concentrations would need to be performed.

If examination of the data has not revealed any additional modifications to data collection, causative factors for persistent exceedances or concerns with remedial controls, then examination on the achievability of one or more of the goals/targets for a specific species and contaminant will need to be performed and documented. These analyses will focus on factors that may be causing the persistent exceedances and may be outside of the influence of the remedial controls (e.g., background, sampling of reference water bodies, etc.). These analyses and determinations will be documented in future Five-Year Review reports and/or other periodic review documents issued by EPA/DEC. NYSDOH and DEC will continue to assess and communicate any changes to the fish consumption advisories as new fish data from Honeywell and DEC become available.

Attachment 1 – Figures and Tables

Attachment 1 – List of Tables

Table 1a: Target Tissue Concentrations for Fish (all concentrations in mg/kg wet weight)		
Contaminants of Concern	**Target Tissue Concentrations**	
Human Health – Fish Fillets	**Reasonable Maximum Exposure**	
Mercury (as MeHg)[4]	0.2	
Total PCBs[5]	0.03 to 0.1	
PCDD/PCDFs (TEQ as 2,3,7,8-TCDD)[6]	4×10^{-7} to 1.3×10^{-6}	
Ecological Exposure Small Fish (3-18 cm) - Whole Fish	**NOAEL**	**LOAEL**
Mercury (as MeHg)	0.009	0.187
Total PCBs	0.013	3.15
DDT and metabolites (sum)	0.005	0.049
Ecological Exposure Large Fish (18-60 cm) - Whole Fish	**NOAEL**	**LOAEL**
Mercury (as MeHg)	0.014	0.341
Total PCBs	0.019	9.6
DDT and metabolites (sum)	0.014	0.15

Table 1a Notes:
1. NOAEL = no-observed-adverse-effect-level; LOAEL = lowest-observed-adverse-effect-level.
2. NOAELs and LOAELs for small (3 to 18 cm) fish are based on the belted kingfisher and mink. NOAELs and LOAELs for large (18 to 60 cm) fish are based on the great blue heron, osprey, and river otter.
3. Only avian fish target concentrations are presented for DDT and metabolites.
4. The human health target tissue concentration for mercury (0.2 mg/kg) is based on young child reasonable maximum exposure (RME) (non-cancer effects). The RME target concentration for adults is slightly higher (0.3 mg/kg).
5. The human health target tissue concentrations for total PCBs are based on RME carcinogenic risks at risk targets ranging from 1E-05 (0.03 mg/kg) to 1E-04 (0.3 mg/kg). The RME targets based on non-cancer effects of 0.04 mg/kg for high molecular weight PCBs and 0.1 mg/kg for low molecular weight PCBs fall within the range based on carcinogenic risks. A target concentration based on the 1E-06 risk level was not selected as a goal since it is much lower than mean background concentrations in US waters and may not be achievable (see Appendix G of the Onondaga Lake FS).
6. TEQ = toxicity equivalent (toxicity-weighted mass of dioxin mixtures). The human health target tissue concentrations for PCDD/PCDFs are based on RME carcinogenic risks at risk targets ranging from 1E-05 (4E-07 mg/kg) to 1E-04 (4E-06 mg/kg). Non-carcinogenic targets were not developed for PCDD/PCDFs prior to the issuance of the ROD. Subsequent to its issuance, a RME noncancer endpoint target of 1.3E-06 mg/kg was developed using the parameters presented in Appendix G of the FS for a target concentration for the non-cancer endpoint, and using the EPA 2012 reference dose of 7E-10 mg/kg-day. The RME target based on non-cancer effects PCDD/PCDFs fall within the range based on carcinogenic risks. A target concentration based on the 1E-06 risk level was not selected as a goal since it is much lower than mean background concentrations in US waters and may not be achievable (see Appendix G of the Onondaga Lake FS).

Table 1b: Sediment Probable Effect Concentrations (PECs)	
Contaminants of Concern	**Performance Criteria Micrograms per Kilogram (μg/kg)**
Mercury	2,200
Ethylbenzene	176
Xylenes	560.8
Chlorobenzene	428
Dichlorobenzenes	239
Trichlorobenzenes	347
Acenapthene	861
Acenaphthylene	1,301
Anthracene	207
Benz[a]anthracene	192
Benzo[a]pyrene	146
Benzo[b]fluoranthene	908
Benzo[ghi]perylene	780
Benzo[k]fluoranthene	203
Chrysene	253
Dibenz[a,h]anthracene	157
Fluoranthene	1,436
Fluorene	264
Indeno[1,2,3-cd]pyrene	183
Naphthalene	917
Phenanthrene	543
Pyrene	344
Total PCBs	295

Table 1b Notes: The 23 site-specific PECs developed during the RI phase which are included in this table were used in the calculations for the mean PECQ approach. In the littoral zone, sediment remediation goals include achieving the mean PECQ of 1 or lower and the mercury PEC of 2.2 mg/kg or lower. In the profundal zone, sediment remediation goals include achieving the mean PECQ of 1 or lower, and achieving the mercury PEC or lower on a point basis and a BSQV of 0.8 mg/kg or lower on an area-wide basis within 10 years following the remediation of upland sources, littoral sediments, and initial thin-layer capping. The 23 PECs and NYSDEC sediment screening criteria for benzene, toluene, and phenol are also chemical isolation performance criteria for capped areas in the Lake's littoral zone, the Wastebed B Outboard Area, and the Wastebeds 1-8 connected wetland. Performance criteria for the Spits at the mouth of Ninemile Creek are based on remedial goals specified in the Geddes Brook/ Ninemile Creek OU2 ROD and include the NYSDEC Lowest Effect Level of 0.15 mg/kg for mercury.

Table 1c: Remediation Goals for Surface Water	
Contaminants of Concern	**New York State Surface Water Quality Standards**
Dissolved Mercury	0.7 ng/L
Chlorobenzene	5 μg/L
Dichlorobenzenes	5 μg/L

Table 1c Notes: Remediation goals for surface water are based on the NYSDEC aquatic (chronic) (A[C]) water quality standard for chlorobenzene and dichlorobenzenes and human health fish consumption (H[FC]) for dissolved mercury.

TABLE 2
CAP MONITORING CHEMICAL PARAMETERS

Remediation Area	Cap Model Area (Inclusive of MPCS)	Chemical Groups That Determined GAC Application Rate	Indicator Chemical Groups	Additional Chemical Groups
A	A1	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	A2[1]	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
B	B1	Phenol	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	B2	Phenol	VOCs[4], LPAHs, mercury, pH	PCBs, HPAHs
C	C1	Phenol	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	C2	LPAHs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	C3	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
D	SMU 2	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	West	Phenol	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	Center[2]	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	East	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
E	E1A[3]	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	E1B[3]	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
	E2	VOCs	VOCs, LPAHs, mercury	PCBs, HPAHs
	E3	VOCs	VOCs, mercury	PCBs, LPAHs, HPAHs
F	F	Sand Only	mercury	VOCs, PCBs, LPAHs, HPAHs
SMU 8 Amended TLCs and GAC Direct Application	SMU 8	Not Applicable	mean PECQ VOCs, PAHs, PCBs, mercury, pH	None
SMU 8 Unamended TLCs	SMU 8	Not Applicable	mean PECQ VOCs, PAHs, PCBs, mercury	None
Wetlands	WB1-8	VOCs	VOCs, LPAHs, mercury, pH	PCBs, HPAHs
	WBB-East	VOCs	VOCs, LPAHs, mercury	PCBs, HPAHs
	WBB-Center	VOCs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs
	WBB-West	VOCs	VOCs, LPAHs, HPAHs, mercury, pH	PCBs

Notes: Naphthalene is included as a VOC.

LPAHs include fluorene, phenanthrene, acenaphthene, acenaphthylene and anthracene. Phenol is not a PAH but is included in the LPAH indicator and additional chemical group for convenience since PAHs and phenol are both analyzed by EPA Method 8270. HPAHs include fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3,-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.

[1] Includes Ninemile Creek Spits and Model Area RA-A-40197.

[2] Includes Model Area OL-VC-10138/40.

[3] E1 consists of two separate areas that were modeled as one area.

[4] VOCs are not considered an indicator chemical group for Model Area B2 based on the original cap modeling but are included because they were modeled as part of the design for the MPCs within that area.

TABLE 3 FINAL WETLAND MITIGATION ACCOUNTING

MITIGATION AREA		MONITORING YEAR	CURRENT ACREAGE
Wetland Acreage			
Ninemile Creek Spits		5	2.47[1]
Mouth of Ninemile Creek In-Lake Wetlands		5	7.84[2]
Wastebeds 1- 8	Perched wetland A	5	2.87[3,4]
	Perched wetland B		3.79[3,4]
	Perched wetland C		0.53[3,4]
	Wastebeds 1-8 Connected Wetlands	5	0.29[4,5,6]
Wastebed B/Harbor Brook Outboard Wetland		5	10.6[7]
		Overall Mitigation Acreage Required	19.5[8]
		Final Mitigation Wetland Acreage	28.39
Open Water Acreages			
Wastebeds 1-8 Connected Wetlands		5	2.3[4,5]
Wastebed B/Harbor Brook Outboard		5	4.1[7]
		Overall Open Water Required	4.6[9]
		Final Open Water Acreage	6.4
Additional Wetland Area[10]			
Mouth of Ninemile Creek Shoreline Enhancement Area		5	0.57

[1] Calculated during a formal wetland delineation in 2021 (Parsons, 2024a). Represents contiguous wetland acreage in the area of the original spits connected to the shoreline.

[2] Calculated during a formal wetland delineation in 2021. Represents the in-lake persistent emergent (5.18 ac.), the floating aquatic (2.53 ac.), and 0.13 acers of the shoreline persistent emergent strip (Appendix 2C, Table 1 and Figure 5 of the 2021 Annual Report) (Parsons, 2024a).

[3] Calculated during a formal wetland delineation in 2019 (Ramboll, 2023).

[4] Wastebeds 1-8 Mitigation Wetland Delineation Report (Ramboll, 2023).

[5] Calculated during a formal wetland delineation in 2020 (Ramboll, 2023).

[6] Additional delineated acreage in excess of the designed 2.3 acres required to account for open water loss within the Wastebeds 1-8 Connected Wetlands.

[7] Calculated during a formal wetland delineation in 2022 (Parsons 2024b).

[8] Mitigation areas taken from Table 7.5A of the Onondaga Lake Monitoring and Maintenance Plan (Parsons, 2018).

[9] Mitigation areas taken from Table 7.5B of the Onondaga Lake Monitoring and Maintenance Plan (Parsons, 2018).

[10] Delineated wetland areas that are a result of restoration efforts but not included in the overall mitigation accounting

Honeywell PARSONS

TABLE 4.1 2022 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)															Comment
								Core 1 Thickness					Core 2 Thickness					Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
Remediation Area A	A1	1	OL-RAA-CAP-0001	12 / 9		6	18 / 15	NM	NM	21	1	Y	NM	NM	24	1	Y	NM	NM	22	1	Y	Several cores collected because location was used for direct extraction filter testing. Core 4: 22" total, native plug present, 1" new sediment; Core 5: 23" total, native plug present, 1" new sediment; Core 6: 21" total, native plug present, 1" new sediment; Core 7: 21" total, native plug present, 1.5" new sediment; Core 8: 18" total, native plug present, 1" new sediment
	A1	1	OL-RAA-CAP-0002	12 / 9		6	18 / 15	NM	NM	23	3	Y	NM	NM	22	4	Y	NA	NA	NA	NA	NA	
	A1	1	OL-RAA-CAP-0003	12 / 9		6	18 / 15	NM	NM	24	5	Y	NM	NM	22	3	Y	NA	NA	NA	NA	NA	
	A1	1	OL-RAA-CAP-0004	12 / 9		6	18 / 15	NM	NM	23	3	Y	NM	NM	28.5	2.5	Y	NM	NM	26	4	Y	Several cores collected because location was used for direct extraction filter testing. Core 4: 26" total, native plug present, 3.5" new sediment; Core 5: 27" total, native plug present, 1.25" new sediment; Core 6: 23" total, native plug present, 1" new sediment; Core 7: 27" total, native plug present, 4" new sediment; Core 8: 26" total, native plug present, 4" new sediment
	A1	1	OL-RAA-CAP-0005	12 / 9		12	24 / 21	NM	NM	24+	4	N	NM	NM	26	5	Y	NA	NA	NA	NA	NA	
	A2	1	OL-RAA-CAP-0006	12 / 9		12	24 / 21	NM	NM	32	4	Y	NM	NM	31	1.5	Y	NA	NA	NA	NA	NA	
	A1	1	OL-RAA-CAP-0007	12 / 9		12	24 / 21	NM	NM	27.5+	3	N	NM	NM	29	1	Y	NA	NA	NA	NA	NA	
	A2	2	OL-RAA-CAP-0008	18 / 9		12	30 / 21	12	20	32	12	Y	11	16+	27+	5	N	NA	NA	NA	NA	NA	
	A1	2	OL-RAA-CAP-0009	18 / 9		12	30 / 21	10	18	28	7	Y	10	12	22	6	Y	NA	NA	NA	NA	NA	
	A2	2	OL-RAA-CAP-0010	18 / 9		12	30 / 21	23	6+	29+	14	N	26	2+	28+	12	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0011	12 / 9	12	12	36 / 21	17	NM	NM	NM	N	17	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0012	12 / 9	12	12	36 / 21	15.5	NM	NM	NM	N	10.5	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RA-A40197	3	OL-RAA-CAP-0013	12 / 9	12	12	36 / 21	12	NM	NM	NM	N	12	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RA-A40197	3	OL-RAA-CAP-0014	12 / 9	12	12	36 / 21	13	NM	NM	NM	N	15	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0015	12 / 9	12	12	36 / 21	16	NM	NM	NM	N	12	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0016	12 / 9	12	12	36 / 21	10.5	NM	NM	NM	N	15	NM	NM	NM	N	NA	NA	NA	NA	NA	Thicknesses are topsoil habitat layer only
	RAA	3	OL-RAA-CAP-0017	19.5 / 9	4.5	12	36 / 21	17	NM	NM	NM	N	16	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0018	19.5 / 9	4.5	12	36 / 21	17	NM	NM	NM	N	19.5	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0019	12 / 9	12	12	36 / 21	18	NM	NM	NM	N	14	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0020	12 / 9	12	12	36 / 21	15.5	NM	NM	NM	N	16	NM	NM	NM	N	NA	NA	NA	NA	NA	
	RAA	3	OL-RAA-CAP-0021	12 / 9	12	12	36 / 21	12.5	NM	NM	NM	N	19	NM	NM	NM	N	NA	NA	NA	NA	NA	
Remediation Area B	B2	1	OL-RAB-CAP-0002	12 / 9		12	24 / 21	NM	NM	31	3.5	Y	NM	NM	29	3	Y	NM	NM	30	4	Y	Core 4: 34" total, native plug present, 3" new sediment. GAC observed shallower than expected in Cores 1 thru 3 (11-19", 8-19", and 9-18", respectively). Sample collected from Core 3 and bottom of H/EP sample interval shifted to 6-9".
	B1/C1	1	OL-RAB-CAP-0015	12 / 9		12	24 / 21	NM	NM	26	0.25	Y	NM	NM	25.5	0.5	Y	NA	NA	NA	NA	NA	
	RA-B-1C (4-10)	2	OL-RAB-CAP-0008	12 / 9		9	21 / 18	9	13	22	0	Y	11	10	21	0	Y	NA	NA	NA	NA	NA	
	RA-B-1E (4-10)	2	OL-RAB-CAP-0016	12 / 9		12	24 / 21	6	14.5	20.5	0	Y	8.5	7.5	16	0	Y	NA	NA	NA	NA	NA	
	RA-B-1A	1	OL-RAB-CAP-0001	12 / 9		7.5	19.5 / 16.5	NM	NM	28	2.5	Y	NM	NM	26	3	Y	NA	NA	NA	NA	NA	
	RA-B-1A	1	OL-RAB-CAP-0003	12 / 9		7.5	19.5 / 16.5	NM	NM	20	0.125	Y	NM	NM	21	2	Y	NM	NM	21	4.5	Y	Core 4: 25" total, native plug present, 2" new sediment. GAC observed shallower than expected in all cores (9-17", 6-15", 11-19", and 10-22", respectively). Sample collected from Core 4 and sample interval shifted to 7-10".
	RA-B-1B	1	OL-RAB-CAP-0004	6 / 3		3	9 / 6	NM	NM	16	0.5	Y	NM	NM	15	1	Y	NA	NA	NA	NA	NA	
	RA-B-1E (10-30)	1	OL-RAB-CAP-0014	12 / 9		6	18 / 15	NM	NM	32	1	Y	NM	NM	30	2	Y	NA	NA	NA	NA	NA	
	WB 1-8 Wetland	3	OL-RAB-CAP-0006	19.5 / 9	4.5	12	36 / 21	12.5	NM	NM	NM	N	14	NM	NM	NM	N	NA	NA	NA	NA	NA	
	WB 1-8 Wetland	3	OL-RAB-CAP-0009	19.5 / 9	4.5	12	36 / 21	12	NM	NM	NM	N	17	NM	NM	NM	N	NA	NA	NA	NA	NA	Thicknesses are topsoil habitat layer only
	WB 1-8 Wetland	3	OL-RAB-CAP-0019	19.5 / 9	4.5	12	36 / 21	15.5	NM	NM	NM	N	21	NM	NM	NM	N	NA	NA	NA	NA	NA	

TABLE 4.1a 2022 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT (CONTINUED)

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)															Comment
								Core 1 Thickness					Core 2 Thickness					Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
Remediation Area C	B1/C1	1	OL-RAC-CAP-0002	12 / 9		12	24 / 21	NM	NM	26	1	Y	NM	NM	30	0.5	Y	NA	NA	NA	NA	NA	
	C2	1	OL-RAC-CAP-0003	12 / 9		12	24 / 21	NM	NM	29	0.25	Y	NM	NM	37	1	Y	NA	NA	NA	NA	NA	
	C2	1	OL-RAC-CAP-0004	12 / 9		12	24 / 21	NM	NM	32	0.25	Y	NM	NM	26.5	0.25	Y	NA	NA	NA	NA	NA	
	C3	1	OL-RAC-CAP-0020	12 / 9		12	24 / 21	NM	NM	36	2	Y	NM	NM	30	1	Y	NA	NA	NA	NA	NA	
	C3	1	OL-RAC-CAP-0021	12 / 9		12	24 / 21	NM	NM	43	1	Y	NM	NM	34	1	Y	NA	NA	NA	NA	NA	
	C3	1	OL-RAC-CAP-0023	13 / 9		13	25 / 21	NM	NM	23+	1.5	N	NM	NM	32	0.5	Y	NA	NA	NA	NA	NA	
	B1/C1	2	OL-RAC-CAP-0001	18 / 9		12	30 / 21	16	17	33	0	Y	12	18.5	30.5	0	Y	NA	NA	NA	NA	NA	
	B1/C1	2	OL-RAC-CAP-0058	18 / 9		12	30 / 21	12+	NM	12+	0	N	15+	NM	15+	12	N	15+	NM	15+	0	N	Gravel cap material necessitated use of steel core barrel, but steel barrel did not effectively capture new sediment or sand. New sediment mixed with water and fell out of core barrel as turbid mixture. Gravel thicknesses all meet targets.
	C3	2	OL-RAC-CAP-0022	18 / 9		12	30 / 21	10.5	24.5+	35+	0.5	N	10	19+	29+	0.5	N	NA	NA	NA	NA	NA	
	RA-C-2A (10-30)	1	OL-RAC-CAP-0005	12 / 9		4.5	16.5 / 13.5	NM	NM	19	0.5	Y	NM	NM	20	1	Y	NA	NA	NA	NA	NA	
	RA-C-2A (10-30)	1	OL-RAC-CAP-0009	12 / 9		4.5	16.5 / 13.5	NM	NM	14	0.25	Y	NM	NM	18.5	1	Y	NA	NA	NA	NA	NA	
	RA-C-1A	1	OL-RAC-CAP-0016	9 / 6		4.5	13.5 / 10.5	NM	NM	15	0.25	Y	NM	NM	12	0.25	Y	NA	NA	NA	NA	NA	13-15" in Core 1 and 8-12" in Core 2 are potentially mixed with underlying native sediment.
		2	OL-RAC-CAP-0007	10 / 7		4.5	14.5 / 11.5	7	8	15	0	Y	5.5	8.5	14	0	Y	NA	NA	NA	NA	NA	
	RA-C-1A	1	OL-RAC-CAP-0017	9 / 6		4.5	13.5 / 10.5	NM	NM	17	0.5	Y	NM	NM	16	1	Y	NA	NA	NA	NA	NA	9-17" in Core 1 is black, potentially mixed with underlying sediment
	D-SMU-2	1	OL-RAD-CAP-0001	12 / 9		12	24 / 21	NM	NM	40	3	Y	NM	NM	39	4	Y	NA	NA	NA	NA	NA	
	D-SMU-2	1	OL-RAD-CAP-0006	12 / 9		12	24 / 21	NM	NM	38	3	Y	NM	NM	37	2	Y	NA	NA	NA	NA	NA	
	D-Addendum East	1	OL-RAD-CAP-0007	12 / 9		12	24 / 21	NM	NM	30+	2	N	NM	NM	37	2	Y	NA	NA	NA	NA	NA	
	D-SMU-2	1	OL-RAD-CAP-0009	12 / 9		12	24 / 21	NM	NM	34.5	3	Y	NM	NM	26.5+	3	N	NA	NA	NA	NA	NA	
	D-West	1	OL-RAD-CAP-0010	12 / 9		12	24 / 21	NM	NM	29.5	1	Y	NM	NM	27	2	Y	NA	NA	NA	NA	NA	Slight mixing of native sediment and sand in bottom 3" of Core 2
	D-Center	1	OL-RAD-CAP-0012	12 / 9		12	24 / 21	NM	NM	31	0.5	Y	NM	NM	30	0	Y	NA	NA	NA	NA	NA	
	D-Center	1	OL-RAD-CAP-0013	12 / 9		12	24 / 21	NM	NM	35	1	Y	NM	NM	31	0.25	Y	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0014	12 / 9		12	24 / 21	NM	NM	32	3	Y	NM	NM	36	2	Y	NM	NM	30	1	Y	Core 4: 26" total, native plug present, 0.5" new sediment.
	D-West	1	OL-RAD-CAP-0015	12 / 9		12	24 / 21	NM	NM	37	0.5	Y	NM	NM	34	1	Y	NA	NA	NA	NA	NA	
	D-SMU-2	1	OL-RAD-CAP-0016	12 / 9		12	24 / 21	NM	NM	30	0.125	Y	NM	NM	28	0	Y	NA	NA	NA	NA	NA	In Core 1: Layer of native material 30-32". In core 2: Layer of native material 25-27".
	D-West	1	OL-RAD-CAP-0020	12 / 9		12	24 / 21	NM	NM	32	0	Y	NM	NM	33	0.25	Y	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0021	12 / 9		12	24 / 21	NM	NM	29+	0	N	NM	NM	35.5	1	Y	NM	NM	29+	0.5	N	Several cores collected because location was used for direct extraction filter testing. Core 4: 27+" total, no native plug, 0.5" new sediment; Core 5: 32+" total, no native plug, 0.25" new sediment; Core 6: 13+" total, no native plug, 0" new sediment; Core 7: 27.5+" total, no native plug, 1" new sediment; Core 8: 26+" total, no native plug, 1" new sediment. Core 9: 30+" total, no native plug, 4" new sediment; Core 10: 28" total, native plug present, 2" new sediment.
	D-East	1	OL-RAD-CAP-0025	12 / 9		12	24 / 21	NM	NM	30	0.5	Y	NM	NM	25	0.5	Y	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0028	9-Dec		12	24 / 21	NM	NM	27.5	0.5	Y	NM	NM	27	0.25	Y	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0031	12 / 9		12	24 / 21	NM	NM	29+	1	N	NM	NM	32	0.5	Y	NM	NM	25	0.5	Y	Core 4: 33" total, native plug present, 0.127" new sediment; Core 5: 24+" total, no native plug, 0.5" new sediment; Core 6: 35" total, native plug present, 0" new sediment; Core 7: 32+" total, no native plug, 1.5" new sediment; Core 8: 39" total, native plug present, 1" new sediment.
	D-East	1	OL-RAD-CAP-0032	12 / 9		12	24 / 21	NM	NM	28+	0.25	N	NM	NM	37.5+	0.25	N	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0033	12 / 9		12	24 / 21	NM	NM	25	3	Y	NM	NM	17+	3.5	N	NM	NM	26	3	Y	In Core 1, interspersed layers of native plug and medium sand cap as follows: native plug: 25-27", med. sand: 27-29", native plug: 29-34", med. sand: 34-35", native plug: 35-38", med. sand: 38-40", native plug 40" to bottom; In Core 3, Interspersed native plug and medium sand cap as follows: native plug: 26-34", med. sand: 34-40", native plug: 40" to bottom.
	D-East	1	OL-RAD-CAP-0038	12 / 9		12	24 / 21	NM	NM	30	1	Y	NM	NM	35	2	Y	NA	NA	NA	NA	NA	
	D-East	1	OL-RAD-CAP-0040	12 / 9		12	24 / 21	NM	NM	32	1	Y	NM	NM	33	2	Y	NA	NA	NA	NA	NA	
	D-Center	2	OL-RAD-CAP-0017	12 / 9		12	24 / 21	8	3	11	0	Y	19	11	28	0	Y	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port. In Core 1, native sediment/cap mixture 11-25" In Core 2, native sediment/cap mixture 28-30" Mixing likely due to disturbance during removal process of core from steel core barrel.

TABLE 4.1 a 2022 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT (CONTINUED)

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)															Comment
								Core 1 Thickness					Core 2 Thickness					Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
Remediation Area D	D-Center	2	OL-RAD-CAP-0018	12 / 9		12	24 / 21	17	5+	23+	1	N	10	8+	18+	0.5	N	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port.
	D-West	2	OL-RAD-CAP-0022	18 / 9		12	30 / 21	22	6+	28+	5	N	25	3.5+	28.5+	5	Y	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port.
	D-Center	2	OL-RAD-CAP-0023	18 / 9		12	30 / 21	16	15+	31+	12	N	13	5+	18+	0	N	NA	NA	NA	NA	NA	
	D-Center	2	OL-RAD-CAP-0024	12 / 9		12	24 / 21	13	5	18	3	Y	9	8	17	0.25	Y	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port. In Core 1, native sediment/cap mixture 18-20" In Core 2, native sediment/cap mixture 17-20" Mixing likely due to disturbance during removal process of core from steel core barrel.
	D-Center	2	OL-RAD-CAP-0026	12 / 9		12	24 / 21	13	9+	22+	0	N	8	0	8	0	Y	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port. In Core 2, native sediment/cap mixture 8-22". Mixing likely due to disturbance during removal process of core from steel core barrel.
	D-Center	2	OL-RAD-CAP-0029	18 / 9		12	30 / 21	18	5	23	2	Y	14	0+	14+	1	N	NA	NA	NA	NA	NA	Co-located with peeper adjacent to sample port. In Core 1, some native sediment mixed in with sand and gravel cap, likely due to disturbance during removal process of core from steel core barrel. In Core 2, sand was observed falling out of the bottom of the core during retrieval.
	D-Center	2	OL-RAD-CAP-0034	18 / 9		12	30 / 21	16	18+	34+	8	N	13	2+	15+	0	N	NA	NA	NA	NA	NA	
	D-East	2	OL-RAD-CAP-0036	12 / 9		12	24 / 21	11	19+	30+	0	N	10	18+	28+	0	N	NA	NA	NA	NA	NA	
	D-Center	SP[6]	OL-RAD-CAP-0017	12 / 9		12	24 / 21	12	20	32	0	Y	17	15	32	0	Y	NA	NA	NA	NA	NA	Collected from within sample port
	D-West	SP[6]	OL-RAD-CAP-0022	12 / 9		12	24 / 21	11	17	28	0	Y	14	3+	17+	0	N	NA	NA	NA	NA	NA	Collected from within sample port
	D-Center	SP[6]	OL-RAD-CAP-0024	18 / 9		12	30 / 21	8	27	35	0.25	Y	4	21	25	0.5	Y	NA	NA	NA	NA	NA	Collected from within sample port. In Core 1, interspersed native sediment and fine gravel/medium sand cap as follows: fine gravel 0-8", native sediment 8-12", medium sand 12-39", native sediment 39-45". In Core 2, interspersed native sediment and fine gravel/medium sand cap as follows: fine gravel 0-4", native sediment 4-9", medium sand 9-30", native sediment 30-35", medium sand 35-37", native sediment 37-45".
	D-Center	SP[6]	OL-RAD-CAP-0026	12 / 9		12	24 / 21	3	17	20	17	Y	3	17	20	12	Y	NA	NA	NA	NA	NA	Collected from within sample port
	D-Center	SP[6]	OL-RAD-CAP-0029	12 / 9		12	24 / 21	8	14	22	0	Y	11.5	9.5	21	0	Y	NA	NA	NA	NA	NA	Collected from within sample port
	RA-D-1A	1	OL-RAD-CAP-0002	12 / 9		6	18 / 15	NM	NM	25+	3.5	N	NM	NM	32	2.5	Y	NA	NA	NA	NA	NA	
	RA-D-1A	1	OL-RAD-CAP-0003	12 / 9		6	18 / 15	NM	NM	30	2	Y	NM	NM	19+	0.25	N	NA	NA	NA	NA	NA	
	RA-D-1A	1	OL-RAD-CAP-0004	12 / 9		6	18 / 15	NM	NM	30+	0.5	N	NM	NM	31.5	1.25	Y	NM	NM	33	1	Y	Several cores collected because location was used for direct extraction filter testing. Core 4: 23" total, native plug present, 0.5" new sediment; Core 5: 35: total, no native plug, 1" new sediment; Core 6: 33" total, native plug present, 3" new sediment; Core 7: 14.5" total, native plug present, 0" new sediment Core 8: 22.75" total, native plug present, 1" new sediment
	RA-D-1A	1	OL-RAD-CAP-0057	12 / 9		6	18 / 15	NM	NM	0	0	Y	NM	NM	0	0	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057A	12 / 9		6	18 / 15	NM	NM	40	1	Y	NM	NM	40+	6	N	NM	NM	14.5	0.25	Y	In Core 3, layers of native sediment and medium sand cap as follows: native sediment 14.4-20", med. sand 20-45"
	RA-D-1A		OL-RAD-CAP-0057B	12 / 9		6	18 / 15	NM	NM	32	1	Y	NM	NM	33	0.25	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057C	12 / 9		6	18 / 15	NM	NM	44+	11	N	NM	NM	37	0.5	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057D	12 / 9		6	18 / 15	NM	NM	1	0.25	Y	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	Native sediment/cap mixture in top 1"; layers of native sediment and medium sand cap as follows: native sediment 1-15", native sediment/med. sand mix 15-20.5", med. sand 20.5-27.5", native sediment 27.5-59"
	RA-D-1A		OL-RAD-CAP-0057E	12 / 9		6	18 / 15	NM	NM	40.5	0.25	Y	NM	NM	37	0.75	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057F	12 / 9		6	18 / 15	NM	NM	8	0	Y	NM	NM	7	0	Y	NA	NA	NA	NA	NA	In Core 1, native sediment/cap mixture 8-26" In Core 2, native sediment/cap mixture 0-7"
	RA-D-1A		OL-RAD-CAP-0057G	12 / 9		6	18 / 15	NM	NM	4	0	Y	NM	NM	6	0	Y	NA	NA	NA	NA	NA	In Core 1, native sediment/cap mixiture 0-4" In Core 2, native sediment/cap mixture 6-7"
	RA-D-1A		OL-RAD-CAP-0057H	12 / 9		6	18 / 15	NM	NM	17	0	Y	NM	NM	8	0	Y	NA	NA	NA	NA	NA	In Core 1, native sediment/cap mixture 17-21" In Core 2, native sediment/cap mixture 8-21"
	RA-D-1A		OL-RAD-CAP-0057I	12 / 9		6	18 / 15	NM	NM	9	0.25	Y	NM	NM	2	0	Y	NA	NA	NA	NA	NA	In Core 1, native sediment/cap mixture 9-15" In Core 2, native sediment/cap mixture 0-2"
	RA-D-1A		OL-RAD-CAP-0057J	12 / 9		6	18 / 15	NM	NM	6	0	Y	NM	NM	5	0	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057K	12 / 9		6	18 / 15	NM	NM	36	0.5	Y	NM	NM	28	0.25	Y	NA	NA	NA	NA	NA	In Core 2, native sediment/cap mixture 28-29"
	RA-D-1A		OL-RAD-CAP-0057L	12 / 9		6	18 / 15	NM	NM	33	0.5	Y	NM	NM	28	0.25	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057M	12 / 9		6	18 / 15	NM	NM	26	1.5	Y	NM	NM	13	0.25	Y	NA	NA	NA	NA	NA	In Core 1, native sediment/cap mixture 26-29"

TABLE 4.1 a 2022 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT (CONTINUED)

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)															Comment
								Core 1 Thickness					Core 2 Thickness					Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
	RA-D-1A		OL-RAD-CAP-0057N	12 / 9		6	18 / 15	NM	NM	16	0.25	Y	NM	NM	11	0	Y	NA	NA	NA	NA	NA	In Core 1, layers of native sediment and cap as follows: native sediment 16-21", native sediment/cap mixture 21-30", native sediment 30-58" In Core 2, layers of native sediment and cap as follows: native sediment 11-23", native sediment/cap mixture 23-37", native sediment 37-56"
	RA-D-1A		OL-RAD-CAP-0057O	12 / 9		6	18 / 15	NM	NM	11	4	Y	NM	NM	15	0.125	Y	NA	NA	NA	NA	NA	
	RA-D-1A		OL-RAD-CAP-0057P	12 / 9		6	18 / 15	NM	NM	13.5	0.25	Y	NM	NM	16	0	Y	NA	NA	NA	NA	NA	
	RA-D-2	1	OL-RAD-CAP-0008	10.5 / 7.5		7.5	18 / 15	NM	NM	20.5	2	Y	NM	NM	20	2	Y	NA	NA	NA	NA	NA	In core 1, GAC 8-11", smear of GAC to 6 but does not continue through width of core. GAC not observed in core 2
	RA-D-2	1	OL-RAD-CAP-0019	10.5 / 7.5		7.5	18 / 15	NM	NM	21	0.5	Y	NM	NM	21	0.5	Y	NA	NA	NA	NA	NA	In core 1, GAC 7-9" and 13-15". In core 2, GAC 8-11". Sampling from Core 2 and adjusting bottom of H/EP sample interval to 5-8" to reflect shallow GAC.
	Outboard West	3	OL-RAD-CAP-0027	19.5 / 9	4.5	12	36 / 21	12	NM	NM	NM	N	18	NM	NM	NM	N	NA	NA	NA	NA	NA	Thicknesses are topsoil habitat layer only
	Outboard West	3	OL-RAD-CAP-0030	19.5 / 9	4.5	12	36/21	15	NM	NM	NM	N	18	NM	NM	NM	N	NA	NA	NA	NA	NA	
	Outboard West	3	OL-RAD-CAP-0035	19.5 / 9	4.5	12	36/21	19	NM	NM	NM	N	16	NM	NM	NM	N	NA	NA	NA	NA	NA	
	Outboard Center	3	OL-RAD-CAP-0037	19.5 / 9	4.5	12	36/21	20	NM	NM	NM	N	12	NM	NM	NM	N	NA	NA	NA	NA	NA	
	Outboard Center	3	OL-RAD-CAP-0039	19.5 / 9	4.5	12	36/21	11	NM	NM	NM	N	12.5	NM	NM	NM	N	15	NM	NM	NM	N	Core 4: 12.5" topsoil. Thicknesses are topsoil habitat layer only. Respective penetrations in cores 3 and 4: 24" and 24", indicating that significant consolidation of cap material occurred during coring.
	Outboard Center	3	OL-RAD-CAP-0041	19.5 / 9	4.5	12	36/21	9	NM	NM	NM	N	8	NM	NM	NM	N	15	NM	NM	NM	N	Core 4: 14" topsoil. Thicknesses are topsoil habitat layer only. Respective penetrations in cores 3 and 4: 28" and 26", indicating that significant consolidation of cap material occurred during coring.
	Outboard East	3	OL-RAD-CAP-0042	19.5 / 9	4.5	12	36/21	13	NM	NM	NM	N	14.5	NM	NM	NM	N	NA	NA	NA	NA	NA	Thicknesses are topsoil habitat layer only
	Outboard East	3	OL-RAD-CAP-0043	19.5 / 9	4.5	12	36/21	13	NM	NM	NM	N	12.5	NM	NM	NM	N	NA	NA	NA	NA	NA	
	Outboard East	3	OL-RAD-CAP-0044	19.5 / 9	4.5	12	36/21	11	NM	NM	NM	N	15	NM	NM	NM	N	NA	NA	NA	NA	NA	
	Outboard East	3	OL-RAD-CAP-0045	19.5 / 9	4.5	12	36/21	7	NM	NM	NM	N	10	NM	NM	NM	N	8	NM	NM	NM	N	Core 4: 15" topsoil. Thicknesses are topsoil habitat layer only. Respective penetrations in cores 3 and 4: 17" and 18", indicating that significant consolidation of cap material occurred during coring.
	Outboard East	3	OL-RAD-CAP-0046	19.5 / 9	4.5	12	36 / 21	18.75	NM	NM	NM	N	25.5	NM	NM	NM	N	NA	NA	NA	NA	NA	Thicknesses are topsoil habitat layer only

Honeywell PARSONS

TABLE 4.1 a 2022 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT (CONTINUED)

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)															Comment
								Core 1 Thickness					Core 2 Thickness					Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
Remediation Area E	E-1 (B)	1	OL-RAE-CAP-0017	12 / 9		6	18 / 15	NM	NM	25	4	Y	NM	NM	24	7	Y	NM	NM	29+	1	N	
	E-1 (B)	1	OL-RAE-CAP-0018	12 / 9		6	18 / 15	NM	NM	24.5	3	Y	NM	NM	19	4	Y	NA	NA	NA	NA	NA	
	E-1 (B)	1	OL-RAE-CAP-0021	12 / 9		6	18 / 15	NM	NM	19	0.5	Y	NM	NM	19.5	1	Y	NA	NA	NA	NA	NA	
	E-3	1	OL-RAE-CAP-0025	12 / 9		6	18 / 15	NM	NM	23	0	Y	NM	NM	21.5	0	Y	NA	NA	NA	NA	NA	
	E-3	1	OL-RAE-CAP-0027	12 / 9		6	18 / 15	NM	NM	21	3	Y	NM	NM	22	3	Y	NA	NA	NA	NA	NA	
	E-3	1	OL-RAE-CAP-0030	12 / 9		6	18 / 15	NM	NM	36	0.25	N	NM	NM	34	2.5	Y	NA	NA	NA	NA	NA	
	E-2	1	OL-RAE-CAP-0031	12 / 9		12	24 / 21	NM	NM	18+	1	Y	NM	NM	31	0.5	Y	NA	NA	NA	NA	NA	
	E-2	3	OL-RAE-CAP-0033	12 / 9		12	24 / 21	NM	NM	28	2.5	Y	NM	NM	31	2	Y	NA	NA	NA	NA	NA	
	E-1 (B)	2	OL-RAE-CAP-0019	12 / 9		12	24 / 21	12	26	38	0	Y	10	10+	20+	0	N	NA	NA	NA	NA	NA	
	E-1 (B)	2	OL-RAE-CAP-0020	12 / 9		12	24 / 21	13	14	27	4	Y	9	11	20	2	Y	NA	NA	NA	NA	NA	
	E-1 (B)	2	OL-RAE-CAP-0022	12 / 9		12	24 / 21	13	10	23	0	Y	17	14	31	1	Y	NA	NA	NA	NA	NA	
	E-3	2	OL-RAE-CAP-0023	12 / 9		12	24 / 21	32	20	52	0	Y	19	19	38	0	Y	NA	NA	NA	NA	NA	
	E-3	2	OL-RAE-CAP-0029	12 / 9		12	24 / 21	39	13	52		Y	31	12	43		Y	NA	NA	NA	NA	NA	
	E-3	2	OL-RAE-CAP-0035	12 / 9		12	24 / 21	16	20	36	3	Y	6	21.5	27.5	0	Y	NA	NA	NA	NA	NA	
	E-2	2	OL-RAE-CAP-0039	12 / 9		12	24 / 21	7	18	25	0	Y	11	15	26	0	Y	17	12	29	0	Y	
	E-2	2	OL-RAE-CAP-0040	12 / 9		12	24 / 21	10	22	32	0	Y	10	18+	28+	0	N	NA	NA	NA	NA	NA	
	E-3	2	OL-RAE-CAP-0026	12 / 9		12	24 / 21	37	1+	38+	0.5	N	48	10	58	0	Y	NA	NA	NA	NA	NA	
RA-F	RAF	1	OL-RAF-CAP-0001	12 / 9		12	24 / 21	NM	NM	22	4	Y	NM	NM	24+	3	N	NA	NA	NA	NA	NA	
	RAF	1	OL-RAF-CAP-0002	12 / 9		12	24 / 21	NM	NM	26	0.25	Y	NM	NM	29	2	Y	NA	NA	NA	NA	NA	

[Boxed cell] Measured thickness is less than the minimum target thickness specificed in the OLMMP.

[1] The coarsest substrates in Zones 1, 2, and 3 are sand, fine gravel and coarse gravel/cobble, respectively.

[2] When the habitat and erosion protection layer are the same substrate, the total thickness of the habitat/erosion protection layer is listed under the habitat layer.

[3] Design thickness specified as a minimum.

[4] Listed thickness is the target minimum thickness specified in the OLMMP.

[5] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

[6] SP - Sample Ports. There are no thickness goals for material within the sample ports. At sample port locations D-22 and D-26, gravel was present and there was at least 15" of sand in one of the cores, therefore samples were collected from the top 3" of sand as specified in the OLMMP.

NA - Not applicable, core was not required or collected.

NM - Not measured. When the entire cap consists of sand, it is not possible to differentiate the different layers, therefore only the total thickness is provided. When the cap design consists of topsoil overlying coarse gravel, the core can be advanced through the topsoil but not the coarse gravel, therefore only the topsoil thickness is provided.

TABLE 4.1b 2022 MONO-LAYER CAP THICKNESS MEASUREMENTS

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)												Comment
						Core 1 Thickness			Core 2 Thickness			Core 3 Thickness			Core 4 Thickness			
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	
RA-B	RA-B-1C (10-20)	1	OL-RAB-CAP-0010	MPC Monolayer	8	6	0	Y	7.5	0	Y	NA	NA	NA	NA	NA	NA	
	RA-B-1D (20-30)	1	OL-RAB-CAP-0011	MPC Monolayer	7.5	5	2	Y	5	0.25	Y	NA	NA	NA	NA	NA	NA	In Core 1: 5-12" interval was slightly discolored and potentially mixed with native material and in 12-15.5" interval, cap was highly mixed with native material. In Core 2: 5-7" interval contains cap and native material mixture.
	RA-B-1D (10-20)	1	OL-RAB-CAP-0013	MPC Monolayer	12	6	0.5	Y	7	2	Y	NA	NA	NA	NA	NA	NA	In Core 2, 7-14" interval had black staining and appeared to be mixed with native material.
	RA-B-1C	1	OL-RAB-CAP-0005	MPC Monolayer	2	2	2	Y	4	3	Y	3.25	0.75	Y	0	4	Y	Core 5: 0.5" cap, 4" new sediment, native plug present. Core 6: 0" cap, 12" new sediment, native plug present. 0-12" interval contained cap and native material mixture. In Cores 1, 2, and 5: cap contained new sediment mixed in.
	RA-B-1C	1	OL-RAB-CAP-005A	MPC Monolayer	2	2.75	0.25	Y	3.5	0.5	Y	6.5	0.5	Y	8	12	Y	Cores collected at C-5A and C-5B as offsets from location C-5 to allow for sufficient sample volume collection. In Cores 1, 2, and 3: cap contained new sediment mixed in.
	RA-B-1C	1	OL-RAB-CAP-005B	MPC Monolayer	2	2	1	Y	2	1	Y	NA	NA	NA	NA	NA	NA	Cores collected at C-5A and C-5B as offsets from location C-5 to allow for sufficient sample volume collection.
	RA-B-1C	1	OL-RAB-CAP-005C	MPC Monolayer	2	3	8	Y	5	2	Y	NA	NA	NA	NA	NA	NA	In both cores: cap contained new sediment mixed in.
	RA-B-1C	1	OL-RAB-CAP-0007	MPC Monolayer	2	6.5	1.5	Y	3.5	0.5	Y	6	2	Y	4.5	0.5	Y	In Cores 1 and 3: cap contained new sediment mixed in. In Core 3: 6-9" interval contained cap and native material mixture.
	RA-B-1C	1	OL-RAB-CAP-0007A	MPC Monolayer	2	4.75	0.25	Y	4.25	0.25	Y	5	0	Y	4.75	0.25	Y	Core 5: 4.75" cap, 0.25" new sediment, native plug present.

TABLE 4.1b 2022 MONO-LAYER CAP THICKNESS MEASUREMENTS (CONTINUED)

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)												Comment
						Core 1 Thickness			Core 2 Thickness			Core 3 Thickness			Core 4 Thickness			
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	
RA-C	RA-C-1B	1	OL-RAC-CAP-0014	GAC Direct App.	0	2.75	0.25	Y	2.5	0.5	Y	5	1	Y	0	1	Y	Core 5: 3" cap, 3" new sediment, native plug present. Core 6: 6" cap, 2" new sediment, native plug present. In Core 2: cap contains new sediment mixed in. In Core 4: 0-1" interval contains cap and native material mixture.
RA-C	RA-C-1B	1	OL-RAC-CAP-0014A	GAC Direct App.	0	7	2	Y	2	6	Y	10	7	N	13	5	Y	Cores collected at C-14A and C-14B as offsets from location C-14 to allow for sufficient sample volume collection. Core 5: 4" cap, 3" new sediment, native plug present.
RA-C	RA-C-1B	1	OL-RAC-CAP-0014B	GAC Direct App.	0	8	2	Y	6.5	2	Y	4	2	Y	4	2	Y	Cores collected at C-14A and C-14B as offsets from location C-14 to allow for sufficient sample volume collection. Core 5: 4.5" cap, 0.5" new sediment, native plug present.
RA-C	RA-C-1B	1	OL-RAC-CAP-0018	GAC Direct App.	0	1.5	0.5	Y	9.75	0.25	Y	1.75	0.25	Y	7.25	0.75	Y	Core 5: 8.5" cap, 0.5" new sediment, native plug present. Core 6: 5.75" cap, 0.25" new sediment, native plug present. 5.75-7.75" interval contains cap and native material mixture. In Core 1: 2-4" interval contains cap and native material mixture. In Core 3: new sediment, mussels, and native sediment mixed in with cap. In Core 4: 7.25-11.25" interval contains cap and native material mixture.
RA-C	RA-C-1C	1	OL-RAC-CAP-0015	GAC Direct App.	0	7.5	0.5	Y	7.5	1	Y	8.5	0.5	Y	7	1	Y	Core 5: 6.5" cap, 0.5" new sediment, native plug present; Core 6: 6.5" cap, 0.5" new sediment, native plug present.
RA-C	RA-C-1D	1	OL-RAC-CAP-0019	MPC Monolayer	9	14	0.5	Y	12	0	Y	NA	NA	NA	NA	NA	NA	In Core 1: 14-16" interval has black staining, potentially mixed with native sediment. In Core 2: 12-14" interval has black staining, potentially mixed with native sediment.

TABLE 4.1b 2022 MONO-LAYER CAP THICKNESS MEASUREMENTS (CONTINUED)

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)												Comment
						Core 1 Thickness			Core 2 Thickness			Core 3 Thickness			Core 4 Thickness			
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	
RA-C	RA-C-2B	1	OL-RAC-CAP-0006	MPC Monolayer	2	4.75	0.25	Y	3.75	0.25	Y	4.75	0.25	Y	5.25	0.25	Y	Core 5: 4.75" cap, 0.25" new sediment, native plug present; Core 6: 2.5" cap, 0.5" new sediment, native plug present; Core 7: 2.75" cap, 0.25" new sediment, native plug present; Core 8: 3.5" cap, 0.125" new sediment, native plug present.
RA-C	RA-C-2B	1	OL-RAC-CAP-0008	MPC Monolayer	2	3.5	0.5	Y	3.5	0.125	Y	4.5	0.125	Y	3.75	0.25	Y	Core 5: 2" cap, 2" new sediment, native plug present. Core 6: 2.5" cap, 0.5" new sediment, native plug present. In Cores 5 and 6: cap contains new sediment mixed in.
RA-C	RA-C-2C	1	OL-RAC-CAP-0011	MPC Monolayer	13.5	15	2	Y	11.5	2	Y	NA	NA	NA	NA	NA	NA	
RA-C	RA-C-2C	1	OL-RAC-CAP-0013	MPC Monolayer	13.5	10	0	Y	12	0.25	Y	NA	NA	NA	NA	NA	NA	In Core 2: 12-13" interval contains cap and native material mixture.
RA-C	RA-C-2D	1	OL-RAC-CAP-0010	GAC Direct App.	0	9.5	1	Y	8	0.125	Y	5.75	0.25	N	6.75	0.125	NA	Core 5: 5.25" cap, 0.25" new sediment, no native plug. Core 6: 6.5" cap, 0.125" new sediment, no native plug. Core 7: 5.75" cap, 0.25" new sediment, no native plug. Core 8: 6.5" cap, 0.5" new sediment, no native plug. In Core 2: 8-9" interval contains slight mixing of cap and native material.
RA-C	RA-C-2D	1	OL-RAC-CAP-0012	GAC Direct App.	0	10.75	0.25	N	9	1	Y	5.75	0.25	Y	8.25	0.25	Y	Core 5: 9.5" cap, 0.5" new sediment, native plug present. Core 6: 10.75" cap, 0.25" new sediment, native plug present. Core 7: 7.75" cap, 0.25" new sediment, native plug present. Core 8: 8.75" cap, 0.25" new sediment, native plug present.
RA-D	RA-D-1B	1	OL-RAD-CAP-0005	MPC Monolayer	4.5	9.5	1	Y	10	4	Y	11.5	1.5	Y	9	4	N	Core 5: 6.5" cap, 2.5" new sediment, no native plug; Core 6: 10" cap, 1" new sediment, no native plug.
RA-D	RA-D-1B	1	OL-RAD-CAP-0011	MPC Monolayer	4.5	8	1	Y	1.5	0.5	Y	7.5	4.5	N	NA	NA	NA	In Core 2, cap contained new sediment mixed in and slight mixing of cap and native material in the 1.5-2.5" interval.
RA-D	RA-D-1B	1	OL-RAD-CAP-0011A	MPC Monolayer	4.5	8	3	Y	7	3	Y	5	0.5	Y	5	3	Y	Core 5: 7" cap, 3" new sediment, native plug present.

TABLE 4.1b 2022 MONO-LAYER CAP THICKNESS MEASUREMENTS (CONTINUED)

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)												Comment
						Core 1 Thickness			Core 2 Thickness			Core 3 Thickness			Core 4 Thickness			
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	
RA-E	MERC E2	1	OL-RAE-CAP-0036	MERC	6	6	0	Y	6	0	Y	7	0.75	Y	7	0	Y	Core 5: 7" cap, no new sediment, native plug present; Core 6: 6" cap, no new sediment, native plug present In Core 3: cap and native sediment mixture 7-20".
RA-E	MERC E3	1	OL-RAE-CAP-0038	MERC	6	7	0.25	Y	0	2	Y	5	0.5	Y	2	0.5	Y	Core 5: 2" cap, no new sediment, native plug present. Core 6: 0" cap, no new sediment, native plug present.
RA-E	MERC E3	1	OL-RAE-CAP-0038A	MERC	6	5	1	Y	6	0.5	Y	1	0.5	Y	NA	NA	NA	
RA-E	MERC E3	1	OL-RAE-CAP-0038B	MERC	6	6	0.5	Y	5.5	1.5	Y	NA	NA	NA	NA	NA	NA	
RA-E	MERC E3	1	OL-RAE-CAP-0038C	MERC	6	3	0.25	Y	5	0.25	Y	NA	NA	NA	NA	NA	NA	
RA-E	MERC E1	1	OL-RAE-CAP-0042	MERC	6	6	0.5	Y	8	0.5	Y	6	0.5	Y	11	0.5	Y	Core 5: 6" cap, 0.5" new sediment, native plug present. Core 6: 6" cap, 0.25" new sediment, native plug present. In all cores: top several inches of cap consisted of a mixture of sand, black new sediment, and organics.
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0014	TLC	2	11	2	Y	8	1	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0017	TLC	2	6+	1	N	11	4	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0018	TLC	2	7	2.5	Y	8+	2	N	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0019	TLC	2	7	3.5	Y	8	5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0020	TLC	2	6	3	Y	6	2	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0008	Amended TLC	4.5	2	0.5	Y	7	2	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0009	Amended TLC	4.5	10+	3	N	0+	4.5	N	8	2	Y	9	4.5	Y	Adjacent to RA-D
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0010	Amended TLC	4.5	8	1	Y	8	3	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0011	Amended TLC	4.5	8	1	Y	7.5	3	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0012	Amended TLC	4.5	9	3	Y	6.5	0.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0013	Amended TLC	4.5	11	4	Y	9.5	3.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0015	Amended TLC	4.5	14	0.5	Y	12	4.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0016	Amended TLC	4.5	18	2	Y	17	0.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0001	TLC	4.5	8	2	Y	5	1	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0002	TLC	4.5	7.5	1	Y	6.5	1	Y	NA	NA	NA	NA	NA	NA	Adjacent to RA-C
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0003	TLC	4.5	5.5	1	Y	7	1.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0004	GAC Direct App.	0	4	1.5	Y	9	8	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0005	GAC Direct App.	0	0	2	Y	13	2	Y	NA	NA	NA	NA	NA	NA	In Core 1: No cap observed, but new sediment felt gritty, potentially indicating cap material mixed in.
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0005A	GAC Direct App.	0	2	0.5	Y	2	0.25	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0006	Transition Zone	4.5	7	2.5	Y	9.5	1.5	Y	NA	NA	NA	NA	NA	NA	Adjacent to RA-C
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0007	Transition Zone	4.5	9.5	0.5	Y	7	1	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0021	TLC	2	8	2	Y	11	2	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0022	TLC	2	11	4	Y	10	2.5	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0023	TLC	2	7.5	3	Y	10	3.5	Y	NA	NA	NA	NA	NA	NA	Adjacent to RA-E
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0024	TLC	2	8	4	Y	8.5	3	Y	NA	NA	NA	NA	NA	NA	
SMU 8	TLC	SMU 8	OL-SMU 8-CAP-0025	TLC	2	9	4	Y	7.5	2	Y	NA	NA	NA	NA	NA	NA	

[1] The design thickness is specified as an average thickness over the model area, except for the unamended SMU 8 TLCs adjacent to remediation areas D and E, which are specificed as a minimum thickness.

[2] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

NA - Not applicable, core not required or collected.

TABLE 4.2a 2023 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)									
								Core 1 Thickness					Core 2 Thickness				
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]
B	RA-B-1E (10-30)	1	OL-RAB-CAP-0014	12 / 9		6	18 / 15	NM	NM	34	0.5	Y	NM	NM	23	5	Y
B	B1/C1	1	OL-RAB-CAP-0015	12 / 9		12	24 / 21	NM	NM	31	3	Y	NM	NM	25	5	Y
D	D-Center	1	OL-RAD-CAP-0013	12 / 9		12	24 / 21	NM	NM	29.5	1.25	Y	NM	NM	29	1	Y
D	D-West	1	OL-RAD-CAP-0015	12 / 9		12	24 / 21	NM	NM	31	3	Y	NM	NM	35	5	Y
D	D-East	1	OL-RAD-CAP-0021	12 / 9		12	24 / 21	NM	NM	30	1.5	Y	NM	NM	29	1	Y

Measured thickness is less than the minimum target thickness specificed in the OLMMP.

[1] The coarsest substrates in Zones 1, 2, and 3 are sand, fine gravel and coarse gravel/cobble, respectively.

[2] When the habitat and erosion protection layer are the same substrate, the total thickness of the habitat/erosion protection layer is listed under the habitat layer.

[3] Design thickness specified as a minimum.

[4] Listed thickness is the target minimum thickness specified in the OLMMP.

[5] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

NA - Not applicable, core was not required or collected.

NM - Not measured. When the entire cap consists of sand, it is not possible to differentiate the different layers, therefore only the total thickness is provided. When the cap design consists of topsoil overlying coarse gravel, the core can be advanced through the topsoil but not the coarse gravel, therefore only the topsoil thickness is provided.

TABLE 4.2a 2023 ONONDAGA CAP MONITORING MULTI-LAYER CAP THICKNESS MEASUREMENT

Rem. Area	Model Area	Zone[1]	Location ID	Design[3]/Target[4] Thickness (inches)				Measured Thickness (inches)					Comment
								Core 3 Thickness					
				Habitat Layer	Erosion Protection Layer[2]	Chemical Isolation Layer	Total	Habitat Layer	Chemical Isolation Layer	Total	Overlying Sediment	Native Plug (y/n)[5]	
B	RA-B-1E (10-30)	1	OL-RAB-CAP-0014	12 / 9		6	**18 / 15**	NM	NM	**28**	**1**	Y	Core 4: 28" total, native plug present, 1" new sediment
B	B1/C1	1	OL-RAB-CAP-0015	12 / 9		12	**24 / 21**	NM	NM	**26.5**	**2.5**	Y	Core 4: 26.5" total, native plug present, 2.5" new sediment
D	D-Center	1	OL-RAD-CAP-0013	12 / 9		12	**24 / 21**	NM	NM	**28**	**1**	Y	Core 4: 28" total, native plug present, 1" new sediment
D	D-West	1	OL-RAD-CAP-0015	12 / 9		12	**24 / 21**	NM	NM	**27.5**	**0**	Y	Core 4: 28" total, native plug present, 0.25" new sediment Core 5: 30" total, native plug present, 1" new sediment Core 6: 29" total, native plug present, 0.5" new sediment
D	D-East	1	OL-RAD-CAP-0021	12 / 9		12	**24 / 21**	NM	NM	**34**	**1**	Y	Core 4: 30" total, native plug present, 1" new sediment Core 4: 44" total, native plug present, 2" new sediment Core 4: 35" total, native plug present, 0.5" new sediment

[ ] Measured thickness is less than the minimum target thickness specificed in the OLMMP.

[1] The coarsest substrates in Zones 1, 2, and 3 are sand, fine gravel and coarse gravel/cobble, respectively.

[2] When the habitat and erosion protection layer are the same substrate, the total thickness of the habitat/erosion protection layer is listed under the habitat layer.

[3] Design thickness specified as a minimum.

[4] Listed thickness is the target minimum thickness specified in the OLMMP.

[5] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

NA - Not applicable, core was not required or collected.

NM - Not measured. When the entire cap consists of sand, it is not possible to differentiate the different layers, therefore only the total thickness is provided. When the cap design consists of topsoil overlying coarse gravel, the core can be advanced through the topsoil but not the coarse gravel, therefore only the topsoil thicknes

TABLE 4.2b 2023 MONO-LAYER CAP THICKNESS MEASUREMENTS

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)					
						Core 1 Thickness			Core 2 Thickness		
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]
B	RA-B-1D (20-30)	1	OL-RAB-CAP-0011	MPC Monolayer	7.5	12	5	Y	8	6	Y
C	RA-C-1B	1	OL-RAC-CAP-0014	GAC Direct App.	0	1.5	0.25	Y	0	0.25	Y

[1] The design thickness for mono-layer caps is specified as an average thickness over the model area, except for the unamended SMU 8 TLCs adjacent to remediation areas D and E, which are specificed as a minimum thickness.

[2] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

NM - Not measured, core not required or collected.

TABLE 4.2b 2023 MONO-LAYER CAP THICKNESS MEASUREMENTS

Rem. Area	Model Area	Zone	Location ID	Cap Type	Design Thickness (inches)[1]	Measured Thickness (inches)						Comment
						Core 3 Thickness			Core 4 Thickness			
						Cap	Overlying Sediment	Native Plug (y/n)[2]	Cap	Overlying Sediment	Native Plug (y/n)[2]	
B	RA-B-1D (20-30)	1	OL-RAB-CAP-0011	MPC Monolayer	7.5	NM	NM	NM	NM	NM	NM	
C	RA-C-1B	1	OL-RAC-CAP-0014	GAC Direct App.	0	5.5	5	Y	6.5	5	Y	Samples were collected from Cores 3 and 4 as Cores 1 and 2 did not have sufficient volume to sample.

[1] The design thickness for mono-layer caps is specified as an average thickness over the model area, except for the unamended SMU 8 TLCs adjacent to remediation areas D and E, which are specificed as a minimum thickness.

[2] The presence of a plug of native sediment in the bottom of the core indicates the core fully penetrated the cap material, allowing measurement of the total cap thickness.

NM - Not measured, core not required or collected.

TABLE 4.3A 2022 RA-A MULTI-LAYER CAPS (NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area A1			Cap Model Area A2		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean [1]	# Samples/ # Detects	# Exceedances	Mean [1]
PAHS								
ACENAPHTHENE	ug/kg	861	14/1	0	0.22	6/0	0	0
ACENAPHTHYLENE	ug/kg	1301	14/2	0	0.71	6/0	0	0
ANTHRACENE	ug/kg	207	14/1	0	0.79	6/0	0	0
BENZO(A)ANTHRACENE	ug/kg	192	12/2	0	5.8	2/0	0	0
BENZO(A)PYRENE	ug/kg	146	12/5	0	10	2/0	0	0
BENZO(B)FLUORANTHENE	ug/kg	908	12/4	0	12	2/0	0	0
BENZO(G,H,I)PERYLENE	ug/kg	780	12/3	0	7.5	2/0	0	0
BENZO(K)FLUORANTHENE	ug/kg	203	12/2	0	3.8	2/0	0	0
CHRYSENE	ug/kg	253	12/3	0	8.6	2/0	0	0
DIBENZO(A,H)ANTHRACENE	ug/kg	157	12/2	0	1.7	2/0	0	0
FLUORANTHENE	ug/kg	1436	12/2	0	16	2/0	0	0
FLUORENE	ug/kg	264	14/1	0	0.31	6/0	0	0
INDENO(1,2,3-CD)PYRENE	ug/kg	183	12/3	0	7.4	2/0	0	0
NAPHTHALENE	ug/kg	917	14/0	0	0	6/0	0	0
PHENANTHRENE	ug/kg	543	14/2	0	4.9	6/0	0	0
PYRENE	ug/kg	344	12/5	0	15	2/0	0	0
VOCS								
BENZENE	ug/L	760	14/0	0	0	6/0	0	0
TOLUENE	ug/L	480	14/8	0	1.9	6/4	0	12
ETHYLBENZENE	ug/kg	176	14/0	0	0	6/0	0	0
XYLENES, TOTAL	ug/kg	560.8	14/0	0	0	6/0	0	0
CHLOROBENZENE	ug/kg	428	14/0	0	0	6/0	0	0
DICHLOROBENZENES	ug/kg	239	14/1	0	0.028	6/0	0	0
TRICHLOROBENZENES	ug/kg	347	14/0	0	0	6/0	0	0
Other								
MERCURY	mg/kg	2.2	14/8	0	0.014	6/0	0	0
PCBS, N.O.S.	ug/kg	295	12/0	0	0	2/0	0	0
PHENOL	ug/L	250	14/8	0	16	6/3	0	1.00

Notes:

[green box] Compound that dictated the GAC application rate during the design (not applicable for A-1, no GAC required)

[1] Non detects set to zero

TABLE 4.3B 2022 RA-B MULTI-LAYER CAPS (NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area B2			Cap Model Area B1/C1		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean[1]	# Samples/ # Detects	# Exceedances	Mean[1]
PAHS								
ACENAPHTHENE	ug/kg	861	7/0	0	0	17/0	0	0
ACENAPHTHYLENE	ug/kg	1301	7/0	0	0	17/0	0	0
ANTHRACENE	ug/kg	207	7/0	0	0	17/0	0	0
BENZO(A)ANTHRACENE	ug/kg	192	7/0	0	0	6/0	0	0
BENZO(A)PYRENE	ug/kg	146	7/0	0	0	6/0	0	0
BENZO(B)FLUORANTHENE	ug/kg	908	7/0	0	0	6/0	0	0
BENZO(G,H,I)PERYLENE	ug/kg	780	7/0	0	0	6/0	0	0
BENZO(K)FLUORANTHENE	ug/kg	203	7/0	0	0	6/0	0	0
CHRYSENE	ug/kg	253	7/0	0	0	6/0	0	0
DIBENZO(A,H)ANTHRACENE	ug/kg	157	7/0	0	0	6/0	0	0
FLUORANTHENE	ug/kg	1436	7/0	0	0	6/0	0	0
FLUORENE	ug/kg	264	7/0	0	0	17/0	0	0
INDENO(1,2,3-CD)PYRENE	ug/kg	183	7/0	0	0	6/0	0	0
NAPHTHALENE	ug/kg	917	7/0	0	0	18/2	0	2.3
PHENANTHRENE	ug/kg	543	7/0	0	0	17/0	0	0
PYRENE	ug/kg	344	7/0	0	0	6/0	0	0
VOCS								
BENZENE	ug/L	760	7/0	0	0	18/1	0	0.019
TOLUENE	ug/L	480	7/5	0	0.41	18/16	0	31
ETHYLBENZENE	ug/kg	176	7/0	0	0	18/0	0	0
XYLENES, TOTAL	ug/kg	560.8	7/0	0	0	18/0	0	0
CHLOROBENZENE	ug/kg	428	7/0	0	0	18/0	0	0
DICHLOROBENZENES	ug/kg	239	7/0	0	0	18/2	0	0.061
TRICHLOROBENZENES	ug/kg	347	7/0	0	0	18/2	0	0.15
Other								
MERCURY	mg/kg	2.2	7/1	0	0.0014	18/4	0	0.0032
PCBS, N.O.S.	ug/kg	295	7/0	0	0	6/0	0	0
PHENOL	ug/L	250	7/3	0	7.5	17/6	0.00	16

Notes:

[green box] Compound that dictated the GAC application rate during the design

[1]Non detects set to zero

TABLE 4.3C 2022 RA-C MULTI-LAYER CAPS (NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area C2			Cap Model Area C3		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean [1]	# Samples/ # Detects	# Exceedances	Mean [1]
PAHS								
ACENAPHTHENE	ug/kg	861	9/0	0	0	12/0	0	0
ACENAPHTHYLENE	ug/kg	1301	9/0	0	0	12/0	0	0
ANTHRACENE	ug/kg	207	9/0	0	0	12/0	0	0
BENZO(A)ANTHRACENE	ug/kg	192	8/0	0	0	10/0	0	0
BENZO(A)PYRENE	ug/kg	146	8/0	0	0	10/2	0	1.1
BENZO(B)FLUORANTHENE	ug/kg	908	8/0	0	0	10/3	0	2.1
BENZO(G,H,I)PERYLENE	ug/kg	780	8/0	0	0	10/1	0	0.63
BENZO(K)FLUORANTHENE	ug/kg	203	8/0	0	0	10/0	0	0
CHRYSENE	ug/kg	253	8/0	0	0	10/2	0	1.4
DIBENZO(A,H)ANTHRACENE	ug/kg	157	8/0	0	0	10/0	0	0
FLUORANTHENE	ug/kg	1436	8/0	0	0	10/3	0	3.5
FLUORENE	ug/kg	264	9/0	0	0	12/0	0	0
INDENO(1,2,3-CD)PYRENE	ug/kg	183	8/0	0	0	10/1	0	0.57
NAPHTHALENE	ug/kg	917	9/2	0	0.90	12/5	0	1.7
PHENANTHRENE	ug/kg	543	9/0	0	0	12/2	0	1.1
PYRENE	ug/kg	344	8/0	0	0	10/4	0	3.4
VOCS								
BENZENE	ug/L	760	9/0	0	0	12/0	0	0
TOLUENE	ug/L	480	9/8	0	2.0	12/11	0	1.2
ETHYLBENZENE	ug/kg	176	9/0	0	0	12/0	0	0
XYLENES, TOTAL	ug/kg	560.8	9/0	0	0	12/0	0	0
CHLOROBENZENE	ug/kg	428	9/0	0	0	12/0	0	0
DICHLOROBENZENES	ug/kg	239	9/0	0	0	12/1	0	0.022
TRICHLOROBENZENES	ug/kg	347	9/0	0	0	12/0	0	0
Other								
MERCURY	mg/kg	2.2	9/2	0	0.0022	12/5	0	0.0051
PCBS, N.O.S.	ug/kg	295	8/0	0	0	10/0	0	0
PHENOL	ug/L	250	9/3	0	6.6	12/3	0	4.3

Notes:

[green box] Compound that didtated the GAC application rate during the design

[1] Non detects set to zero

TABLE 4.3D 2022 RA-D MULTI-LAYER CAPS(NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area D-SMU-2			Cap Model Area D-West			Cap Model Area D-Center [1]			Cap Model Area D-East		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean [1]	# Samples/ # Detects	# Exceedances	Mean [1]	# Samples/ # Detects	# Exceedances	Mean [1]	# Samples/ # Detects	# Exceedances	Mean [1]
PAHS														
ACENAPHTHENE	ug/kg	861	8/0	0	0	12/1	0	0.21	28/1	0	0.093	22/1	0	0.19
ACENAPHTHYLENE	ug/kg	1301	8/0	0	0	12/1	0	0.17	28/0	0	0	22/1	0	0.20
ANTHRACENE	ug/kg	207	8/0	0	0	12/0	0	0	28/0	0	0	22/1	0	0.24
BENZO(A)ANTHRACENE	ug/kg	192	8/0	0	0	11/3	0	1.9	15/4	0	2.4	20/4	0	0.86
BENZO(A)PYRENE	ug/kg	146	8/2	0	1.2	11/3	0	1.8	15/4	0	3.0	20/2	0	0.51
BENZO(B)FLUORANTHENE	ug/kg	908	8/3	0	2.0	11/4	0	2.8	15/6	0	5.7	20/2	0	0.78
BENZO(G,H,I)PERYLENE	ug/kg	780	8/2	0	0.97	11/3	0	2.1	15/4	0	3.6	20/1	0	0.28
BENZO(K)FLUORANTHENE	ug/kg	203	8/0	0	0	11/2	0	0.96	15/3	0	1.4	20/0	0	0
CHRYSENE	ug/kg	253	8/2	0	1.0	11/3	0	1.9	15/5	0	3.2	20/2	0	0.80
DIBENZO(A,H)ANTHRACENE	ug/kg	157	8/0	0	0	11/1	0	0.48	15/1	0	0.39	20/0	0	0
FLUORANTHENE	ug/kg	1436	8/3	0	3.2	11/3	0	3.8	15/6	0	7.0	20/5	0	3.1
FLUORENE	ug/kg	264	8/0	0	0	12/1	0	5.2	28/2	0	0.17	22/4	0	0.88
INDENO(1,2,3-CD)PYRENE	ug/kg	183	8/2	0	0.84	11/3	0	1.6	15/2	0	1.6	20/0	0	0
NAPHTHALENE	ug/kg	917	8/4	0	1.8	13/4	0	18	29/7	0	6.8	22/13	0	17
PHENANTHRENE	ug/kg	543	8/2	0	1.3	12/3	0	2.3	28/5	0	1.8	22/5	0	2.1
PYRENE	ug/kg	344	8/3	0	2.6	11/4	0	3.8	15/7	0	6.2	20/5	0	2.6
VOCS														
BENZENE	ug/L	760	8/0	0	0	12/0	0	0	26/0	0	0	22/1	0	0.024
TOLUENE	ug/L	480	8/4	0	0.14	12/7	0	2.8	26/4	0	3.9	22/8	1	27
ETHYLBENZENE	ug/kg	176	8/0	0	0	12/0	0	0	28/0	0	0	22/0	0	0
XYLENES, TOTAL	ug/kg	560.8	8/0	0	0	12/1	0	0.65	28/0	0	0	22/2	0	0.53
CHLOROBENZENE	ug/kg	428	8/3	0	0.13	12/5	0	0.47	28/2	0	0.034	22/5	0	2.1
DICHLOROBENZENES	ug/kg	239	8/0	0	0	12/4	0	0.24	28/1	0	0.028	22/3	0	1.4
TRICHLOROBENZENES	ug/kg	347	8/0	0	0	12/0	0	0	28/0	0	0	22/2	0	0.048
Other														
MERCURY	mg/kg	2.2	8/8	0	0.015	12/4	0	0.0068	28/5	0	0.0048	22/5	0	0.011
PCBS, N.O.S.	ug/kg	295	8/0	0	0	11/0	0	0	15/0	0	0	20/0	0	0
PHENOL	ug/L	250	6/0	0	0	12/1	0	0.78	26/8	0	12	22/12	1	23

Notes:

[green outlined box] Compound that dictated the GAC application rate during the design

Includes results from model area OL-VC-10138/40

[1]Non detects set to zero

Honeywell

PARSONS

TABLE 4.3E 2022 RA-E MULTI-LAYER CAPS (NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area E-1			Cap Model Area E-2			Cap Model Area E-3		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean[1]	# Samples/ # Detects	# Exceedances	Mean[1]	# Samples/ # Detects	# Exceedances	Mean[1]
PAHS											
ACENAPHTHENE	ug/kg	861	18/0	0	0	14/0	0	0	18/0	0	0
ACENAPHTHYLENE	ug/kg	1301	18/0	0	0	14/0	0	0	18/2	0	0.33
ANTHRACENE	ug/kg	207	18/0	0	0	14/0	0	0	18/0	0	0
BENZO(A)ANTHRACENE	ug/kg	192	6/0	0	0	4/2	0	3.4	6/3	0	4.6
BENZO(A)PYRENE	ug/kg	146	6/4	0	4.0	4/2	0	2.7	6/4	0	7.3
BENZO(B)FLUORANTHENE	ug/kg	908	6/4	0	5.7	4/2	0	3.5	6/4	0	8.3
BENZO(G,H,I)PERYLENE	ug/kg	780	6/4	0	3.6	4/2	0	2.3	6/4	0	5.4
BENZO(K)FLUORANTHENE	ug/kg	203	6/0	0	0	4/1	0	1.2	6/1	0	1.3
CHRYSENE	ug/kg	253	6/3	0	3.2	4/2	0	3.3	6/4	0	6.5
DIBENZO(A,H)ANTHRACENE	ug/kg	157	6/0	0	0	4/1	0	0.88	6/1	0	0.57
FLUORANTHENE	ug/kg	1436	6/4	0	7.2	4/2	0	5.3	6/4	0	11
FLUORENE	ug/kg	264	18/0	0	0	14/0	0	0	18/0	0	0
INDENO(1,2,3-CD)PYRENE	ug/kg	183	6/3	0	2.8	4/1	0	1.2	6/4	0	5.1
NAPHTHALENE	ug/kg	917	18/3	0	0.64	14/1	0	0.4	18/3	0	1.5
PHENANTHRENE	ug/kg	543	18/3	0	0.96	14/1	0	0.61	18/4	0	1.7
PYRENE	ug/kg	344	6/4	0	6.3	4/2	0	5.2	6/4	0	11
VOCS											
BENZENE	ug/L	760	18/0	0	0	14/1	0	0.018	18/0	0	0
TOLUENE	ug/L	480	18/11	0	0.74	14/8	0	1.8	18/15	0	1.3
ETHYLBENZENE	ug/kg	176	18/0	0	0	14/0	0	0	18/0	0	0
XYLENES, TOTAL	ug/kg	560.8	18/0	0	0	14/0	0	0	18/0	0	0
CHLOROBENZENE	ug/kg	428	18/0	0	0	14/0	0	0	18/2	0	0.092
DICHLOROBENZENES	ug/kg	239	18/2	0	0.033	14/0	0	0	18/1	0	0.19
TRICHLOROBENZENES	ug/kg	347	18/0	0	0	14/0	0	0	18/0	0	0
Other											
MERCURY	mg/kg	2.2	18/5	0	0.0029	14/3	0	0.0042	18/5	0	0.011
PCBS, N.O.S.	ug/kg	295	6/0	0	0	4/0	0	0	6/0	0	0
PHENOL	ug/L	250	18/3	0	0.28	14/3	0	1.0	18/2	0	0.93

Notes:

[green box] Compound that dictated the GAC application rate during the design (Not applicable for E-1, no GAC required)

[1]Non detects set to zero

TABLE 4.3F 2022 RA-F MULTI-LAYER CAPS (NON-TOPSOIL) HABITAT LAYER CHEMICAL MONITORING RESULTS

Model Area			Cap Model Area F		
Parameter Name	Units	Cap Criteria	# Samples/ # Detects	# Exceedances	Mean[1]
PAHS					
ACENAPHTHENE	ug/kg	861	4/0	0	0
ACENAPHTHYLENE	ug/kg	1301	4/0	0	0
ANTHRACENE	ug/kg	207	4/0	0	0
BENZO(A)ANTHRACENE	ug/kg	192	4/2	0	3.2
BENZO(A)PYRENE	ug/kg	146	4/2	0	3.6
BENZO(B)FLUORANTHENE	ug/kg	908	4/2	0	4.2
BENZO(G,H,I)PERYLENE	ug/kg	780	4/1	0	1.7
BENZO(K)FLUORANTHENE	ug/kg	203	4/2	0	1.5
CHRYSENE	ug/kg	253	4/1	0	1.9
DIBENZO(A,H)ANTHRACENE	ug/kg	157	4/0	0	0
FLUORANTHENE	ug/kg	1436	4/2	0	3.5
FLUORENE	ug/kg	264	4/0	0	0
INDENO(1,2,3-CD)PYRENE	ug/kg	183	4/1	0	1.4
NAPHTHALENE	ug/kg	917	4/0	0	0
PHENANTHRENE	ug/kg	543	4/0	0	0
PYRENE	ug/kg	344	4/2	0	3.4
VOCS					
BENZENE	ug/L	760	4/0	0	0
TOLUENE	ug/L	480	4/0	0	0
ETHYLBENZENE	ug/kg	176	4/0	0	0
XYLENES, TOTAL	ug/kg	560.8	4/0	0	0
CHLOROBENZENE	ug/kg	428	4/0	0	0
DICHLOROBENZENES	ug/kg	239	4/0	0	0
TRICHLOROBENZENES	ug/kg	347	4/0	0	0
Other					
MERCURY	mg/kg	2.2	4/2	0	0.079
PCBS, N.O.S.	ug/kg	295	4/0	0	0
PHENOL	ug/L	250	4/0	0	0

Notes:
[1]Non detects set to zero

TABLE 4.4 2022 EXCEEDANCES OF CAP HABITAT LAYER PERFORMANCE CRITERIA

Station	Cap Type	Contaminant	Depth (in)	Cap Layer	Sample Type	Mean PECQ	Measured Result		Units	Criteria	Units	Notes
D-21	Multi-layer	Phenol	3-9	H	Peeper	NA	24.2		ug/L	250	ug/L	Recommend resampling in 2023 to validate
D-21	Multi-layer	Phenol	9-12	H	Peeper	NA	264		ug/L	250	ug/L	
D-21	Multi-layer	Phenol	12-15	CI	Peeper	NA	231		ug/L	250	ug/L	
D-21	Multi-layer	Toluene	3-6	H	Peeper	NA	0.22	U	ug/L	480	ug/L	
D-21	Multi-layer	Toluene	9-12	H	Peeper	NA	594		ug/L	480	ug/L	
D-21	Multi-layer	Toluene	12-15	CI	Peeper	NA	583		ug/L	480	ug/L	
D-42	Topsoil	Benzo(a)pyrene (and other PAHs)	3-6	H	Solid Phase	0.28	440		ug/kg	146	ug/kg	All 5 locations are wetland topsoil near the mouth of Harbor Brook. Multiple PAHs exceeded the cap habitat layer criteria in the 3 to 6 inch interval at all 5 locations. Concentrations for Benzo(a)pyrene are listed because its criteria exceedance factor was the greatest at 8 samples at all 5 locations. PAH concentrations were typically lower in the deepest habitat layer sample, indicating the exceedances are not a result of chemical migration from underlying sediments. The PAH exceedances in this area are primarily a result of PAHs migrating from portions of Harbor Brook and its tributaries (ditches), as well as reaches upstream of the areas Honeywell was responsible for remediating.
D-42	Topsoil		11-15	H	Solid Phase	0.19	190		ug/kg	146	ug/kg	
D-43	Topsoil		3-6	H	Solid Phase	0.19	190		ug/kg	146	ug/kg	
D-43	Topsoil		10-13	H	Solid Phase	0.10	100		ug/kg	146	ug/kg	
D-44	Topsoil		3-6	H	Solid Phase	0.36	330		ug/kg	146	ug/kg	
D-44	Topsoil		12-15	H	Solid Phase	0.35	350		ug/kg	146	ug/kg	
D-45	Topsoil		3-6	H	Solid Phase	1.22	1200		ug/kg	146	ug/kg	
D-45	Topsoil		7-10	H	Solid Phase	0.69	690		ug/kg	146	ug/kg	
D-46	Topsoil		3-6	H	Solid Phase	0.39	570		ug/kg	146	ug/kg	
D-46	Topsoil		20-23	H	Solid Phase	0.11	95		ug/kg	146	ug/kg	

Note: The listed results for peeper porewater incorporate a correction factor of 1.1, consistent with the PDI and remedial design

H - Habitat

CI - Chemical Isolation

U - Undetected at the listed detection limit

[shaded box] Measured concentration exceeds cap habitat layer criteria within the habitat layer

NA - Not Applicable

TABLE 5.1 SUMMARY OF MERCURY MEASURED DURING 2021 COMPLIANCE EVENT SEDIMENT SAMPLES

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
Littoral Zone						
S306	OL-3707-09	0 - 0.5	05/21/2021	0.11		63.4
S93	OL-3706-02	0 - 0.5	05/20/2021	0.2		56.2
S94	OL-3706-01	0 - 0.5	05/20/2021	0.057	J	46.9
S100	OL-3707-08	0 - 0.5	05/21/2021	0.057	J	56.9
S112	OL-3707-07	0 - 0.5	05/21/2021	1.9		50.2
S373	OL-3707-02	0 - 0.5	05/21/2021	0.83	J	59.8
S371	OL-3707-06	0 - 0.5	05/21/2021	0.32	J	39
S361	OL-3706-15	0 - 0.5	05/20/2021	0.18	J	48
S364	OL-3706-12	0 - 0.5	05/20/2021	0.12	J	31.3
S67	OL-3706-14	0 - 0.5	05/20/2021	0.31	J	31.9
S26	OL-3707-05	0 - 0.5	05/21/2021	0.11		62.1
S367	OL-3707-03	0 - 0.5	05/21/2021	0.26		55
S61	OL-3707-04	0 - 0.5	05/21/2021	0.19		57
S329	OL-3707-10	0 - 0.5	05/21/2021	0.12		56.6
North Basin						
OL-STA-80069	OL-3702-09	0 - 0.13	05/18/2021	0.63	J	24.2
OL-STA-80069	OL-3702-10	0.13 - 0.33	05/18/2021	1.1	J	26.3
OL-STA-80072	OL-3702-05	0 - 0.13	05/18/2021	0.54	J	26.6
OL-STA-80072	OL-3702-06	0.13 - 0.33	05/18/2021	1.4	J	24.9
OL-STA-80225	OL-3702-01	0 - 0.13	05/18/2021	0.51	J	19.6
OL-STA-80225	OL-3702-02	0.13 - 0.33	05/18/2021	1	J	23.1
OL-VC-80157	OL-3702-03	0 - 0.13	05/18/2021	0.46	J	22.2
OL-VC-80157	OL-3702-04	0.13 - 0.33	05/18/2021	0.87	J	26.1
OL-STA-80067	OL-3703-06	0 - 0.13	05/19/2021	0.66	J	26.7
OL-STA-80067	OL-3703-07	0.13 - 0.33	05/19/2021	0.86	J	28.3
OL-STA-80068	OL-3703-12	0 - 0.13	05/19/2021	0.54	J	20.2
OL-STA-80068	OL-3703-13	0.13 - 0.33	05/19/2021	0.93	J	25.9
OL-STA-80070	OL-3703-14	0 - 0.13	05/19/2021	0.3	J	22.4
OL-STA-80070	OL-3703-15	0.13 - 0.33	05/19/2021	0.92	J	23.6
OL-SS-80002-SS	OL-3704-14	0 - 0.13	05/19/2021	0.47	J	18.7
OL-SS-80002-SS	OL-3704-15	0.13 - 0.33	05/19/2021	1.1	J	22.2
OL-STA-80071	OL-3704-16	0 - 0.13	05/19/2021	0.44	J	21.1
OL-STA-80071	OL-3704-17	0.13 - 0.33	05/19/2021	1.3	J	22.7
Ninemile Creek Outlet Area						
OL-STA-80073	OL-3700-17	0 - 0.13	05/18/2021	0.6	J	28.1
OL-STA-80073	OL-3700-18	0.13 - 0.33	05/18/2021	1.2	J	27.5
OL-STA-80074	OL-3701-01	0 - 0.13	05/18/2021	0.42	J	30.5
OL-STA-80074	OL-3701-02	0.13 - 0.33	05/18/2021	1.6	J	29.5
OL-STA-80091	OL-3701-13	0 - 0.13	05/18/2021	0.44	J	33.3
OL-STA-80091	OL-3701-14	0.13 - 0.33	05/18/2021	1.2	J	28.6
OL-STA-80227	OL-3701-15	0 - 0.13	05/18/2021	0.57	J	24.5
OL-STA-80227	OL-3701-16	0.13 - 0.33	05/18/2021	1.2	J	26.6
OL-VC-80046	OL-3701-11	0 - 0.13	05/18/2021	0.46	J	35.5
OL-VC-80046	OL-3701-12	0.13 - 0.33	05/18/2021	1	J	37.1
OL-VC-80047	OL-3701-05	0 - 0.13	05/18/2021	0.24	J	32.9
OL-VC-80047	OL-3701-06	0.13 - 0.33	05/18/2021	0.46	J	43.6
OL-VC-80048	OL-3701-17	0 - 0.13	05/18/2021	0.18	J	40.8
OL-VC-80048	OL-3701-18	0.13 - 0.33	05/18/2021	0.3		58.5
OL-STA-80226	OL-3703-03	0 - 0.13	05/19/2021	0.65	J	25.3

TABLE 5.1 SUMMARY OF MERCURY MEASURED DURING 2021 COMPLIANCE EVENT SEDIMENT SAMPLES (CONTINUED)

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
OL-STA-80226	OL-3703-04	0.13 - 0.33	05/19/2021	1.3	J	26.9
Saddle						
OL-STA-80075	OL-3700-15	0 - 0.13	05/18/2021	0.38	J	28.8
OL-STA-80075	OL-3700-16	0.13 - 0.33	05/18/2021	0.96	J	28.9
OL-STA-80103	OL-3701-07	0 - 0.13	05/18/2021	0.43	J	26.9
OL-STA-80103	OL-3701-08	0.13 - 0.33	05/18/2021	1.4	J	25.7
OL-STA-80234	OL-3701-09	0 - 0.13	05/18/2021	0.42	J	22.6
OL-STA-80234	OL-3701-10	0.13 - 0.33	05/18/2021	1.1	J	21.7
South Basin						
OL-STA-80077	OL-3700-11	0 - 0.13	05/18/2021	0.72	J	27.8
OL-STA-80077	OL-3700-12	0.13 - 0.33	05/18/2021	1.5	J	27.7
OL-VC-80044	OL-3700-01	0 - 0.13	05/18/2021	0.32	J	31
OL-VC-80044	OL-3700-02	0.13 - 0.33	05/18/2021	1.1	J	31.7
OL-STA-80229	OL-3702-07	0 - 0.13	05/18/2021	0.47	J	24.6
OL-STA-80229	OL-3702-08	0.13 - 0.33	05/18/2021	1	J	22
OL-VC-80045	OL-3701-03	0 - 0.13	05/18/2021	0.22	J	39
OL-VC-80045	OL-3701-04	0.13 - 0.33	05/18/2021	1.1	J	35.8
OL-STA-80076	OL-3703-01	0 - 0.13	05/19/2021	0.34	J	24.4
OL-STA-80076	OL-3703-02	0.13 - 0.33	05/19/2021	1.2	J	25.7
OL-STA-80078	OL-3703-18	0 - 0.13	05/19/2021	0.45	J	27
OL-STA-80078	OL-3703-19	0.13 - 0.33	05/19/2021	1.1	J	25.8
OL-STA-80080	OL-3703-08	0 - 0.13	05/19/2021	0.78	J	25.2
OL-STA-80080	OL-3703-09	0.13 - 0.33	05/19/2021	1.9	J	26.9
OL-VC-80024	OL-3703-10	0 - 0.13	05/19/2021	0.36	J	27.6
OL-VC-80024	OL-3703-11	0.13 - 0.33	05/19/2021	0.88	J	26.7
OL-VC-80079	OL-3703-16	0 - 0.13	05/19/2021	0.28	J	27.3
OL-VC-80079	OL-3703-17	0.13 - 0.33	05/19/2021	0.77	J	28.8
OL-STA-80081	OL-3704-10	0 - 0.13	05/19/2021	0.44	J	22.4
OL-STA-80081	OL-3704-11	0.13 - 0.33	05/19/2021	0.7	J	23.1
OL-STA-80084	OL-3704-12	0 - 0.13	05/19/2021	0.25	J	24.2
OL-STA-80084	OL-3704-13	0.13 - 0.33	05/19/2021	1.2	J	21.4
OL-STA-80082	OL-3706-03	0 - 0.13	05/20/2021	0.34	J	24.1
OL-STA-80082	OL-3706-04	0.13 - 0.33	05/20/2021	1	J	24
OL-STA-80083	OL-3706-05	0 - 0.13	05/20/2021	0.39	J	25.1
OL-STA-80083	OL-3706-06	0.13 - 0.33	05/20/2021	0.65	J	24.7
ST51	OL-3706-09	0 - 0.13	05/20/2021	0.48	J	23.3
ST51	OL-3706-10	0.13 - 0.33	05/20/2021	1.1	J	22.2
South Corner						
OL-STA-80085	OL-3700-05	0 - 0.13	05/18/2021	0.3	J	29.5
OL-STA-80085	OL-3700-06	0.13 - 0.33	05/18/2021	1	J	31.2
OL-STA-80237	OL-3700-09	0 - 0.13	05/18/2021	0.16	J	47.7
OL-STA-80237	OL-3700-10	0.13 - 0.33	05/18/2021	0.96	J	35
OL-VC-80068	OL-3700-07	0 - 0.13	05/18/2021	0.39	J	35.2
OL-VC-80068	OL-3700-08	0.13 - 0.33	05/18/2021	1.2	J	35.3
OL-VC-80070	OL-3700-19	0 - 0.13	05/18/2021	0.96	J	38.9
OL-VC-80070	OL-3700-20	0.13 - 0.33	05/18/2021	1.8	J	38.9
OL-VC-80172	OL-3700-03	0 - 0.13	05/18/2021	0.35	J	32.5
OL-VC-80172	OL-3700-04	0.13 - 0.33	05/18/2021	0.94	J	32.4
OL-STA-80236	OL-3704-18	0 - 0.13	05/19/2021	0.29	J	28.4
OL-STA-80236	OL-3704-19	0.13 - 0.33	05/19/2021	1	J	26.2

TABLE 5.1 SUMMARY OF MERCURY MEASURED DURING 2021 COMPLIANCE EVENT SEDIMENT SAMPLES (CONTINUED)

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
OL-STA-80239	OL-3704-01	0 - 0.13	05/19/2021	0.36	J	32.1
OL-STA-80239	OL-3704-02	0.13 - 0.33	05/19/2021	1.3	J	28.8
OL-VC-80039	OL-3704-05	0 - 0.13	05/19/2021	0.18	J	33.5
OL-VC-80039	OL-3704-06	0.13 - 0.33	05/19/2021	0.3	J	45.2
OL-VC-80040	OL-3704-03	0 - 0.13	05/19/2021	0.2	J	29.3
OL-VC-80040	OL-3704-04	0.13 - 0.33	05/19/2021	0.56	J	39.4
OL-VC-80071	OL-3704-08	0 - 0.13	05/19/2021	0.18	J	21.2
OL-VC-80071	OL-3704-09	0.13 - 0.33	05/19/2021	0.31	J	38.7
OL-VC-80051	OL-3705-05	0 - 0.13	05/19/2021	0.62	J	30.9
OL-VC-80051	OL-3705-06	0.13 - 0.33	05/19/2021	1.6	J	31
OL-VC-80062	OL-3705-03	0 - 0.13	05/19/2021	0.32	J	27.5
OL-VC-80062	OL-3705-04	0.13 - 0.33	05/19/2021	0.9	J	30
OL-VC-80177	OL-3705-01	0 - 0.13	05/19/2021	0.43	J	27.7
OL-VC-80177	OL-3705-02	0.13 - 0.33	05/19/2021	1.3	J	26.1
OL-STA-80238	OL-3706-07	0 - 0.13	05/20/2021	0.34	J	28
OL-STA-80238	OL-3706-08	0.13 - 0.33	05/20/2021	0.98	J	44.3
OL-VC-80064	OL-3706-16	0 - 0.13	05/20/2021	0.21	J	25.8
OL-VC-80064	OL-3706-17	0.13 - 0.33	05/20/2021	1.4	J	33.6

TABLE 5.2 SUMMARY OF MERCURY MEASURED DURING 2022 COMPLIANCE EVENT SEDIMENT SAMPLES

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
Littoral Zone						
S112	OL-3743-01	0 - 0.5	08/11/2022	2.6		57.4
S373	OL-3743-02	0 - 0.5	08/11/2022	0.43		56.1
North Basin						
OL-STA-80069	OL-3741-01	0 - 0.13	05/25/2022	0.48	J	25.7
OL-STA-80069	OL-3741-02	0.13 - 0.33	05/25/2022	1.2	J	27.1
OL-STA-80072	OL-3740-10	0 - 0.13	05/25/2022	0.46	J	25.1
OL-STA-80072	OL-3740-11	0.13 - 0.33	05/25/2022	1.2	J	22.6
OL-STA-80225	OL-3740-14	0 - 0.13	05/25/2022	0.45	J	20.9
OL-STA-80225	OL-3740-15	0.13 - 0.33	05/25/2022	1.1	J	25.6
OL-VC-80157	OL-3740-01	0 - 0.13	05/25/2022	0.53	J	22.6
OL-VC-80157	OL-3740-02	0.13 - 0.33	05/25/2022	1.2	J	24.5
OL-STA-80067	OL-3741-16	0 - 0.13	05/25/2022	0.79	J	27.8
OL-STA-80067	OL-3741-17	0.13 - 0.33	05/25/2022	1.3	J	33.1
OL-STA-80068	OL-3741-06	0 - 0.13	05/25/2022	0.46	J	22.4
OL-STA-80068	OL-3741-07	0.13 - 0.33	05/25/2022	1.1	J	25.8
OL-STA-80070	OL-3739-05	0 - 0.13	05/24/2022	0.57	J	22.8
OL-STA-80070	OL-3739-06	0.13 - 0.33	05/24/2022	0.82	J	25.1
OL-SS-80002-SS	OL-3740-07	0 - 0.13	05/25/2022	1.1	J	23
OL-SS-80002-SS	OL-3740-09	0.13 - 0.33	05/25/2022	2	J	28.5
OL-STA-80071	OL-3739-03	0 - 0.13	05/24/2022	0.47	J	25.5
OL-STA-80071	OL-3739-04	0.13 - 0.33	05/24/2022	1	J	26.3
Ninemile Creek Outlet Area						
OL-STA-80073	OL-3740-05	0 - 0.13	05/25/2022	0.41	J	25.4
OL-STA-80073	OL-3740-06	0.13 - 0.33	05/25/2022	1	J	29.6
OL-STA-80074	OL-3742-01	0 - 0.13	05/25/2022	0.55	J	36.2
OL-STA-80074	OL-3742-02	0.13 - 0.33	05/25/2022	1.1	J	35.5
OL-STA-80091	OL-3740-16	0 - 0.13	05/25/2022	0.57	J	34.7
OL-STA-80091	OL-3740-17	0.13 - 0.33	05/25/2022	1.1	J	33.5
OL-STA-80227	OL-3739-01	0 - 0.13	05/24/2022	0.8	J	27.9
OL-STA-80227	OL-3739-02	0.13 - 0.33	05/24/2022	1.3	J	31.3
OL-VC-80046	OL-3740-18	0 - 0.13	05/25/2022	0.31	J	41.9
OL-VC-80046	OL-3740-19	0.13 - 0.33	05/25/2022	0.88	J	46.4
OL-VC-80047	OL-3741-03	0 - 0.13	05/25/2022	0.32	J	36.8
OL-VC-80047	OL-3741-05	0.13 - 0.33	05/25/2022	0.63	J	49.5
OL-VC-80048	OL-3740-12	0 - 0.13	05/25/2022	0.16	J	44.9
OL-VC-80048	OL-3740-13	0.13 - 0.33	05/25/2022	0.059	J	80.2
OL-STA-80226	OL-3740-03	0 - 0.13	05/25/2022	0.68	J	26.3
OL-STA-80226	OL-3740-04	0.13 - 0.33	05/25/2022	1.3	J	29.4

TABLE 5.2 SUMMARY OF MERCURY MEASURED DURING 2022 COMPLIANCE EVENT SEDIMENT SAMPLES (CONTINUED)

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
Saddle						
OL-STA-80075	OL-3738-16	0 - 0.13	05/24/2022	0.33	J	26.1
OL-STA-80075	OL-3738-17	0.13 - 0.33	05/24/2022	0.81	J	29.4
OL-STA-80103	OL-3741-14	0 - 0.13	05/25/2022	0.34	J	28.1
OL-STA-80103	OL-3741-15	0.13 - 0.33	05/25/2022	1.1	J	27.4
OL-STA-80234	OL-3741-18	0 - 0.13	05/25/2022	0.55	J	23.6
OL-STA-80234	OL-3741-19	0.13 - 0.33	05/25/2022	1.3	J	25.8
South Basin						
OL-STA-80077	OL-3738-14	0 - 0.13	05/24/2022	0.6	J	27.8
OL-STA-80077	OL-3738-15	0.13 - 0.33	05/24/2022	1.3	J	29.5
OL-VC-80044	OL-3738-10	0 - 0.13	05/24/2022	0.42	J	32.7
OL-VC-80044	OL-3738-11	0.13 - 0.33	05/24/2022	1.1	J	34.8
OL-STA-80229	OL-3741-08	0 - 0.13	05/25/2022	0.41	J	30.1
OL-STA-80229	OL-3741-09	0.13 - 0.33	05/25/2022	1.1	J	25.1
OL-VC-80045	OL-3738-12	0 - 0.13	05/24/2022	0.23	J	47.6
OL-VC-80045	OL-3738-13	0.13 - 0.33	05/24/2022	1.3	J	36.1
OL-STA-80076	OL-3741-12	0 - 0.13	05/25/2022	0.4	J	23.8
OL-STA-80076	OL-3741-13	0.13 - 0.33	05/25/2022	1.8	J	25.4
OL-STA-80078	OL-3738-18	0 - 0.13	05/24/2022	0.46	J	28.8
OL-STA-80078	OL-3738-19	0.13 - 0.33	05/24/2022	1.3	J	26.6
OL-STA-80080	OL-3738-07	0 - 0.13	05/24/2022	0.75	J	26.8
OL-STA-80080	OL-3738-09	0.13 - 0.33	05/24/2022	1.8	J	27
OL-VC-80024	OL-3741-10	0 - 0.13	05/25/2022	0.53	J	30.8
OL-VC-80024	OL-3741-11	0.13 - 0.33	05/25/2022	1.1	J	26.1
OL-VC-80079	OL-3738-05	0 - 0.13	05/24/2022	0.33	J	28.8
OL-VC-80079	OL-3738-06	0.13 - 0.33	05/24/2022	0.82	J	27.7
OL-STA-80081	OL-3737-09	0 - 0.13	05/24/2022	0.6	J	28.2
OL-STA-80081	OL-3737-10	0.13 - 0.33	05/24/2022	1.2	J	26.7
OL-STA-80084	OL-3736-11	0 - 0.13	05/24/2022	0.4	J	29.9
OL-STA-80084	OL-3736-12	0.13 - 0.33	05/24/2022	1	J	30.4
OL-STA-80082	OL-3736-03	0 - 0.13	05/24/2022	0.58	J	25.8
OL-STA-80082	OL-3736-04	0.13 - 0.33	05/24/2022	1.1	J	26.3
OL-STA-80083	OL-3736-05	0 - 0.13	05/24/2022	0.31	J	28.5
OL-STA-80083	OL-3736-06	0.13 - 0.33	05/24/2022	0.98	J	27.8
ST51	OL-3738-03	0 - 0.13	05/24/2022	0.47	J	27.8
ST51	OL-3738-04	0.13 - 0.33	05/24/2022	1.1	J	24.7

TABLE 5.2 SUMMARY OF MERCURY MEASURED DURING 2022 COMPLIANCE EVENT SEDIMENT SAMPLES (CONTINUED)

Location ID	Field Sample ID	Depth (ft)	Date	Mercury (mg/kg dry)		Solids (%)
South Corner						
OL-STA-80085	OL-3737-13	0 - 0.13	05/24/2022	0.28	J	31.3
OL-STA-80085	OL-3737-14	0.13 - 0.33	05/24/2022	0.97	J	33.4
OL-STA-80237	OL-3736-15	0 - 0.13	05/24/2022	0.22	J	47.1
OL-STA-80237	OL-3736-16	0.13 - 0.33	05/24/2022	2	J	33.5
OL-VC-80068	OL-3737-11	0 - 0.13	05/24/2022	0.24	J	32.1
OL-VC-80068	OL-3737-12	0.13 - 0.33	05/24/2022	1.3	J	27.6
OL-VC-80070	OL-3736-13	0 - 0.13	05/24/2022	0.51	J	33.1
OL-VC-80070	OL-3736-14	0.13 - 0.33	05/24/2022	1.9	J	34.9
OL-VC-80172	OL-3737-01	0 - 0.13	05/24/2022	0.42	J	33.3
OL-VC-80172	OL-3737-02	0.13 - 0.33	05/24/2022	1.2	J	32.4
OL-STA-80236	OL-3737-07	0 - 0.13	05/24/2022	0.63	J	31.6
OL-STA-80236	OL-3737-08	0.13 - 0.33	05/24/2022	1.8	J	27.9
OL-STA-80239	OL-3737-03	0 - 0.13	05/24/2022	0.26	J	35
OL-STA-80239	OL-3737-04	0.13 - 0.33	05/24/2022	0.97	J	38.2
OL-VC-80039	OL-3736-09	0 - 0.13	05/24/2022	0.14	J	35.8
OL-VC-80039	OL-3736-10	0.13 - 0.33	05/24/2022	0.3	J	49.1
OL-VC-80040	OL-3737-17	0 - 0.13	05/24/2022	0.14	J	36.2
OL-VC-80040	OL-3737-18	0.13 - 0.33	05/24/2022	0.2	J	36.6
OL-VC-80071	OL-3738-01	0 - 0.13	05/24/2022	0.26	J	33.6
OL-VC-80071	OL-3738-02	0.13 - 0.33	05/24/2022	0.55	J	47.3
OL-VC-80051	OL-3736-07	0 - 0.13	05/24/2022	0.46	J	34.5
OL-VC-80051	OL-3736-08	0.13 - 0.33	05/24/2022	1.7	J	35.9
OL-VC-80062	OL-3736-17	0 - 0.13	05/24/2022	0.44	J	33.3
OL-VC-80062	OL-3736-18	0.13 - 0.33	05/24/2022	1.9	J	34.1
OL-VC-80177	OL-3736-01	0 - 0.13	05/24/2022	0.43	J	35
OL-VC-80177	OL-3736-02	0.13 - 0.33	05/24/2022	1.4	J	33.3
OL-STA-80238	OL-3737-15	0 - 0.13	05/24/2022	0.32	J	34.9
OL-STA-80238	OL-3737-16	0.13 - 0.33	05/24/2022	1.2	J	45.4
OL-VC-80064	OL-3737-05	0 - 0.13	05/24/2022	0.22	J	32.6
OL-VC-80064	OL-3737-06	0.13 - 0.33	05/24/2022	1	J	38.6

TABLE 6.1 SURFACE SEDIMENT AREA-WEIGHTED AVERAGE MERCURY CONCENTRATION WITH 2021 COMPLIANCE DATA

Sub-Basin	Final Design Model-Predicted Surface Sediment Area-Wegihted Average Mercury Concentration (mg/kg) [1]	Calculated Surface Sediment Area-Weighted Average Mercury Concentration (mg/kg) [2]
North Basin	0.70	0.64
Ninemile Creek Outlet Area	0.51	0.32
Saddle	0.63	0.39
South Basin	0.66	0.39
South Corner	0.50	0.36

Notes:

1. Model-predicted surface sediment area-weighted average mercury concentrations are reported for the end of 2021.

2. Surface sediment area-weighted concentrations calculated utilizing 2021 monitoring data, 2019 surface sediment data from the CSX area, 2019 cap data, and 2021 littoral zone data supplemented with PDI/RI data for locations not sampled in 2021.

TABLE 6.2 SURFACE SEDIMENT AREA-WEIGHTED AVERAGE MERCURY CONCENTRATION WITH 2022 COMPLIANCE DATA

Sub-Basin	Final Design Model-Predicted Surface Sediment Area-Weighted Average Mercury Concentration (mg/kg)[1]	Calculated Surface Sediment Area-Weighted Average Mercury Concentration (mg/kg)[2]
North Basin	0.67	0.67
Ninemile Creek Outlet Area	0.47	0.47
Saddle	0.58	0.39
South Basin	0.61	0.42
South Corner	0.45	0.39

Notes:

1. Model-predicted surface sediment area-weighted average mercury concentrations are reported for the end of 2022.

2. Surface sediment area-weighted concentrations calculated utilizing 2022 monitoring data, 2019 surface sediment data from the CSX area, 2022 cap data, and 2021/2022 littoral zone data supplemented with PDI/RI data for locations not sampled in 2021/2022.

TABLE 7 2023 PEEPER RESAMPLE RESULTS

				Toluene ug/l				Phenol ug/l			
Location	Layer	Start Depth (inches)	End Depth (inches)	2022		2023		2022		2023	
OL-RAB-CAP-0011-H	Habitat	2	5	0.62	J			132		1.43	U
OL-RAB-CAP-0014-H	Habitat	3	6	1.03	J	0.22	UJ	NA		NA	
OL-RAB-CAP-0014-H	Habitat	3	9	NA		NA		15.4	J	0.74	U
OL-RAB-CAP-0014-H	Habitat	9	12	176	J-	0.22	U	4.95	J	1.98	U
OL-RAB-CAP-0014-I	Isolation	12	15	638		0.22	U	517		2.09	U
OL-RAB-CAP-0015-H	Habitat	3	6	1.54	J-	0.22	U	NA		NA	
OL-RAB-CAP-0015-H	Habitat	3	9	NA		NA		35.2	J	0.85	U
OL-RAB-CAP-0015-H	Habitat	9	12	264		0.22	U	209		1.32	U
OL-RAB-CAP-0015-I	Isolation	12	15	132	J-	0.22	U	4.95	J	2.2	U
OL-RAD-CAP-0013-H	Habitat	3	6	3.52	J-	0.22	U	NA		NA	
OL-RAD-CAP-0013-H	Habitat	3	9	NA		NA		66		1.02	U
OL-RAD-CAP-0013-H	Habitat	9	12	97		7.81		110		82.5	
OL-RAD-CAP-0013-I	Isolation	12	15	891		5.61		550		95.7	J+
OL-RAD-CAP-0015-H	Habitat	3	6	0.22	UJ	NA		NA		NA	
OL-RAD-CAP-0015-H	Habitat	3	9	NA		NA		0.36	U	0.89	U
OL-RAD-CAP-0015-H	Habitat	9	12	23.1	J-	NA		9.35		1.43	U
OL-RAD-CAP-0015-I	Isolation	12	15	165	J-	NA		308		1.87	U
OL-RAD-CAP-0021-H	Habitat	3	6	0.22	UJ	45.1		NA		NA	
OL-RAD-CAP-0021-H	Habitat	3	9	NA		NA		24.2		55	J+
OL-RAD-CAP-0021-H	Habitat	9	12	594	J	1650		264	J+	165	J+
OL-RAD-CAP-0021-I	Isolation	12	15	583		902		231	J+	176	J+

NA - Not applicable

U - Undetected at the listed detection limit

J - Estimated value

[shaded] Exceeds cap performance criteria for toluene (480 ug/L) or for phenol (250 ug/L) in habitat layer

TABLE 8 COMPARISON OF HISTORIC, 2016, AND 2019 MEAN PECQ AND MERCURY IN CSX AREA

Location ID	Historic			2016			2019		
	Sample Depth (ft)	Mean PECQ	Mercury Conc. (mg/Kg)	Sample Depth (ft)	Mean PECQ	Mercury Conc. (mg/Kg)	Sample Depth (ft)	Mean PECQ	Mercury Conc. (mg/Kg)
OL-RAE-CAP-0001-H	0 - 1	5.96	11.9	0 - 0.5	10.21	7.9	0 - 0.5	11.69	6.20
OL-RAE-CAP-0002-H	NA	NA	NA	0 - 0.5	2.17	3.1	0 - 0.5	9.93	4.30
OL-RAE-CAP-0003-H	NA	NA	NA	0 - 0.5	2.24	2.10	0 - 0.5	2.04	2.00
OL-RAE-CAP-0004-H	0 - 1	15.66	4.1	0 - 0.5	15.60	5.90	0 - 0.5	21.16	5.10
OL-RAE-CAP-0005-H	NA	NA	NA	0 - 0.5	8.02	1.60	0 - 0.5	0.66	0.88
OL-RAE-CAP-0006-H	0 - 3.3	27.02	0.73	0 - 0.5	4.41	0.37	0 - 0.5	1.93	0.96
OL-RAE-CAP-0007-H	0 - 1	5.99	3.3	0 - 0.5	4.10	0.79	0 - 0.5	1.66	1.10
OL-RAE-CAP-0008-H	NA	NA	NA	0 - 0.5	23.30	0.66	0 - 0.5	0.35	0.05
OL-RAE-CAP-0009-H	0 - 1	18.33	0.71	0 - 0.5	15.27	1.60	0 - 0.5	6.51	0.53
OL-RAE-CAP-0010-H	NA	NA	NA	0 - 0.5	0.06	0.01	0 - 0.5	0.43	0.35
OL-RAE-CAP-0011-H	0 - 1	1.44	0.69	0 - 0.5	1.37	0.53	0 - 0.5	0.41	0.37
OL-RAE-CAP-0012-H	NA	NA	NA	0 - 0.5	25.97	0.77	0 - 0.5	2.40	0.32
OL-RAE-CAP-0013-H	0 - 1	1.22	0.89	0 - 0.5	1.66	0.87	0 - 0.5	0.28	0.49
OL-RAE-CAP-0014-H	NA	NA	NA	0 - 0.5	0.13	0.27	0 - 0.5	0.12	0.31
OL-RAE-CAP-0015-H	0 - 1	1.42	0.85	0 - 0.5	1.08	0.14	0 - 0.5	1.83	0.21
OL-RAE-CAP-0016-H	NA	NA	NA	0 - 0.5	1.44	0.39	0 - 0.5	0.30	0.25
AVERAGE	-	9.63	2.90	-	7.31	1.69	-	3.86	1.46

NA - Not analyzed

TABLE 9

FISH TISSUE REMEDIAL GOALS (MERCURY) AND TARGET CONCENTRATIONS (ORGANIC CHEMICALS)

	Human Health	**Ecological**[a]
Remedial Goals		
Mercury (mg/kg)	0.2 to 0.3[b]	0.14[c] for small and large prey fish
Target Concentrations		
PCBs (mg/kg)	0.04 to 0.3[d]	0.19[c] for small and large prey fish
Dioxin/furan TEQ (ng/kg)	1.3 to 4[e]	NA
DDT and Metabolites (mg/kg)	NA	0.049[f] for small prey fish 0.14[g] for large prey fish

Notes:

- Contaminant concentrations in fillet samples of sportfish (i.e., identified as Smallmouth Bass, Walleye, Pumpkinseed, and Common Carp in the OLMMP) are compared to remedial goals and target concentration ranges for protection of human health.
- Contaminant concentrations in 1) whole body samples of large prey fish, 2) composite whole body samples of small prey fish, and 3) whole-body concentrations in sportfish of appropriate sizes calculated from fillet concentrations are compared to remedial goals and target concentrations for protection of ecological receptors. The OLMMP identifies White Sucker and Banded Killifish for large and small prey fish, but states that other comparable species may be substituted if these species are difficult to obtain.
- Concentrations are on a wet-weight basis.
- While not collected as prey fish, remedial goals and target concentrations may be compared to contaminant concentrations in whole body sportfish (i.e., specifically Smallmouth Bass, Walleye, Pumpkinseed, and Common Carp in the OLMMP) where fillet data is converted to whole body data using "conversion factors developed in the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (i.e., 0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) (TAMS, 2002)," For these calculations, fish with lengths 180-600 mm and 30-180 mm are compared to goal and target concentrations for large and small prey fish, respectively.

NA – not applicable. Dioxin/furans and DDT were not identified as posing risk to ecological receptors and human health, respectively.

a – Ecological remedial goals and targets based on lowest observed adverse effect levels presented in Appendix G of the FS (Parsons et al. 2004). Protection of ecological receptors (wildlife) based on the exposure assumptions from the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (TAMS, 2002). No-observed-adverse-effect-levels were not identified as ecological remedial goals or targets as they are below background levels identified in the ROD and may not be achievable.

b – Lower end of the mercury range is based on reasonable maximum exposure (RME), non-carcinogenic risk. The higher end of the range is EPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms and is expressed as mg/kg in fish tissue.

c – Protection of river otter.

d – Lower end of PCB range represents the RME non-carcinogenic target for high molecular weight PCBs and is approximately equal to the target for $1x10^{-5}$ carcinogenic risk (0.03 mg/kg). Upper end of range is the RME target for 1×10^{-4} carcinogenic risk.

e – Although non-carcinogenic targets were not developed for dioxin/furans at the time of the ROD (2005), using the parameters presented in Appendix G of the FS (Parsons et al. 2004) for a target concentration for the noncancer endpoint, and using the USEPA 2012 reference dose of 7E-10 mg/kg-day, the non-cancer target at a hazard quotient of 1 was determined by USEPA to be 1.3E-06 mg/kg (or 1.3 ng/kg) and is the lower end of the range. The upper end of the range is for protection of carcinogenic risk of $1x10^{-4}$, reasonable maximum exposure (RME).

f – Protection of belted kingfisher

g – Protection of osprey

Attachment 1 – List of Figures

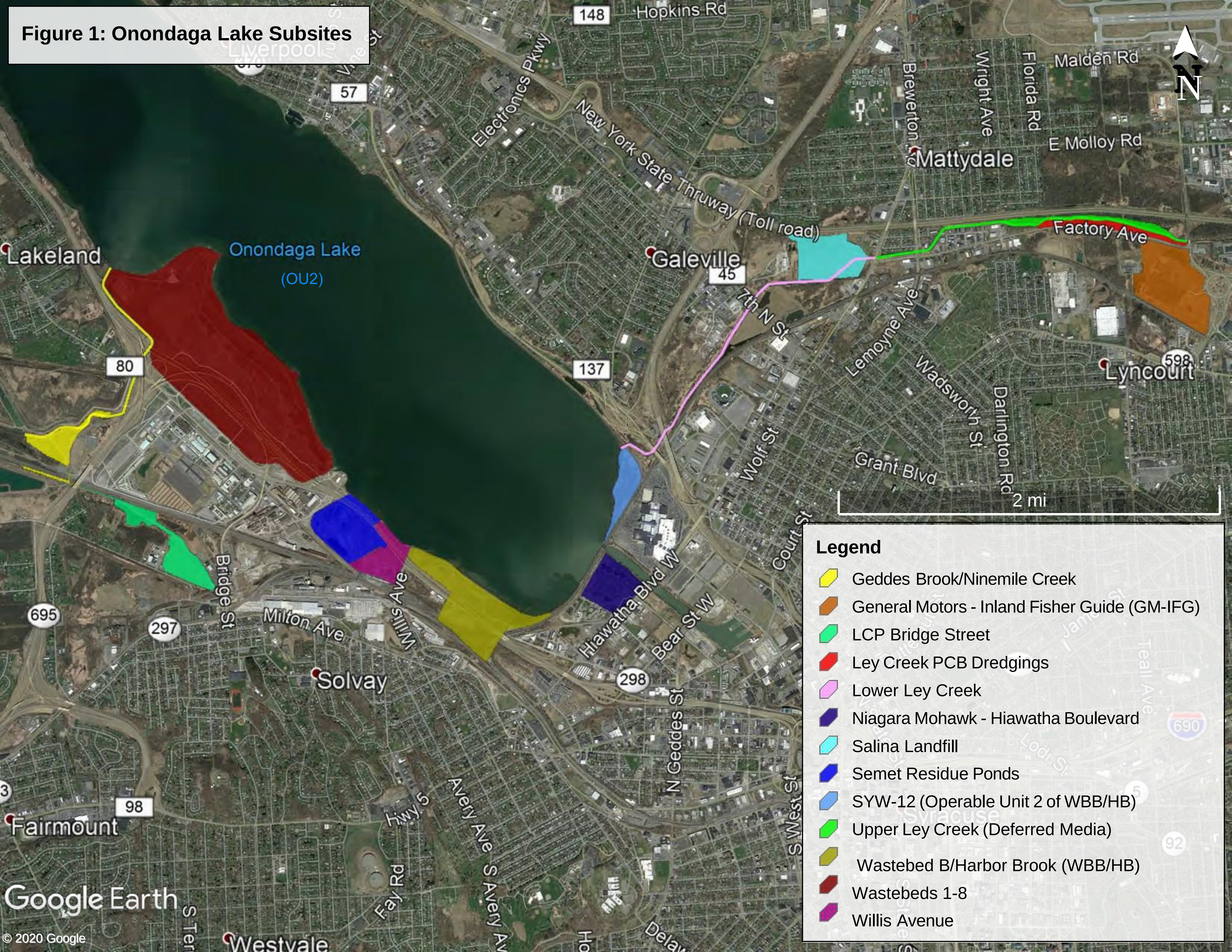


Figure 1: Onondaga Lake Subsites

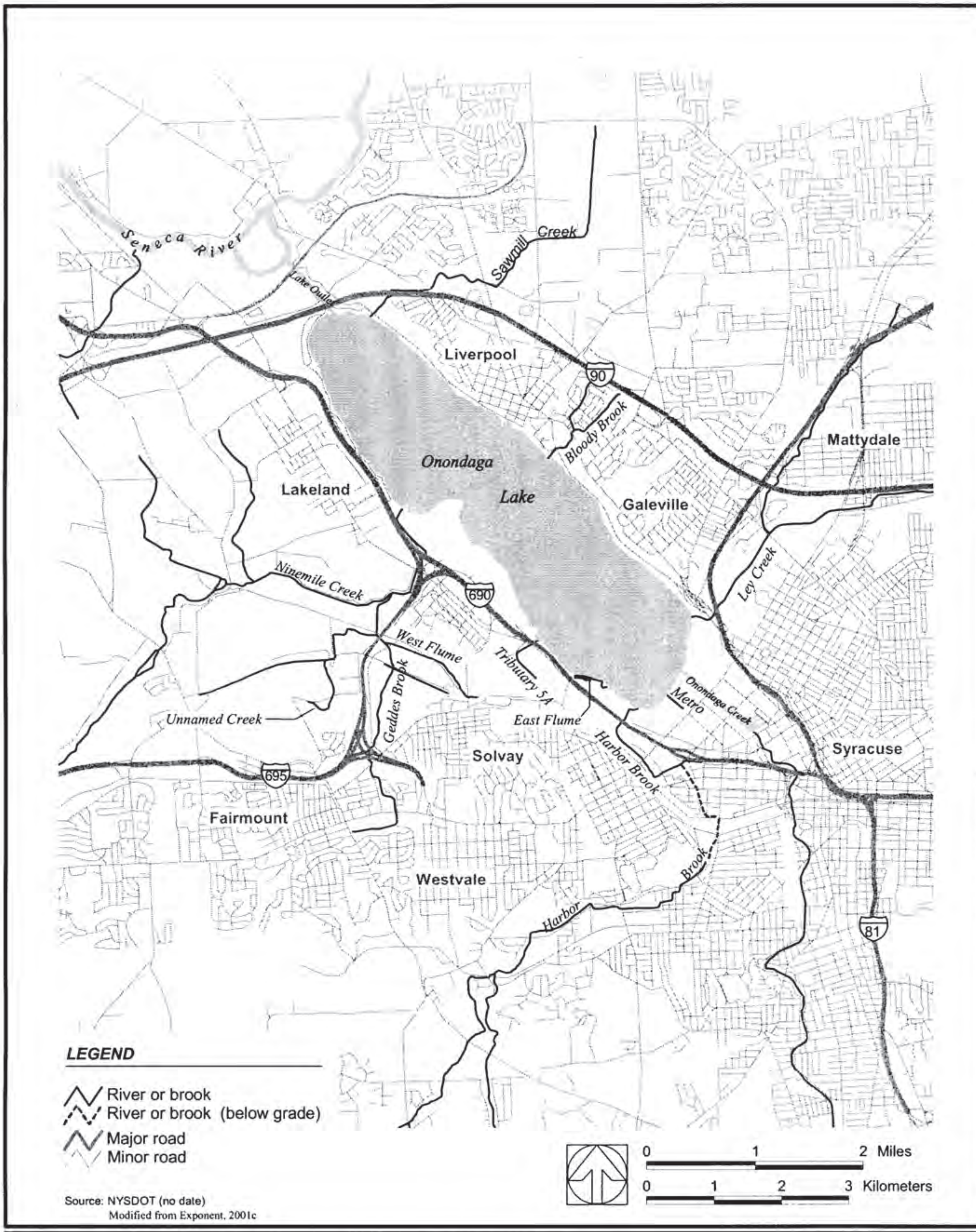


Figure 2 Onondaga Lake Area Tributaries and Roads

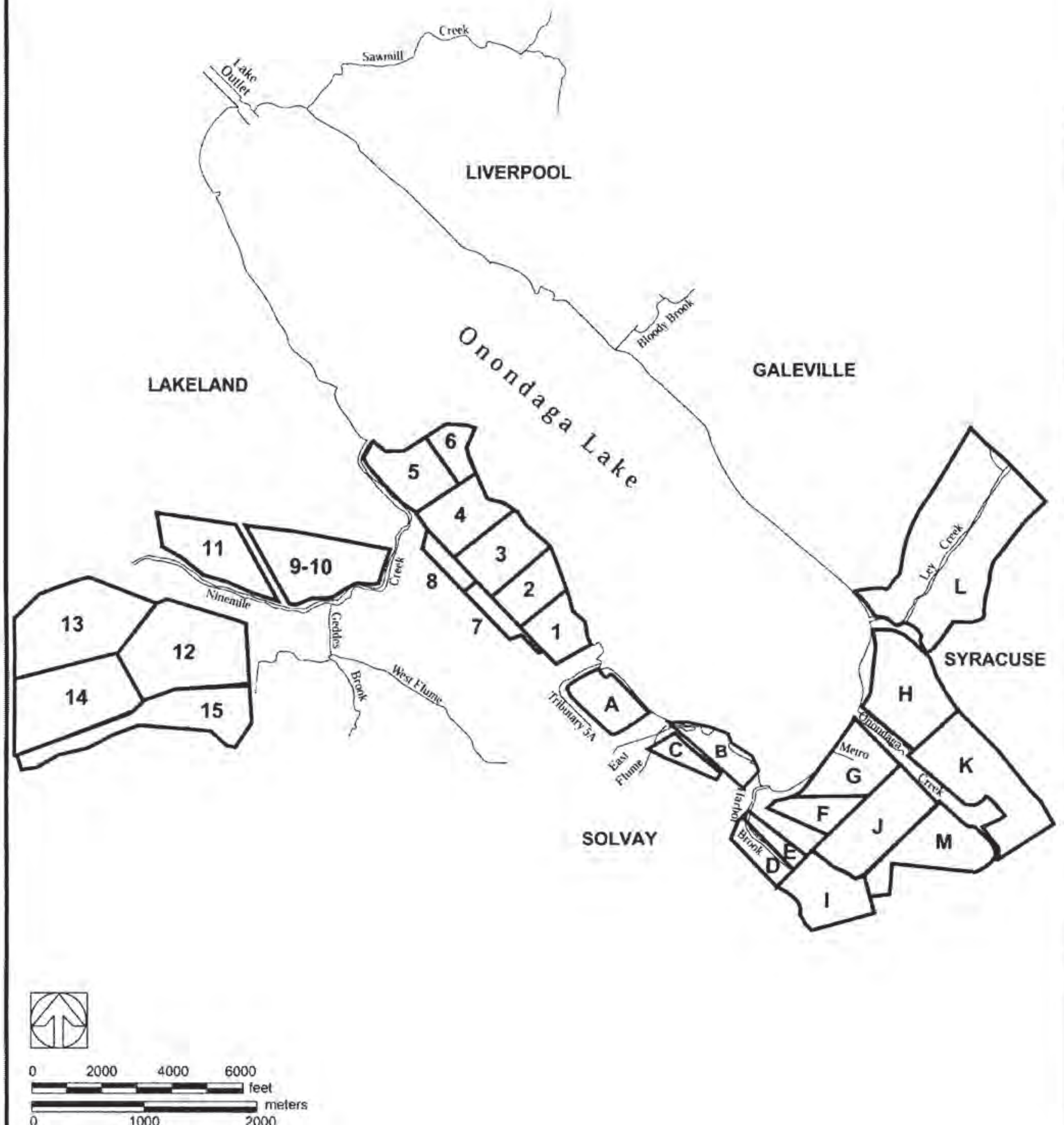
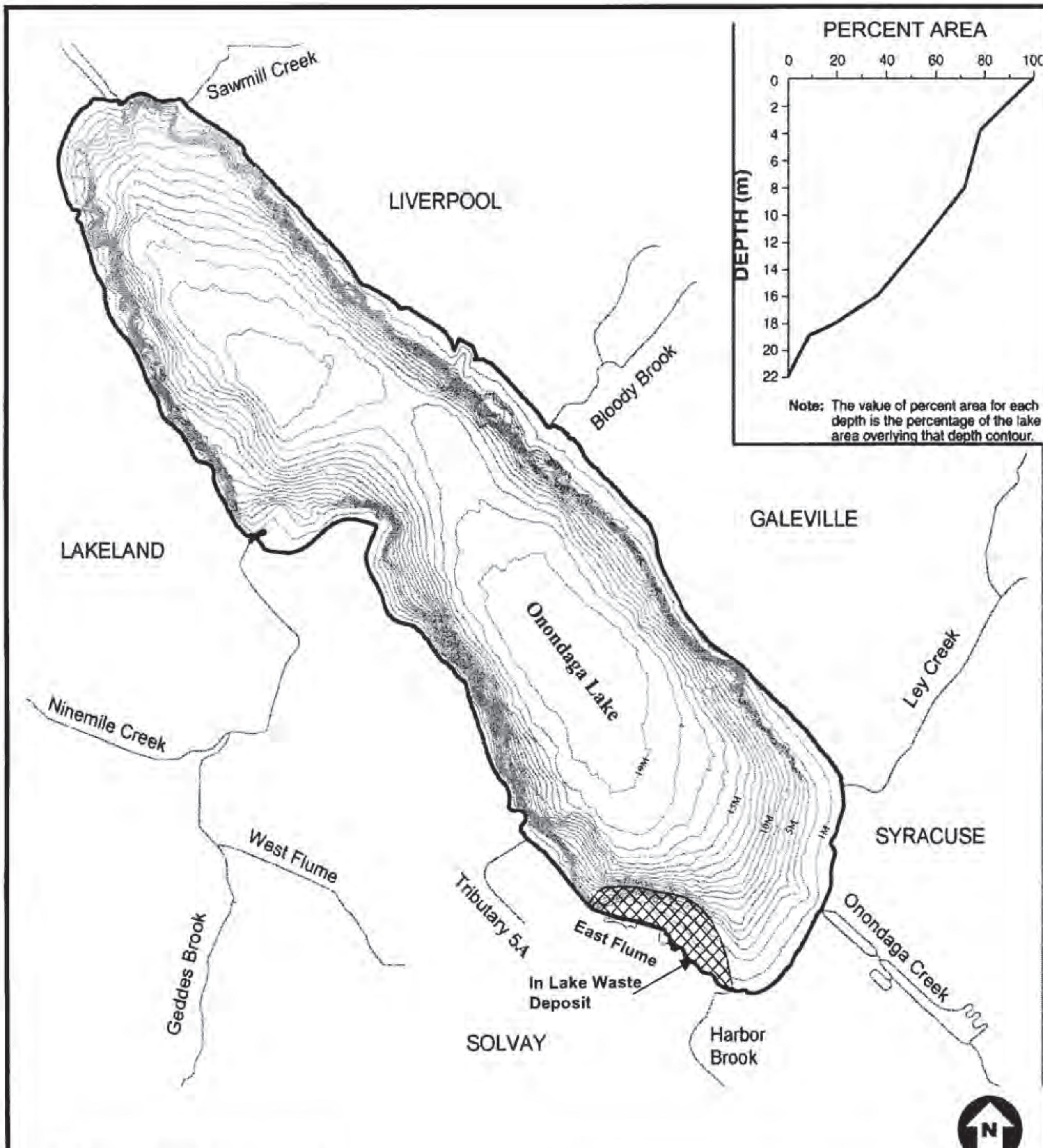


Figure 3 Historical Locations of Solvay Wastebeds



Bathymetry is in 1 meter intervals.

Water surface elevation is 363.39 Feet (110.76 Meters) above mean sea level

Figure 4

ONONDAGA LAKE
SYRACUSE, NEW YORK

Approximate Location of the In-Lake Waste Deposit

Remediation Area Boundary

Sediment Management Unit (SMU) Boundary

Extent of ILWD in Littoral Zone

Willis/Semet IRM Barrier Wall

West Wall Portion of the WB-B/HB IRM

East Wall Portion of the WB-B/HB IRM

New York State Digital Orthoimagery from 2009

1,800 900 0 1,800
Feet

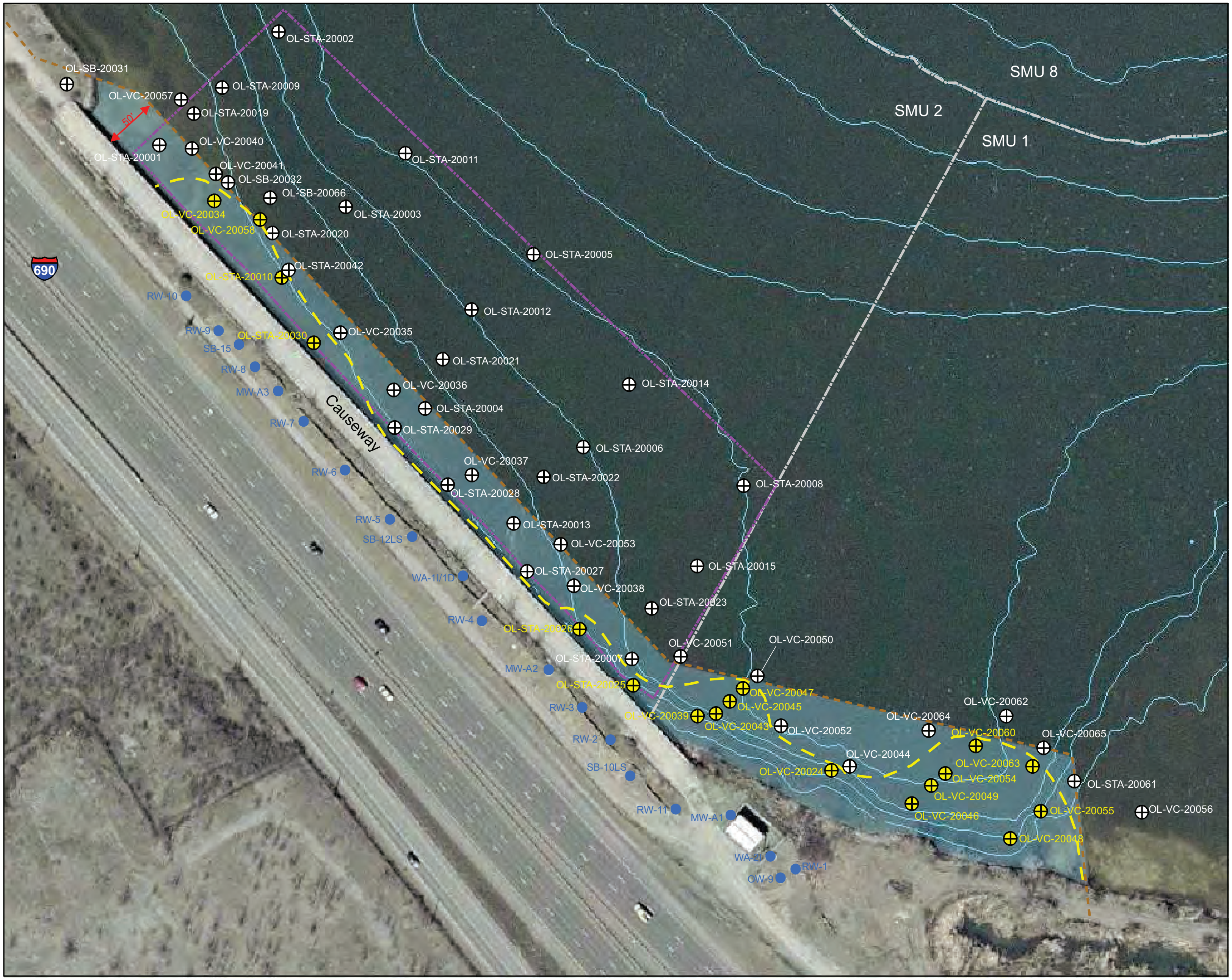
FIGURE 5

Honeywell — Onondaga Lake, Syracuse, New York

SMU Boundaries an Rem iation Area

PARSONS
301 PLAINFIELD RD, SUITE 350, S RA USE, N 13 1

User: p0013927
D e Revised: 2/15/2012 11:16:50 AM
P : : GIS GIS_L ke CAP MXD SMUs_Rem_Are s.m d



N

- Existing Onshore NAPL Recovery Well
- 2005/2006 Core does not contain pooled NAPL but may contain isolated NAPL stringers, seams and/or globules in Solvay Waste (see text in ESD)
- 2005/2006 Core Contains pooled NAPL (see text in ESD)
- Barrier Wall Alignment (Approximate)
- Extent of Pooled NAPL
- Extent of Pooled NAPL Removal Area Assumed in the FS/ROD

Notes:

1. Bathymetry is shown in 4' intervals.

90 45 0 90

Feet

FIGURE 6

Honeywell

Onondaga Lake
Syracuse, New York

Pooled NAPL Extent and Barrier Wall Alignment

PARSONS

290 ELWOOD DAVIS RD, SUITE 312, LIVERPOOL, NY 13088 Phone:(315)451-9560

Q:\GIS\GIS_Lake\dnapl_invest\pooled_napl_barr_wall_101306.mxd

Remediation Area Boundary
Offset/Buffer Area
Isolation Cap Area
SMU 8 Thin-layer Cap Area
Dredge Area
Sediment Management Unit (SMU) Boundary
Wave Damper (Approximate Location)
Willis/Semet IRM Barrier Wall
West Wall Portion of the WB-B/HB IRM
East Wall Portion of the WB-B/HB IRM
Eastern Shoreline Groundwater Collection Trench

N

New York State Digital Orthoimagery from 2009

650 325 0 650

Feet

FIGURE 7

Honeywell Onondaga Lake Syracuse, New York

Remediation Area E Shoreline Offset and Wave Damper

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

User: 40189
Date Revised: 6/20/2014 1:11:42 PM
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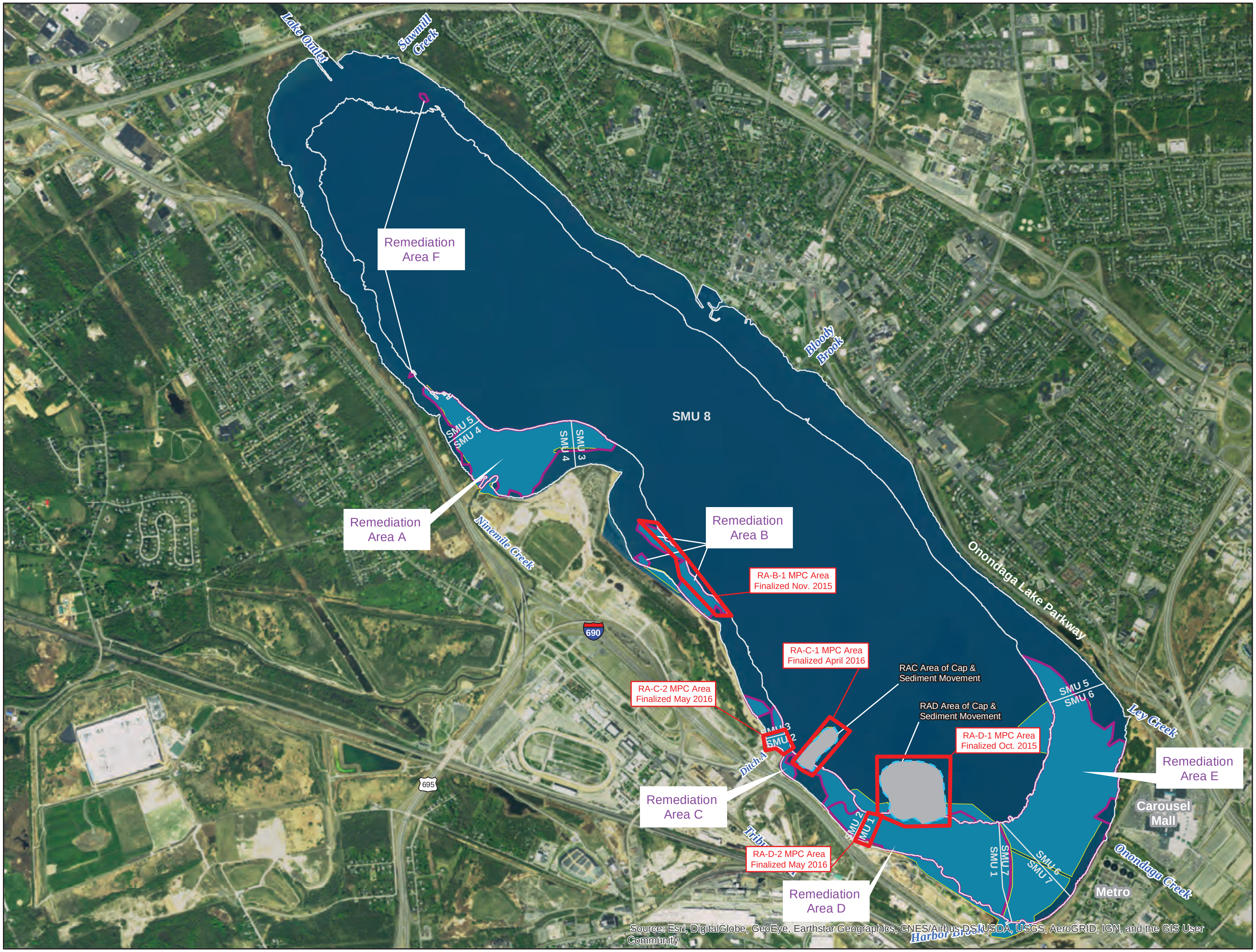


Remediation Area Boundary

Sediment Management Unit (SMU) Boundary

Capped Area

Area of Cap and Sediment Movement

Approximate Area of Modified Protective Caps (see Figures 4 through 8) and Date of Design Revision

1,800 900 0 1,800
Feet

FIGURE 8

Honeywell Onondaga Lake Syracuse, New York

ESD AREAS OF INTEREST

PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

User: 40189
Date Revised: 12/19/2017 2:58:32 PM
Path: Q:\GIS\GIS_Lake\CAP\MXD\2017\SMUs_Rem_Areas-2017.mxd

REMEDIATION AREA BOUNDARY

SMU BOUNDARY

DREDGE AREAS

CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)

DREDGE AND CAP RAILROAD ACCESS

FIGURE 9

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

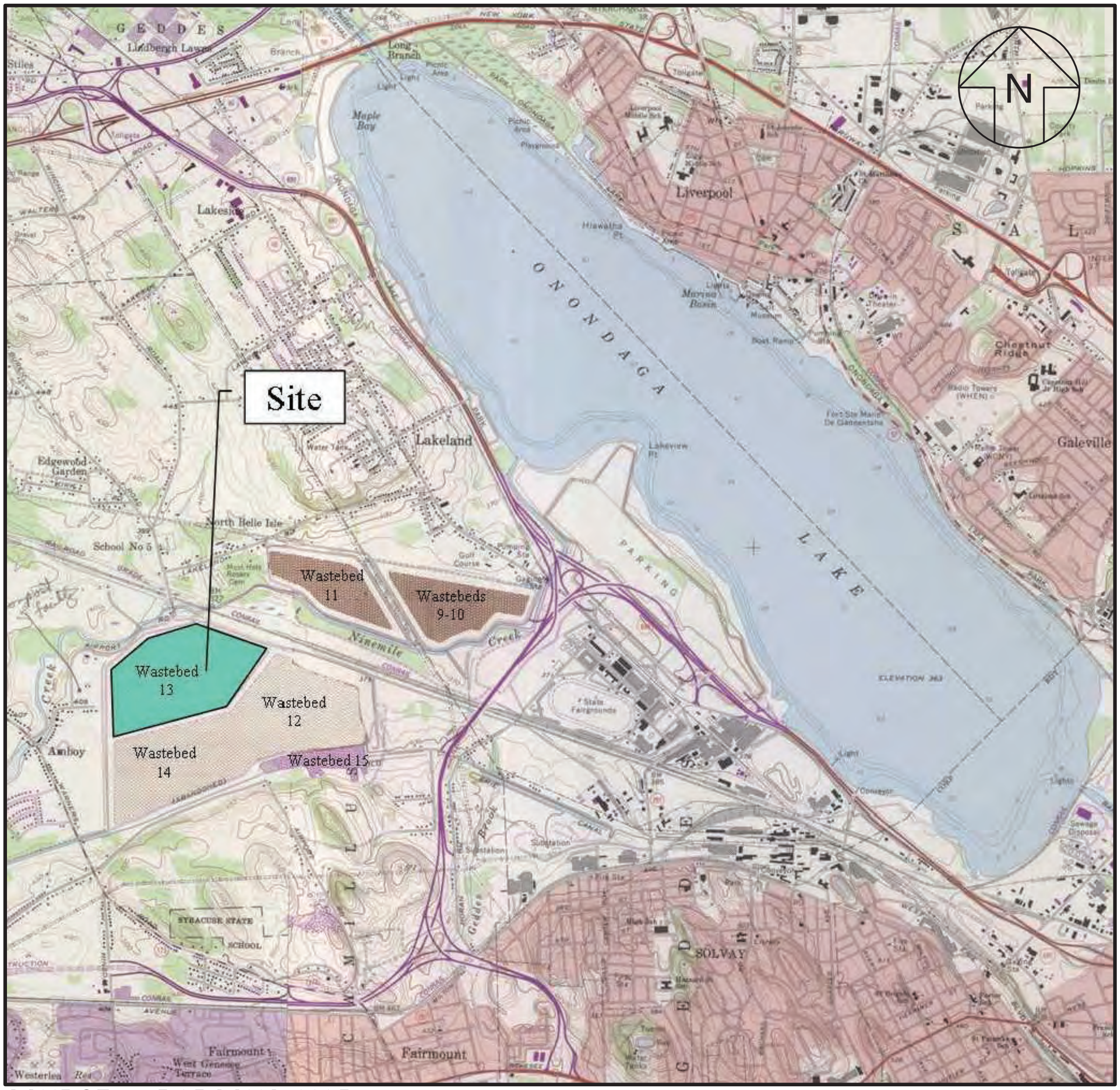
ONONDAGA LAKE DREDGE AND CAP

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\449883 GB NMC FER\10.0 TECHNICAL CATEGORIES\GRAPHICS\449883-LAKE CAPPING.DWG
PLOT DATE: 10/25/2018 11:37 AM PLOTTED BY: RUSSO, JILL

WASTEBED 13 LOCATION MAP



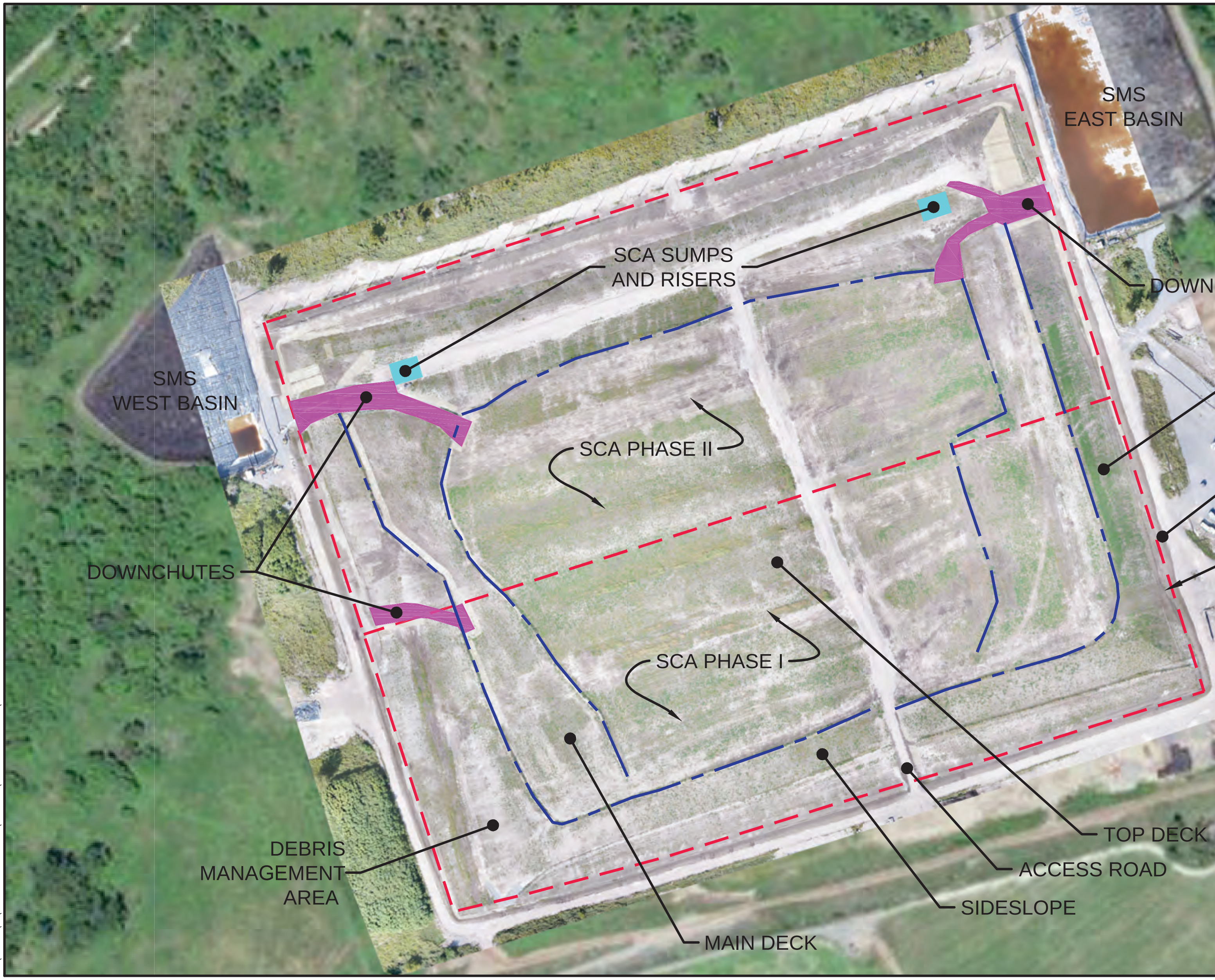
SOURCE: PARSONS MAP

Geosyntec consultants

KENNESAW, GA

DATE:	January 2018	SCALE:	NTS
PROJECT NO.	GQ5825A	FILE NO.	4706f001
DOCUMENT NO.	–	FIGURE NO.	10

L:\CADD\O\ONONDAGA LAKE\PERMIT\SCA GEOTUBES\ISSUED FOR CONSTRUCTION REV-0\REDUCED SET (NO FINAL COVER)\4706F001



NOTE:

1. FIGURE IS COMPRISED OF AERIAL IMAGES FROM PARSONS,THEW AND BING

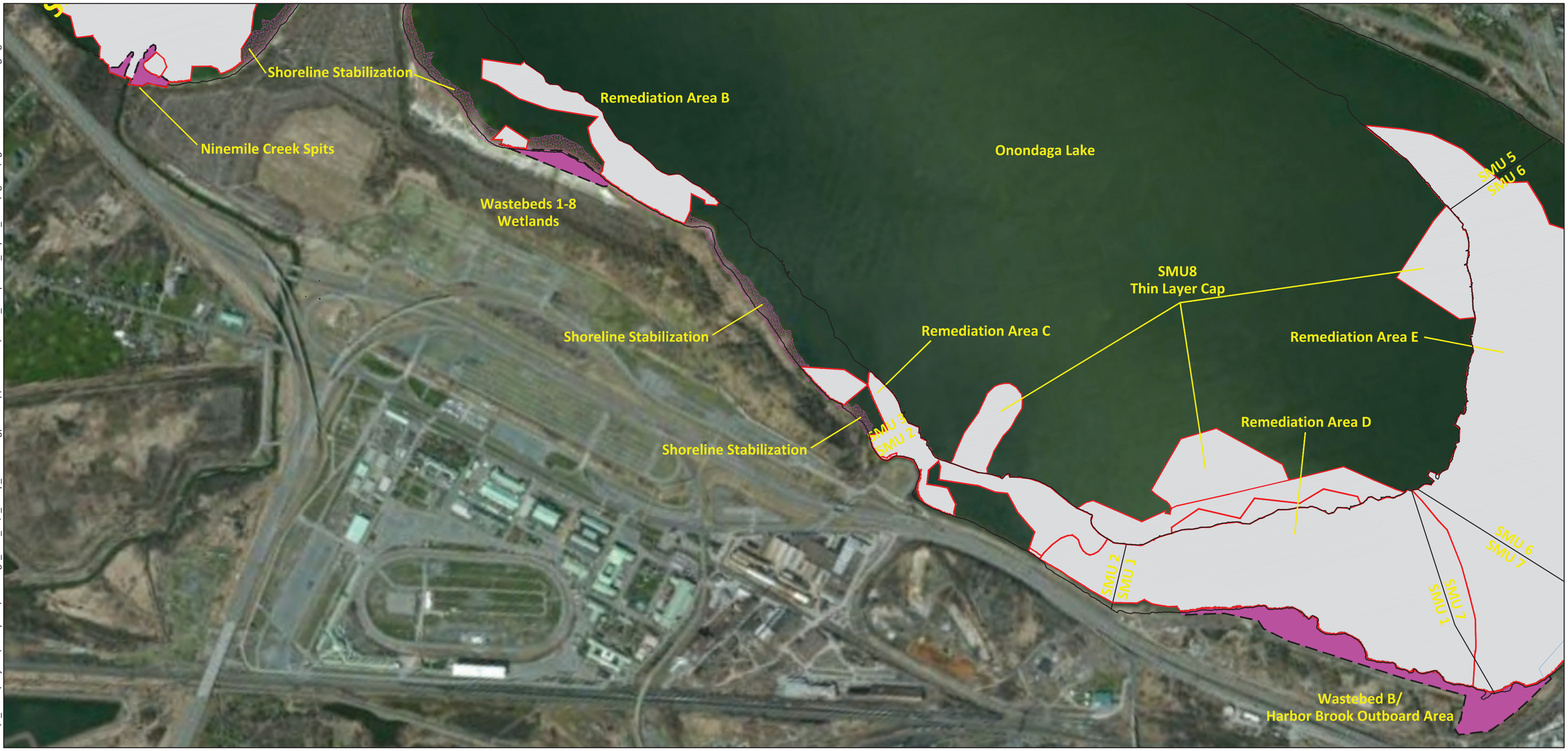
ONONDAGA LAKE
SCA CLOSURE SITE LAYOUT

Geosyntec consultants

FIGURE 11

PROJECT NO: 5825A-07 | FEBRUARY 2018

L:\CADD\O\ONONDAGA LAKE\PERMIT\SCA GEOTUBES\FIGURE 2



SOURCE: Aerial Source: Bing Maps
HORIZONTAL DATUM: New York State Plane, Central Zone, North American Datum 1983 (NAD83), U.S. Feet
VERTICAL DATUM: North American Vertical Datum 1988 (NAVD88)

LEGEND:

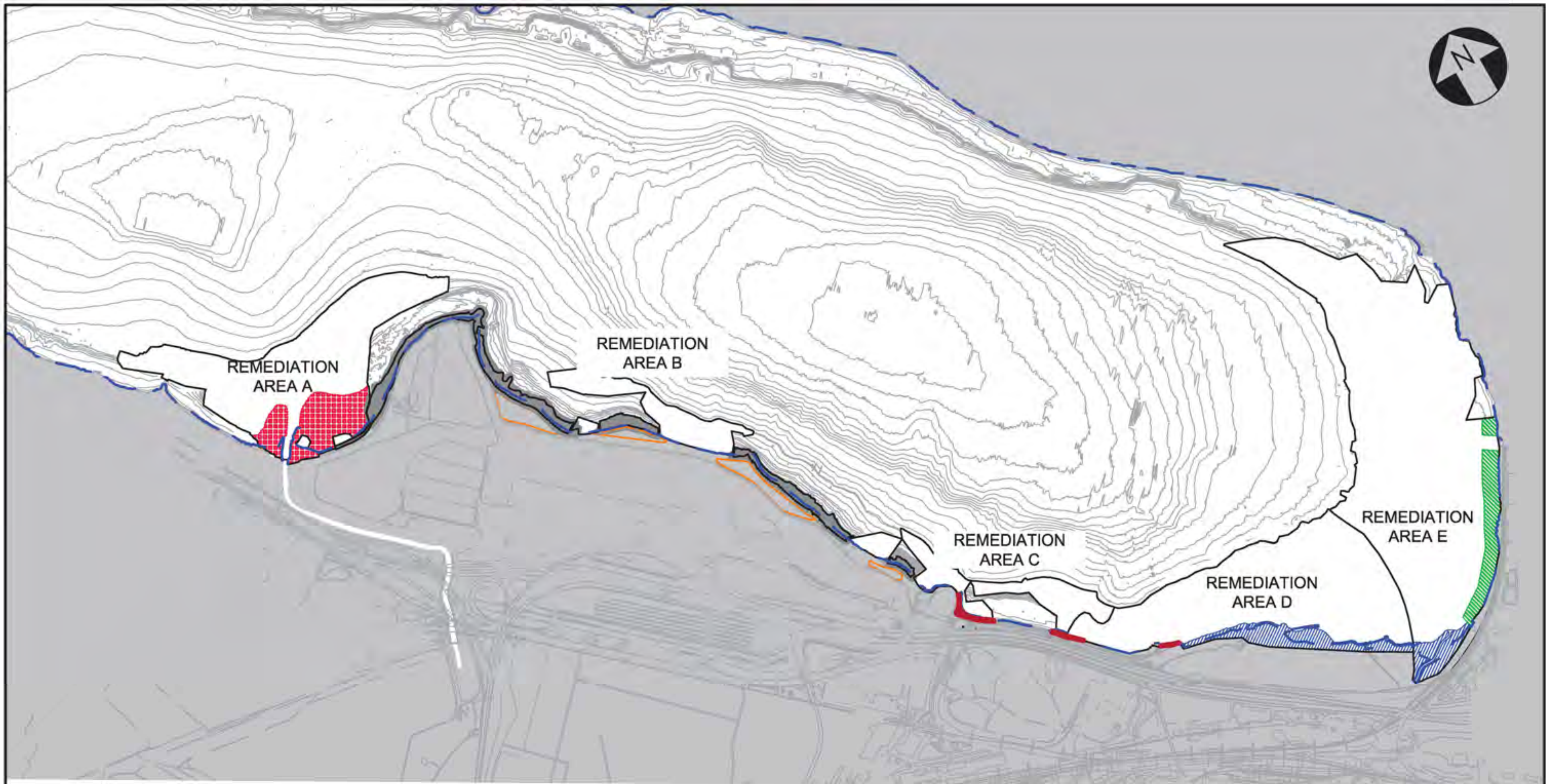
- Adjacent Remedial Area
- SMU Boundary
- Remediation Area Boundary
- Shoreline Stabilization Area

0 1000
Scale in Feet

Honeywell

ANCHOR QEA

Figure 12
Adjacent Remediation Areas
Construction Completion Report
Onondaga Lake Capping and Dredging



LEGEND:

- NINEMILE CREEK SPITS AND ADJACENT PLANTED AREA
- WASTEBED B/HARBOR BROOK OUTBOARD PLANTED AREA
- SMU 3 & 4 SHORELINE HABITAT ENHANCEMENT AREAS
- WASTEBED 1–8 IRM WETLANDS
- SPECIAL SHORELINE TRANSITION AREA
- CSX SHORELINE
- REMEDIATION AREA BOUNDARIES
- SHORELINE

NOTE:
1. FIGURE TAKEN FROM ONONDAGA LAKE CAPPING, DREDGING, HABITAT AND PROFUNDAL ZONE (SMU 8) FINAL DESIGN ADDENDUM.

2000 1000 0 2000 4000

SCALE: 1"=2000'

FIGURE 13

Honeywell

ONONDAGA LAKE HABITAT CONSTRUCTION REPORT

HABITAT RESTORATION, REMEDIATION, AND ENHANCEMENT AREAS

PARSONS

301 PLAINFIELD ROAD * SUITE 350 * SYRACUSE, NY 13212 * 315/451–9560
OFFICES IN PRINCIPAL CITIES

FILE NAME: P:\HONEYWELL –SYR\450550 2017 HABITAT WORK\10.0 TECHNICAL CATAGORIES\10.1 CAD\FIGURES\450550-100-SK-001.DWG
PLOT DATE: 4/11/2018 9:37 AM PLOTTED BY: RUSSO, JILL

Figure 14

Honeywell

OUTBOARD AREA BERM AND HARBOR BROOK PLAN VIEW

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212

FILE NAME: \\NYSYR04FS01\PROJDATA\GIS\HON_SYRACUSE\OLMMS\OMM SURVEY\2022 SURVEY\CAD\BERM SURVEY\OLMMP_2022_BERM CROSS SECTIONS.DWG
PLOT DATE: 6/7/2023 10:43 AM PLOTTED BY: DOMANSKI, JOSHUA [US-US]

2023 Nitrate Application Locations

Bathymetry Contours For Water Depth

10 Foot Intervals

30 Foot Water Depth Contour

0 1,200 2,400 4,800 7,200

Feet

Figure 15

Honeywell

Onondaga Lake
Syracuse, New York

Nitrate Application Locations

PARSONS

301 Plainfield Road, Suite 350; Syracuse NY 13212 Phone:(315)451-9560

LEGEND:

DEMARCATION FOR BSQV SUBAREAS (DELINEATION IS APPROXIMATE AND MAY BE MODIFIED BASED ON DEVELOPMENT OF FINAL THIESSEN POLYGONS FOR BSQV EVALUATION)

LITTORAL REMEDIATION AREA BOUNDARY

SMU BOUNDARY

CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT. (PRE-REMEDY CONTOURS SHOWN)
2. WATER DEPTH BASED ON AVERAGE LAKE ELEVATION OF 362.5 FT.

2000 1000 0 2000 4000

SCALE: 1"=2000'

FIGURE 16

Honeywell

ONONDAGA LAKE SUBAREAS FOR EVALUATION OF BSQV COMPLIANCE

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\450102 - 2016 OL REMEDIAL GOAL MONITORING\10 TECHNICAL CATEGORIES\CAD\2016\450102-MNR-015.DWG
PLOT DATE: 10/9/2017 11:52 AM PLOTTED BY: RUSSO, JILL

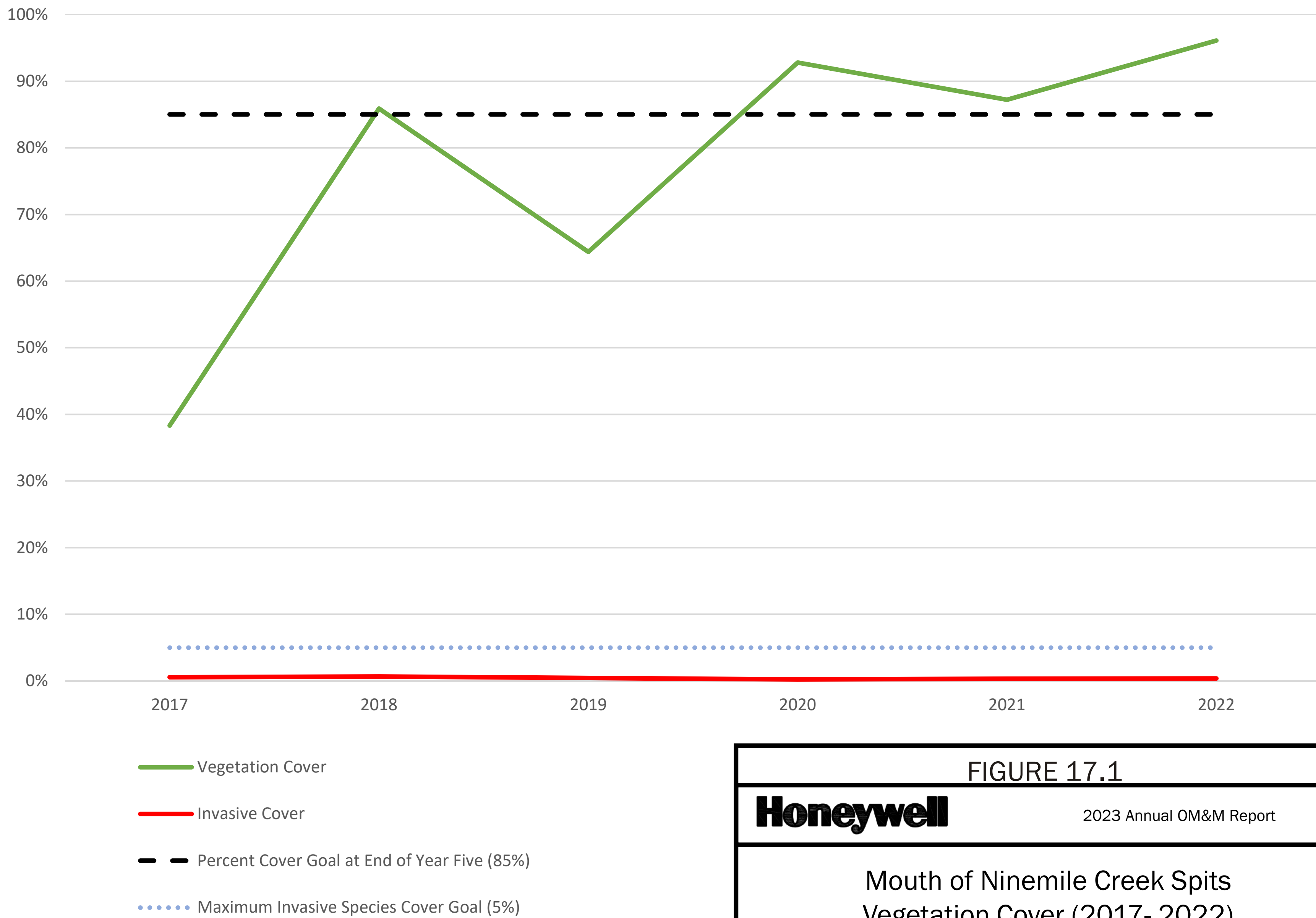


FIGURE 17.1

Honeywell

2023 Annual OM&M Report

Mouth of Ninemile Creek Spits
Vegetation Cover (2017- 2022)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

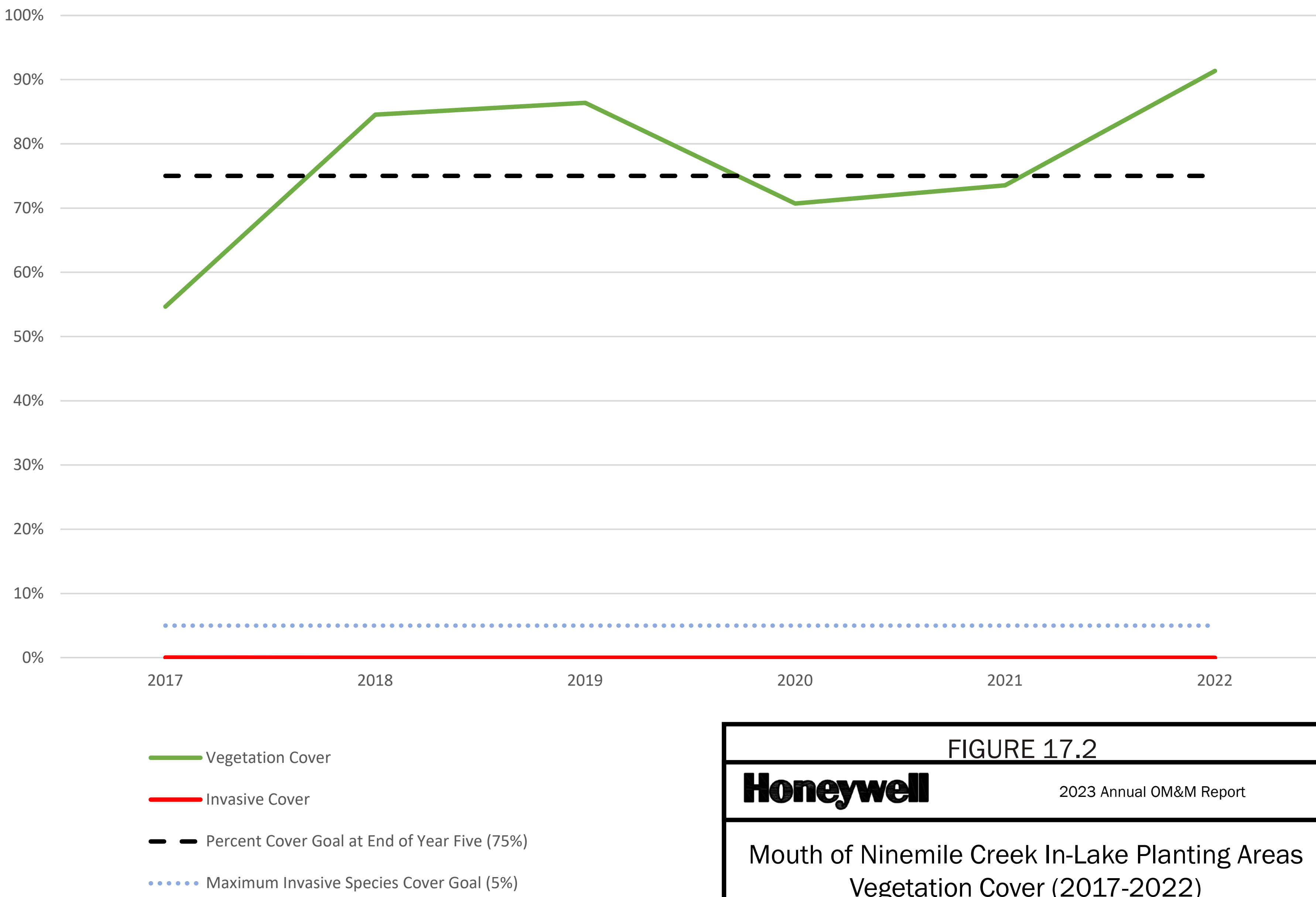


FIGURE 17.2

Honeywell

2023 Annual OM&M Report

Mouth of Ninemile Creek In-Lake Planting Areas
Vegetation Cover (2017-2022)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

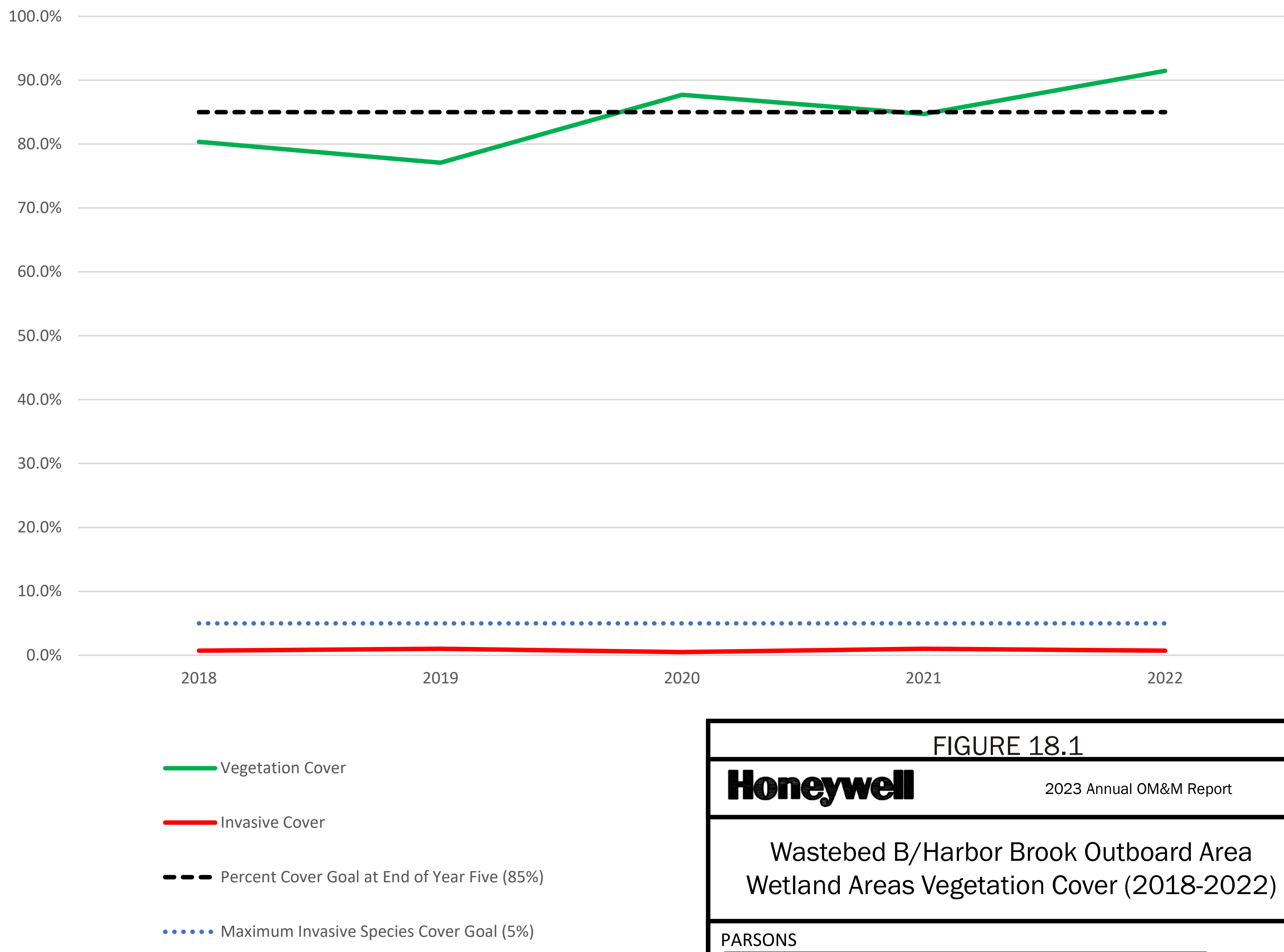


FIGURE 18.1

Honeywell

2023 Annual OM&M Report

Wastebed B/Harbor Brook Outboard Area
Wetland Areas Vegetation Cover (2018-2022)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

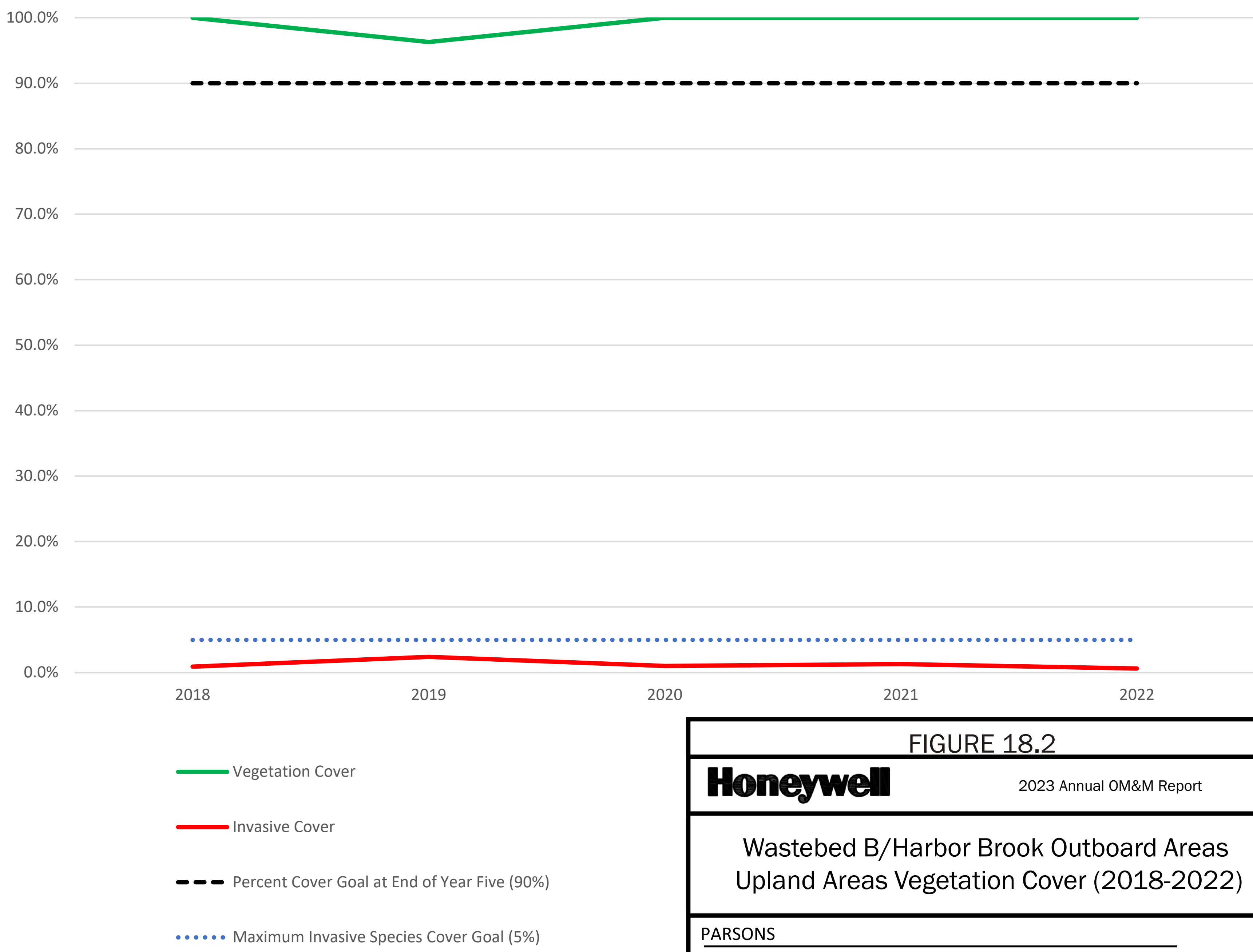


FIGURE 18.2

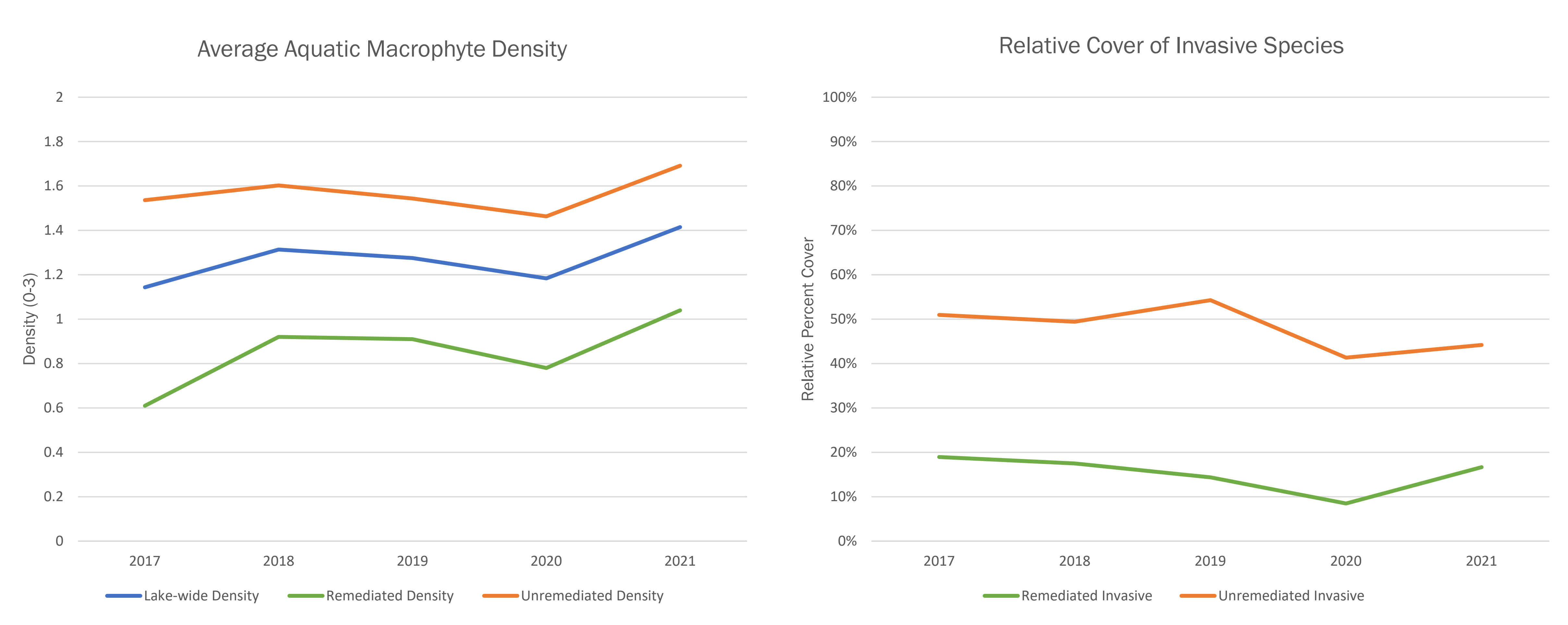
Honeywell

2023 Annual OM&M Report

Wastebed B/Harbor Brook Outboard Areas Upland Areas Vegetation Cover (2018-2022)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560



Notes

1. Relative cover is a measure of the cover of a species in relation to that of other species at each sampling location, where the total cover of plant species equals 100 percent regardless of the overall density of the sampling location.

FIGURE 19

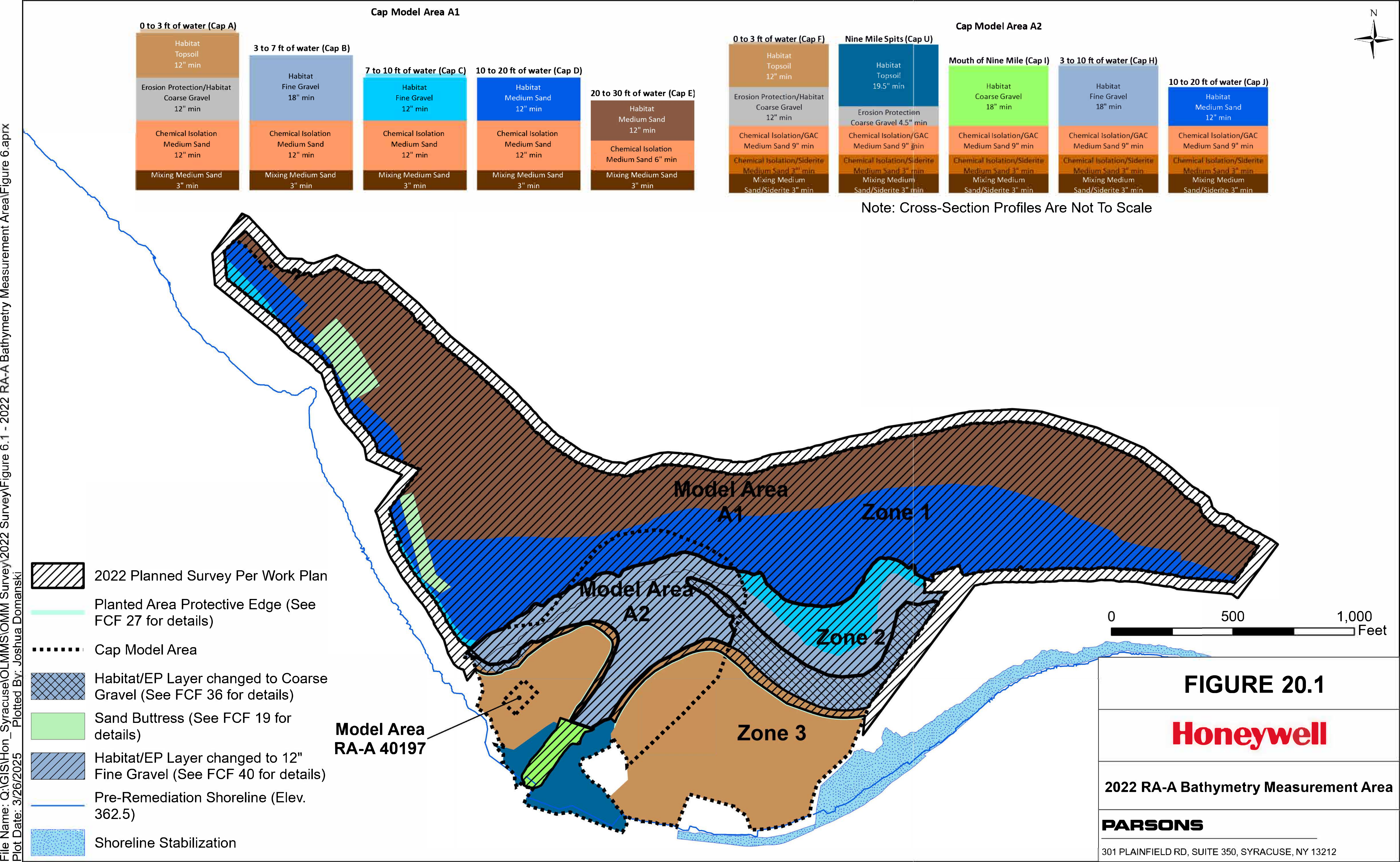
Honeywell

2023 Annual OM&M Report

Lake Wide Aquatic Macrophyte Trends (2017- 2021)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560



Cap Model Area A1
0 to 3 ft of water (Cap A)
Habitat Topsoil 12" min
Erosion Protection/Habitat Coarse Gravel 12" min
Chemical Isolation Medium Sand 12" min
Mixing Medium Sand 3" min
3 to 7 ft of water (Cap B)
Habitat Fine Gravel 18" min
Chemical Isolation Medium Sand 12" min
Mixing Medium Sand 3" min
7 to 10 ft of water (Cap C)
Habitat Fine Gravel 12" min
Chemical Isolation Medium Sand 12" min
Mixing Medium Sand 3" min
10 to 20 ft of water (Cap D)
Habitat Medium Sand 12" min
Chemical Isolation Medium Sand 12" min
Mixing Medium Sand 3" min
20 to 30 ft of water (Cap E)
Habitat Medium Sand 12" min
Chemical Isolation Medium Sand 6" min
Mixing Medium Sand 3" min
Cap Model Area A2
0 to 3 ft of water (Cap F)
Habitat Topsoil 12" min
Erosion Protection/Habitat Coarse Gravel 12" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
Nine Mile Spits (Cap U)
Habitat Topsoil 19.5" min
Erosion Protection Coarse Gravel 4.5" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
Mouth of Nine Mile (Cap I)
Habitat Coarse Gravel 18" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
3 to 10 ft of water (Cap H)
Habitat Fine Gravel 18" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
10 to 20 ft of water (Cap J)
Habitat Medium Sand 12" min
Chemical Isolation/GAC Medium Sand 9" min
Chemical Isolation/Siderite Medium Sand 3" min
Mixing Medium Sand/Siderite 3" min
Note: Cross-Section Profiles Are Not To Scale
N
Model Area A1
Zone 1
Model Area A2
Zone 2
Zone 3
Model Area RA-A 40197
0
500
1,000
Feet
2022 Planned Survey Per Work Plan
Planted Area Protective Edge (See FCF 27 for details)
Cap Model Area
Habitat/EP Layer changed to Coarse Gravel (See FCF 36 for details)
Sand Buttress (See FCF 19 for details)
Habitat/EP Layer changed to 12" Fine Gravel (See FCF 40 for details)
Pre-Remediation Shoreline (Elev. 362.5)
Shoreline Stabilization
FIGURE 20.1
Honeywell
2022 RA-A Bathymetry Measurement Area
PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212
File Name: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2022 Survey\Figure 6.1 - 2022 RA-A Bathymetry Measurement Area\Figure 6.aprx
Plot Date: 3/26/2025 Plotted By: Joshua Domanski

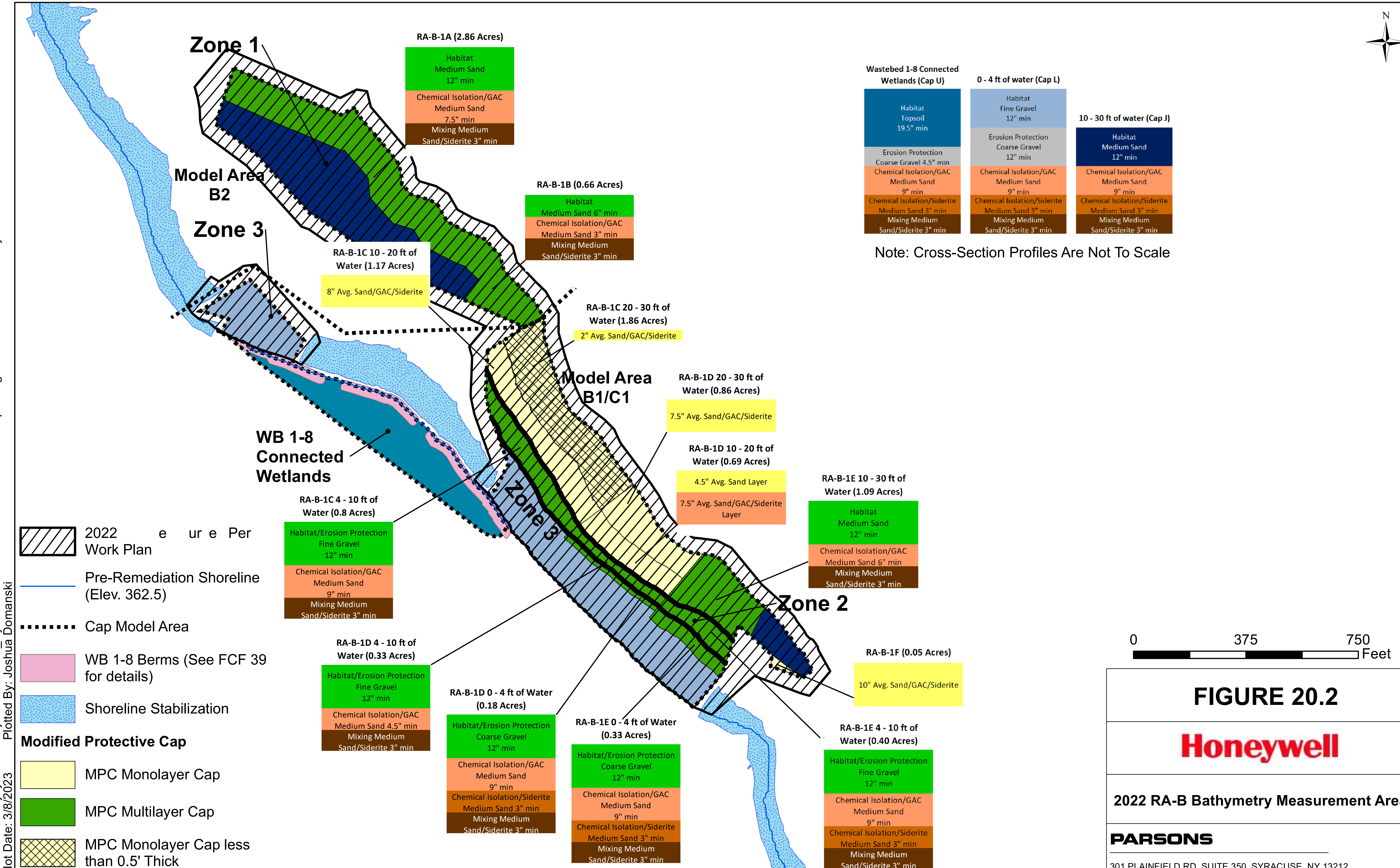
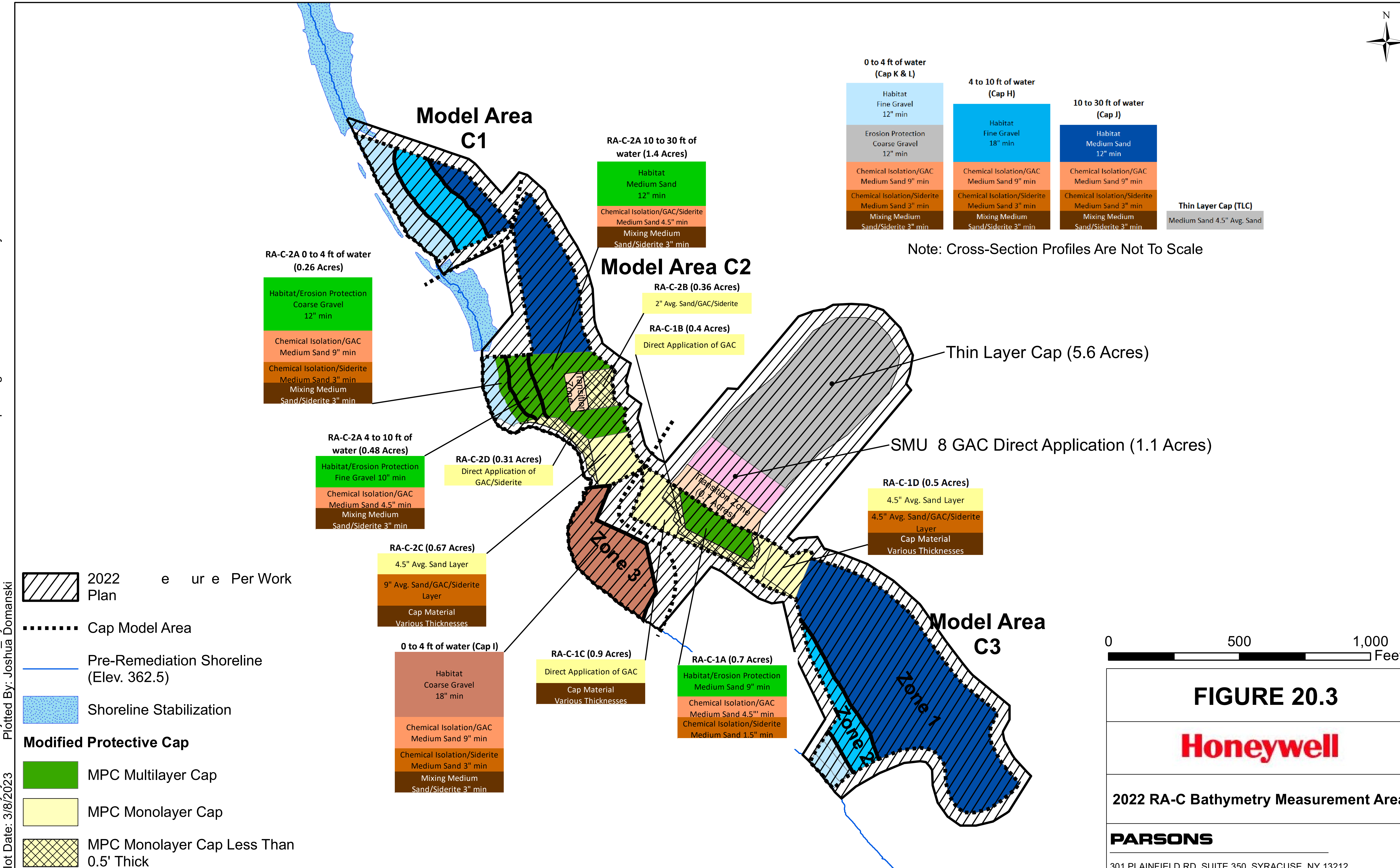


FIGURE 20.2

2022 RA-B Bathymetry Measurement Area

File Name: \\nysyr04fs01\PrjData\GIS\Hon_Syracuse\OLMMS\MXDs\2022 OLMM Report\Figure 6.2 - 2022 RAB Bathy.mxd
Plot Date: 3/8/2023
Plotted By: Joshua Domanski



File Name: \\nysyr04fs01\PrjData\GIS\Hon_Syracuse\OLMMS\MXDs\2022 OLMM Report\Figure 6.3 - 2022 RAC Bathy.mxd
Plotted By: Joshua Domanski
Plot Date: 3/8/2023

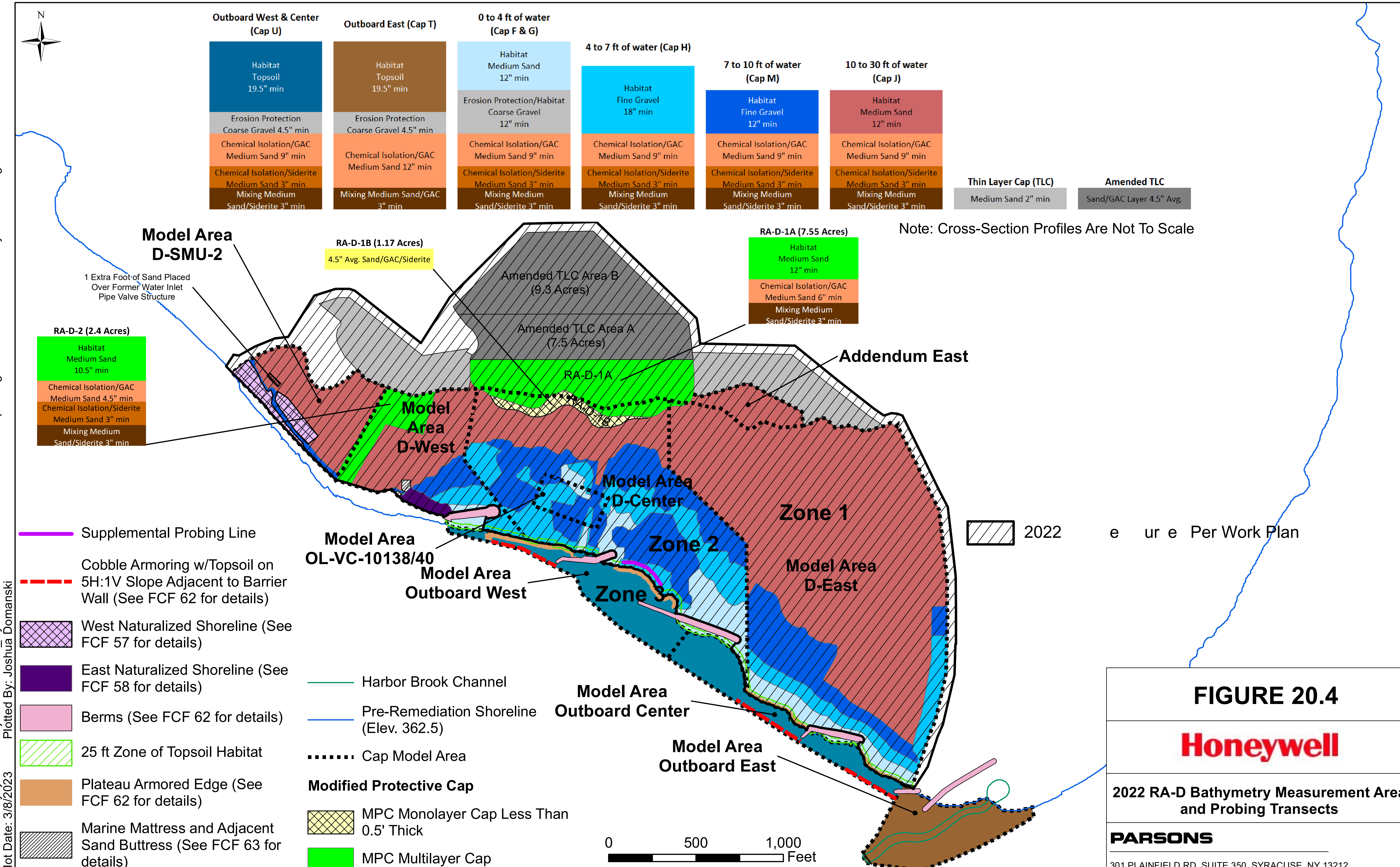


FIGURE 20.4

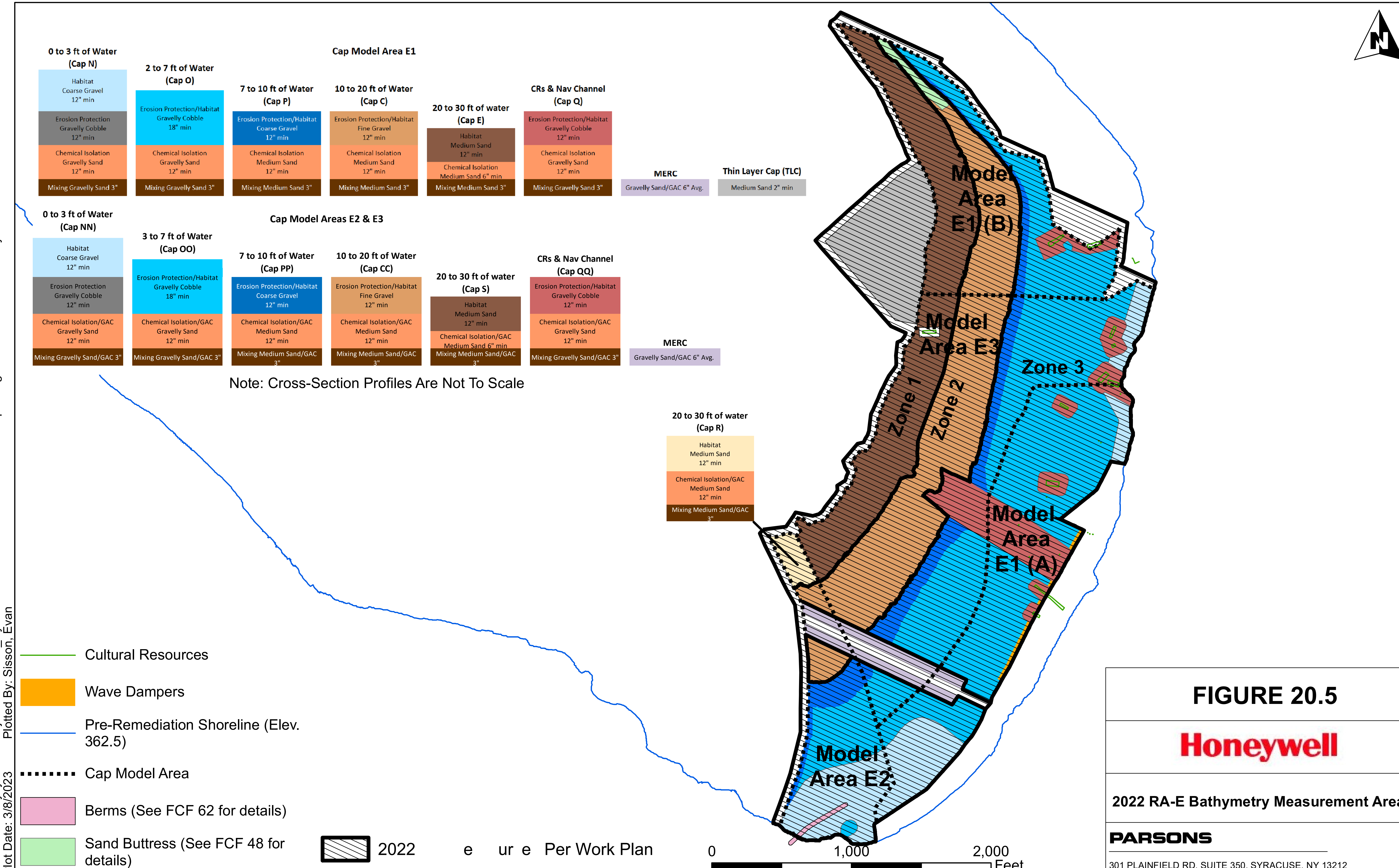
Honeywell

2022 RA-D Bathymetry Measurement Area and Probing Transects

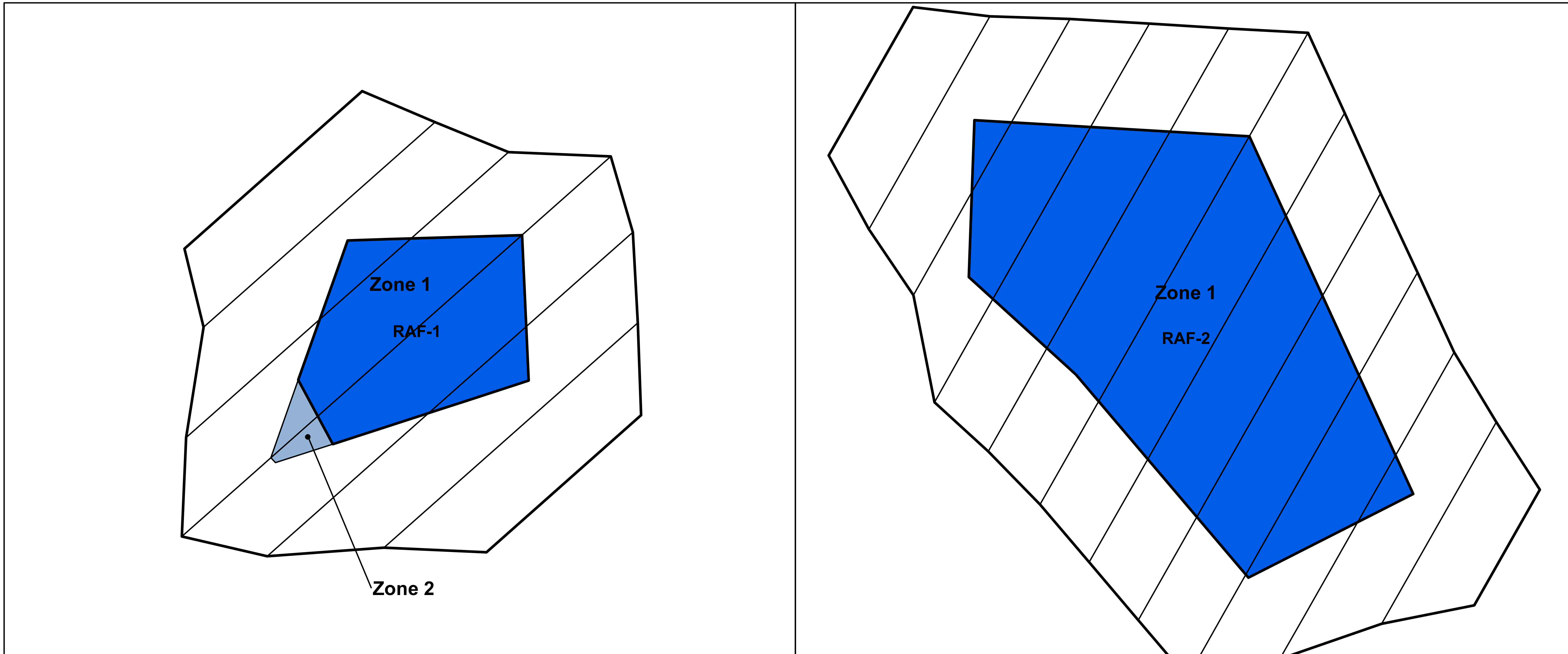
PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

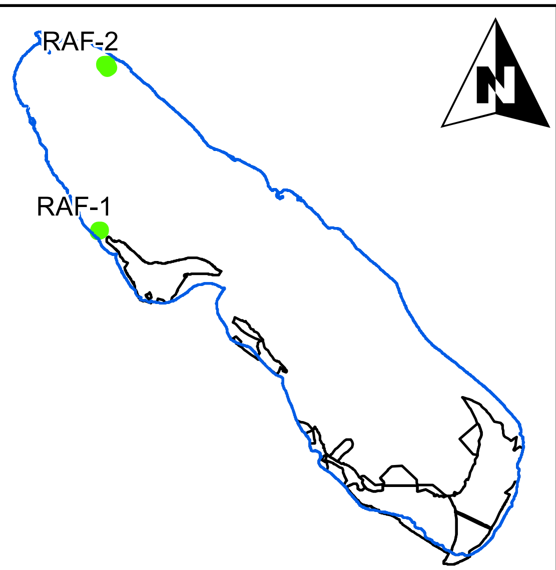
File Name: \\nysyr04fs01\PrjData\GIS\Hon_Syracuse\OLMMS\MXDs\2022 OLMM Report\Figure 6.4 - 2022 RAD Bathy and Probing.mxd
Plot Date: 3/8/2023   Plotted By: Joshua Domanski

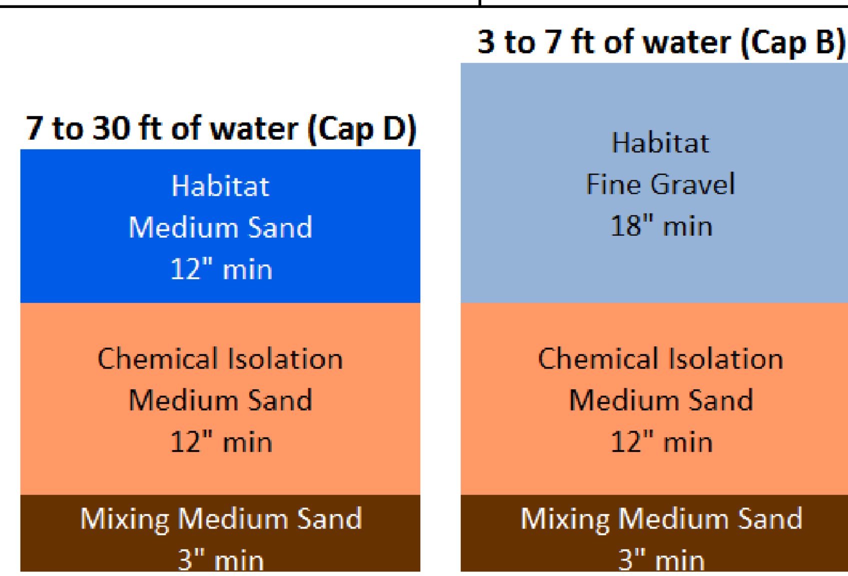


File Name: \\nysyr04fs01\PrjData\GIS\Hon_Syracuse\OLMMS\MXDs\2022 OLMM Report\Figure 6.5 - 2022 RAE Bathy.mxd
Plot Date: 3/8/2023 Plotted By: Sisson, Evan



2022 e ur e Per Work Plan





Note: Cross-Section Profiles Are Not To Scale

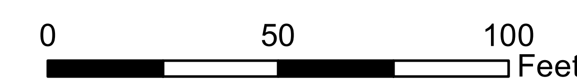


FIGURE 20.6

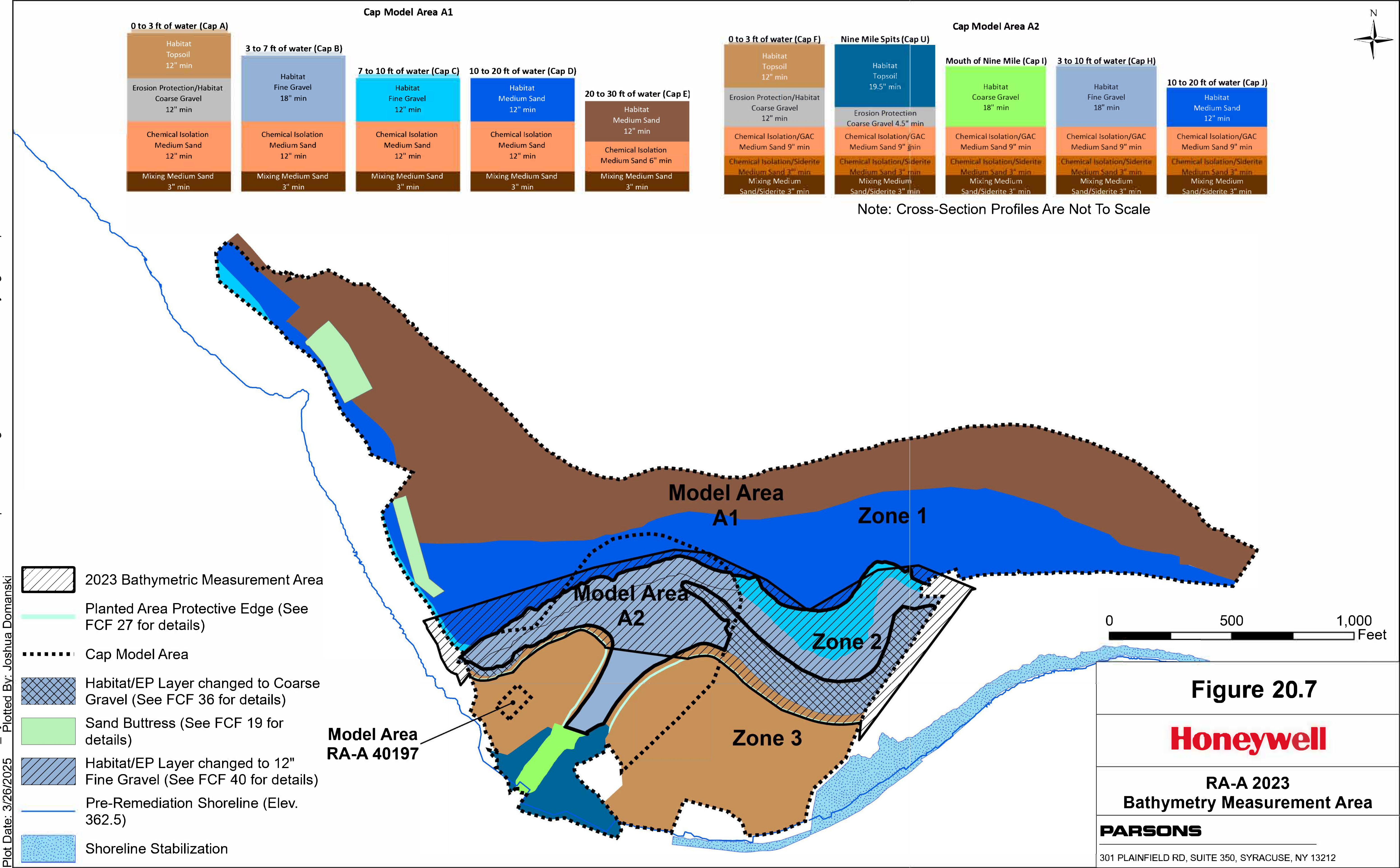
Honeywell

2022 RA-F Bathymetry Measurement Area

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: \\nysyr04fs01\PrjData\GIS\Hon_Syracuse\OLMMS\MXDs\2022 OLMM Report\Figure 6.6 - 2022 RAF Bathy.mxd
Plot Date: 3/8/2023 Plotted By: Joshua Domanski



File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\APRXs\Figure 6.7 - 2023 RAA Bathy\Figure 6.aprx
Plot Date: 3/26/2025 Plotted By: Joshua Domanski

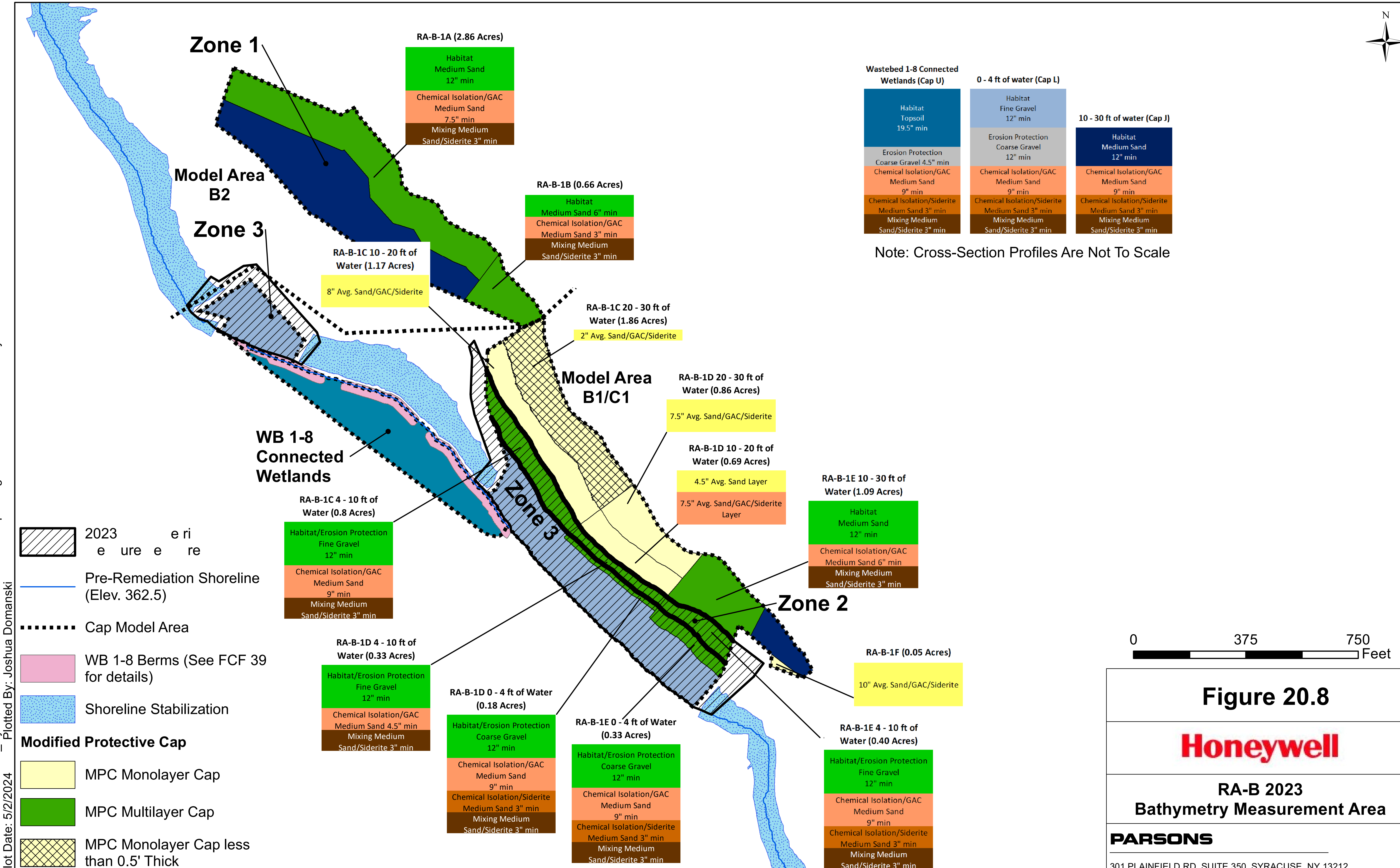


Figure 20.8
RA-B 2023 Bathymetry Measurement Area

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.8 - 2023 RAB Bathy.mxd
Plot Date: 5/2/2024 Plotted By: Joshua Domanski

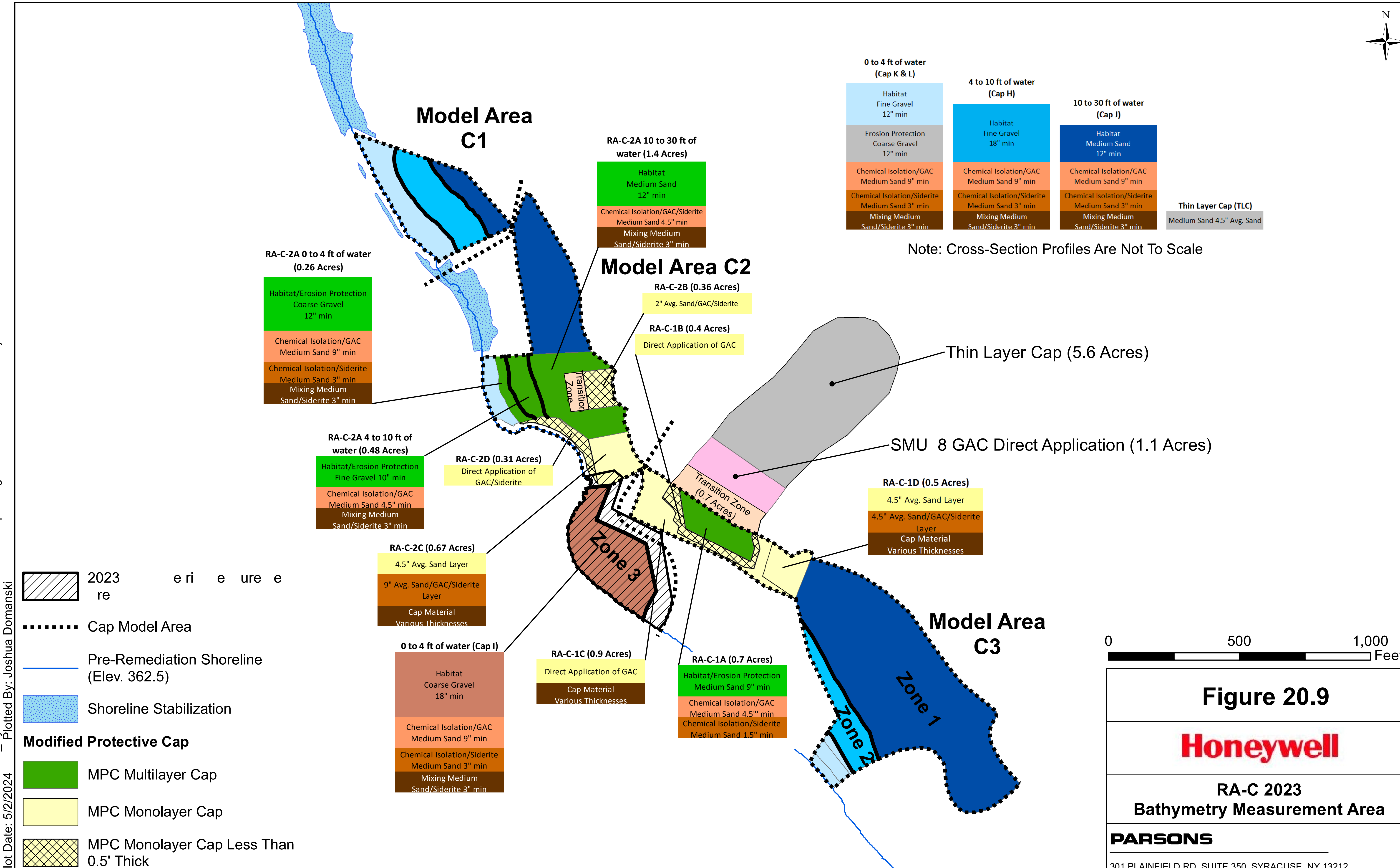


Figure 20.9

RA-C 2023 Bathymetry Measurement Area

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.9 - 2023 RAC Bathy.mxd
Plot Date: 5/2/2024 Plotted By: Joshua Domanski

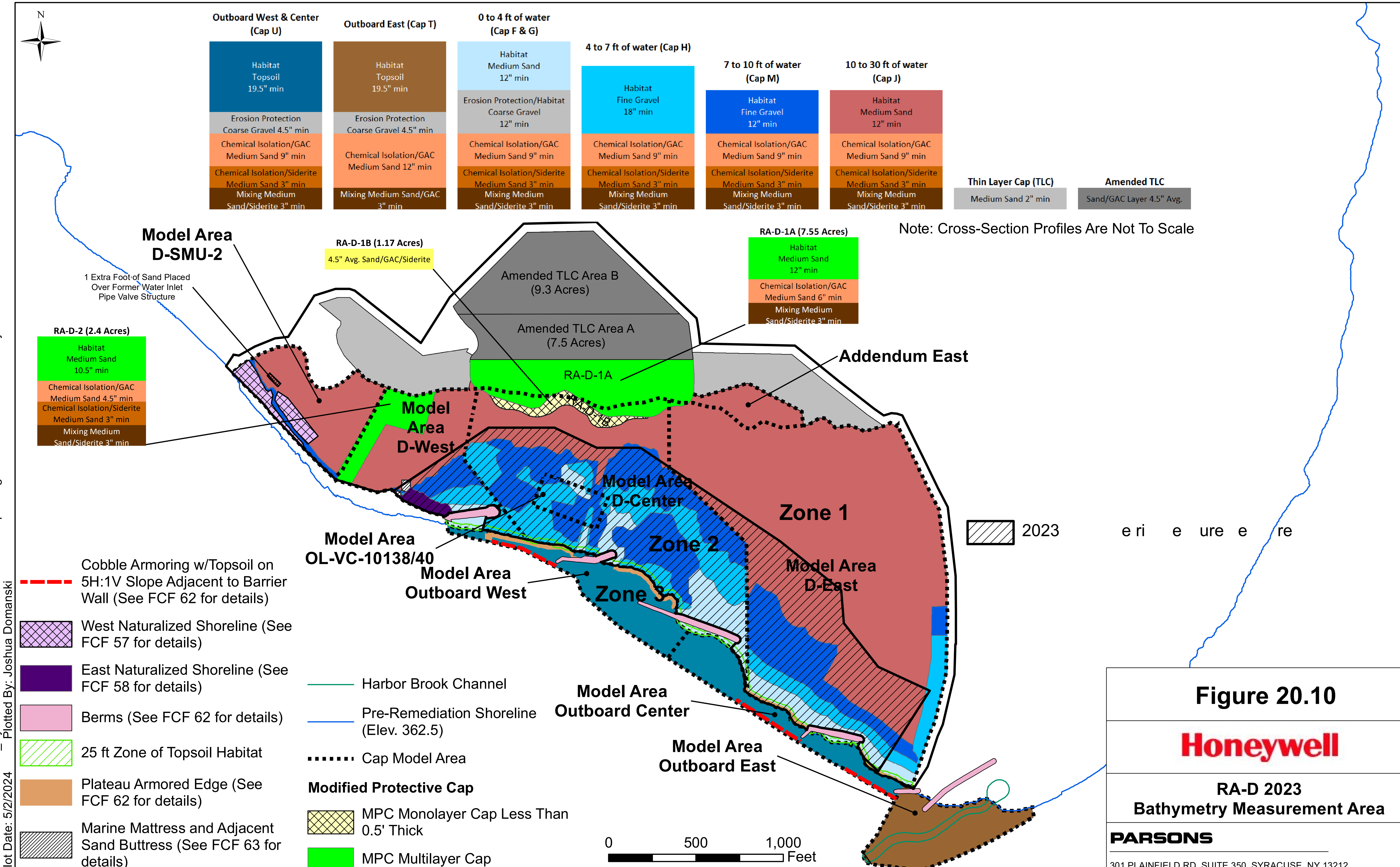


Figure 20.10

Honeywell

RA-D 2023 Bathymetry Measurement Area

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.10 - 2023 RAD Bathy.mxd
Plot Date: 5/2/2024 Plotted By: Joshua Domanski

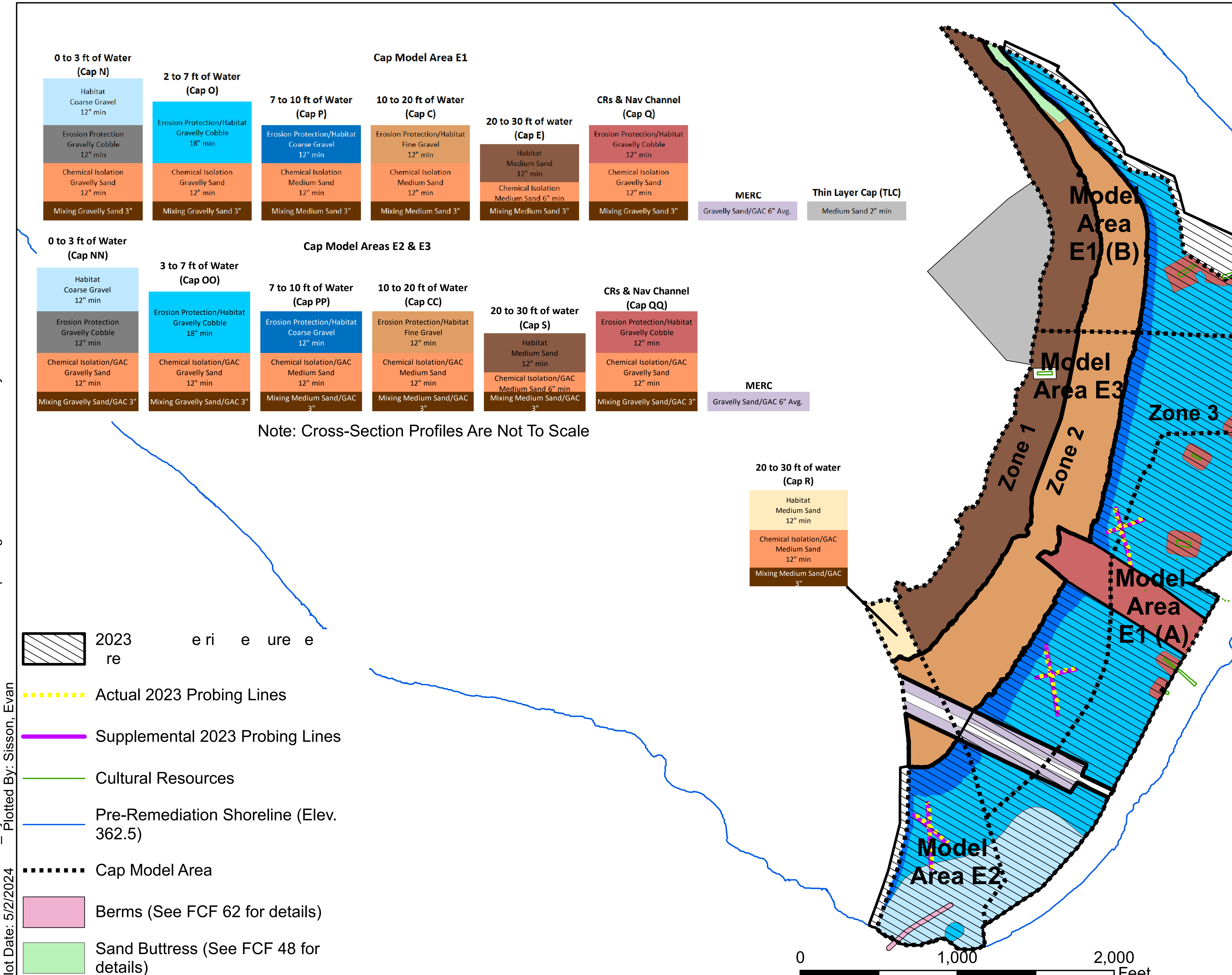


Figure 20.11

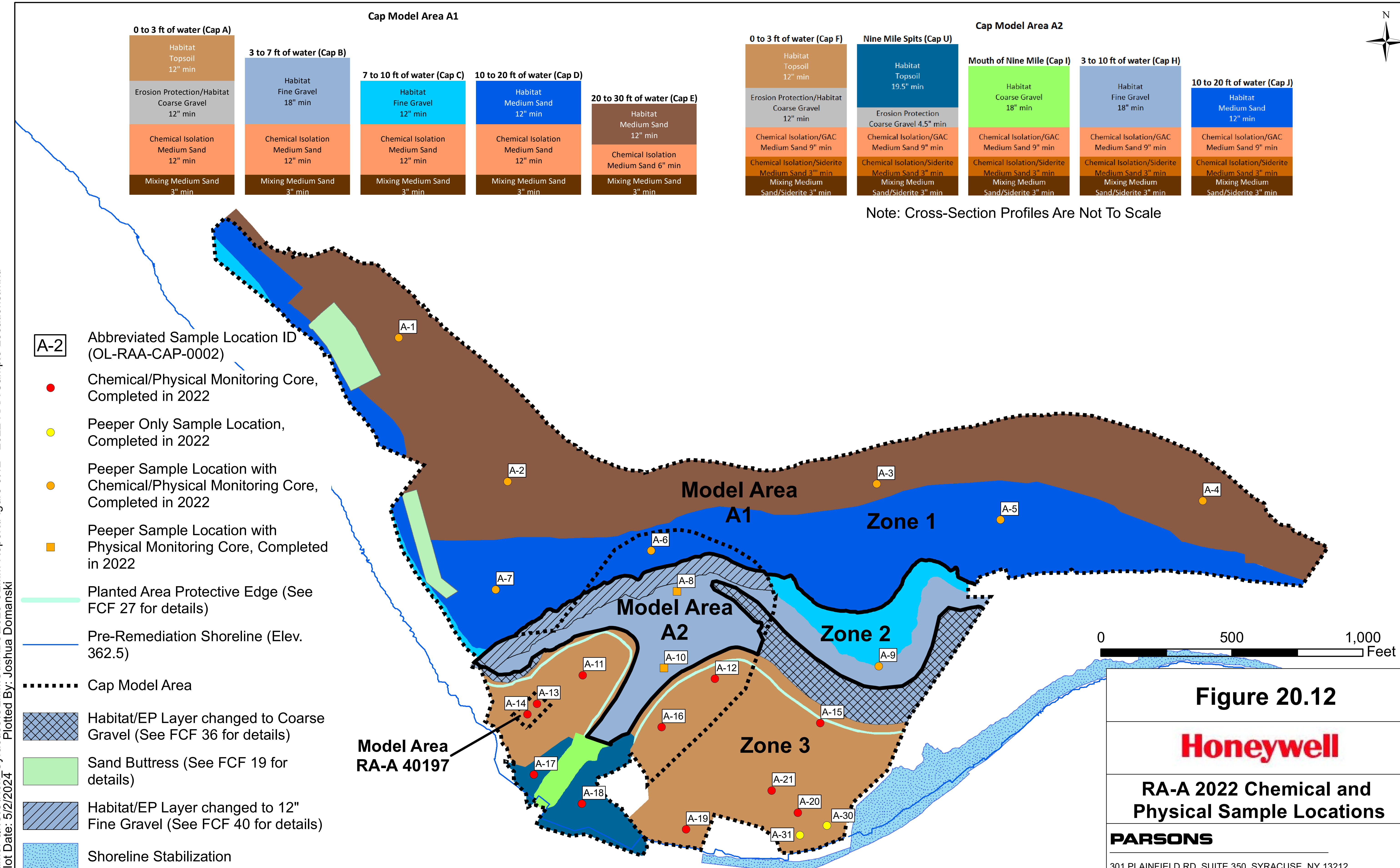
Honeywell

RA-E 2023 Bathymetry Measurement Area and Probing Transects

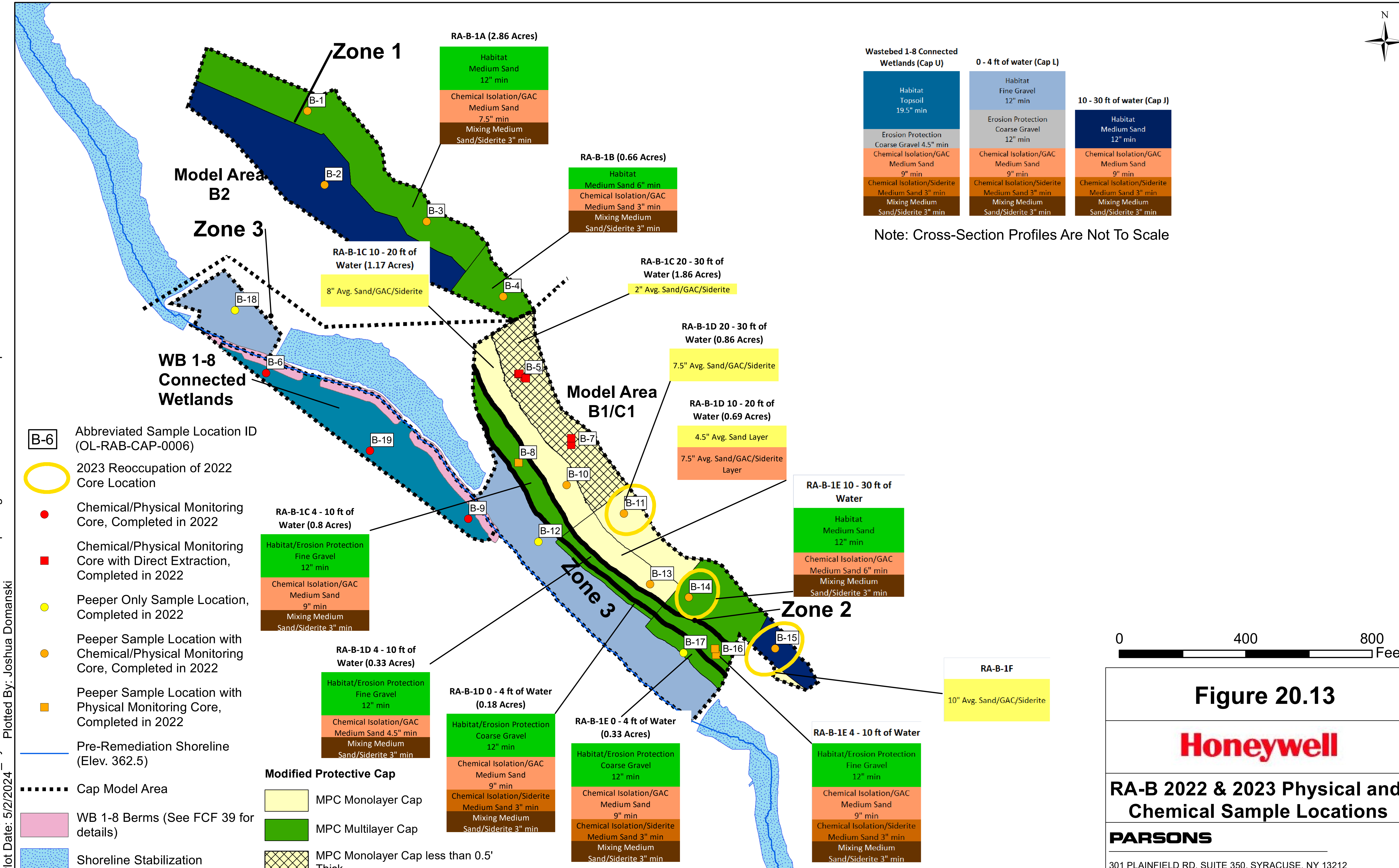
PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

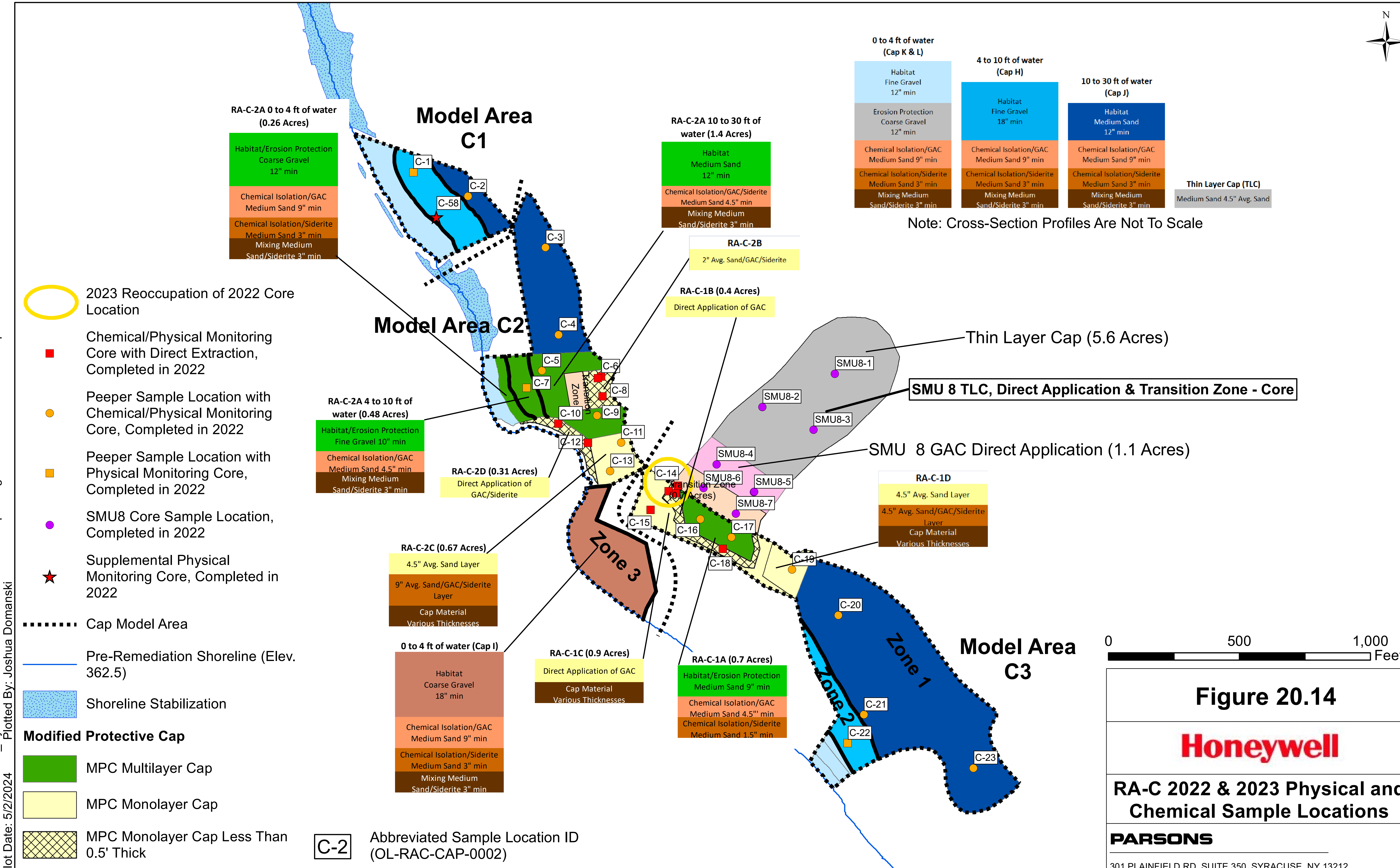
File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.11 - 2023 RAE Bathy.mxd
Plot Date: 5/2/2024 Plotted By: Sisson, Evan



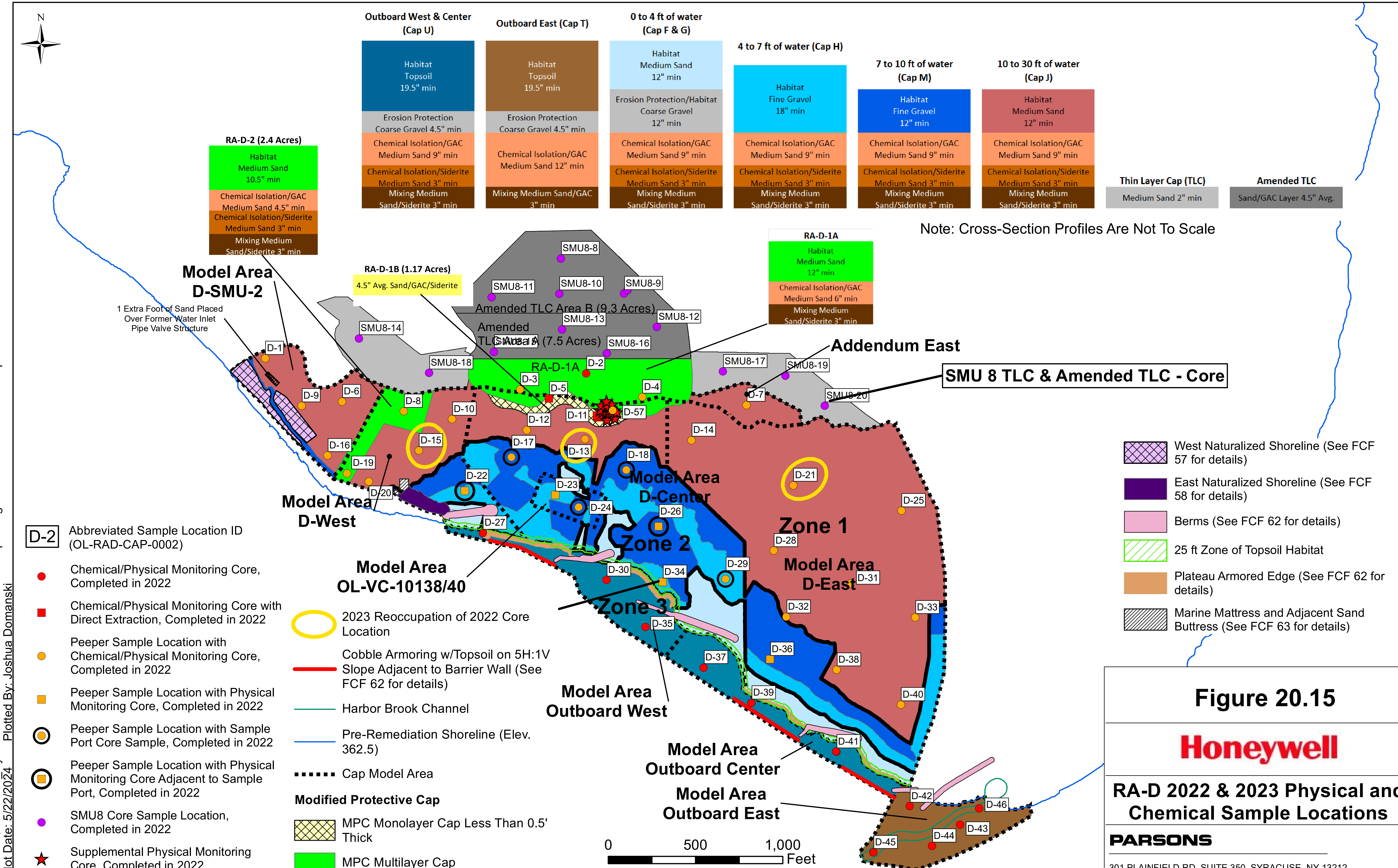
File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.12 - 2022 RAA Sample Locations.mxd
Plotted By: Joshua Domanski
Plot Date: 5/2/2024



File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.13 - 2023 RAB Sample Locations.mxd
Plot Date: 5/2/2024
Plotted By: Joshua Domanski



File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.14 - 2023 RAC Sample Locations.mxd
Plotted By: Joshua Domanski
Plot Date: 5/2/2024



File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.15 - 2023 RAD Sample Locations.mxd
Plot Date: 5/22/2024 Plotted By: Joshua Domanski

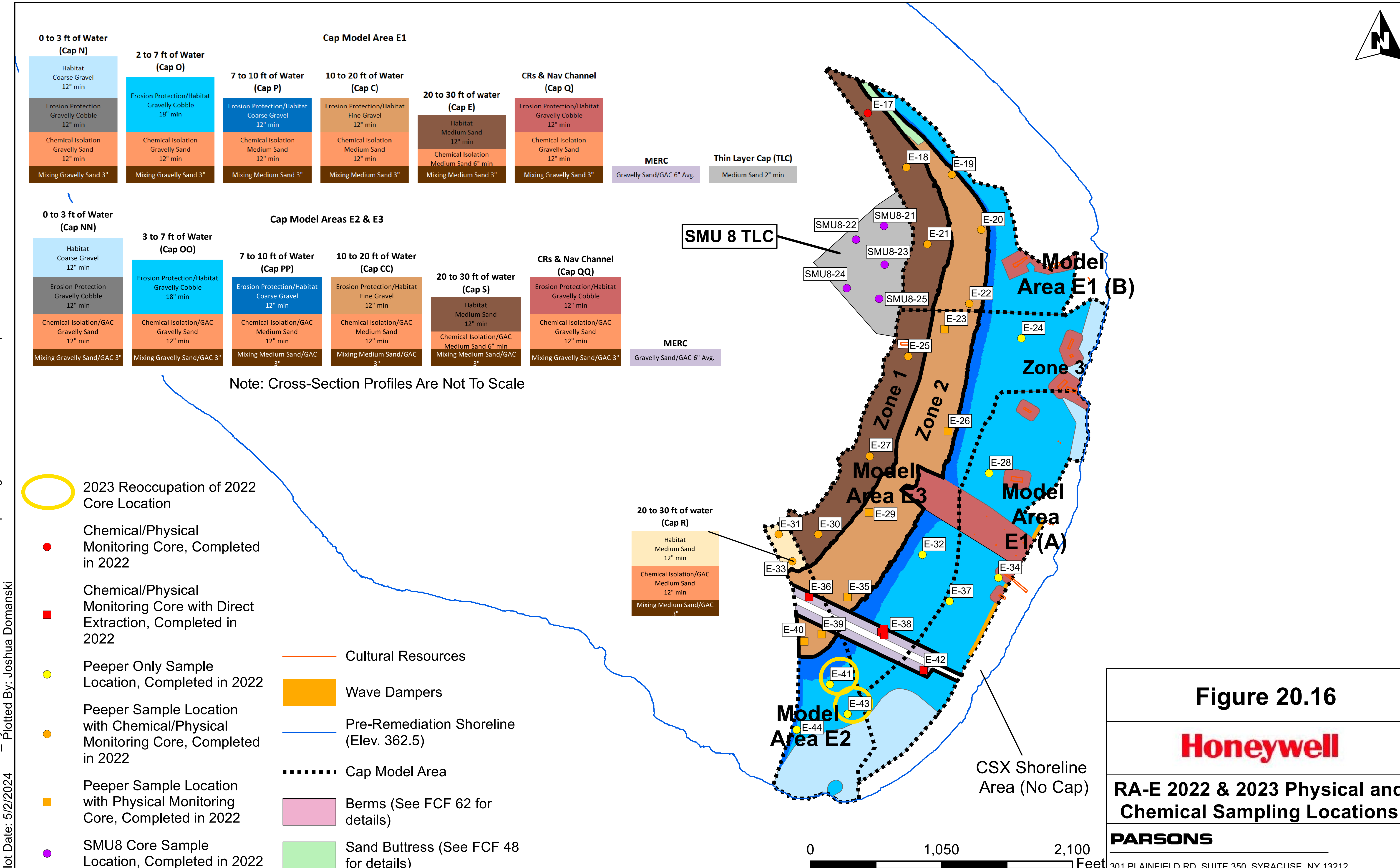
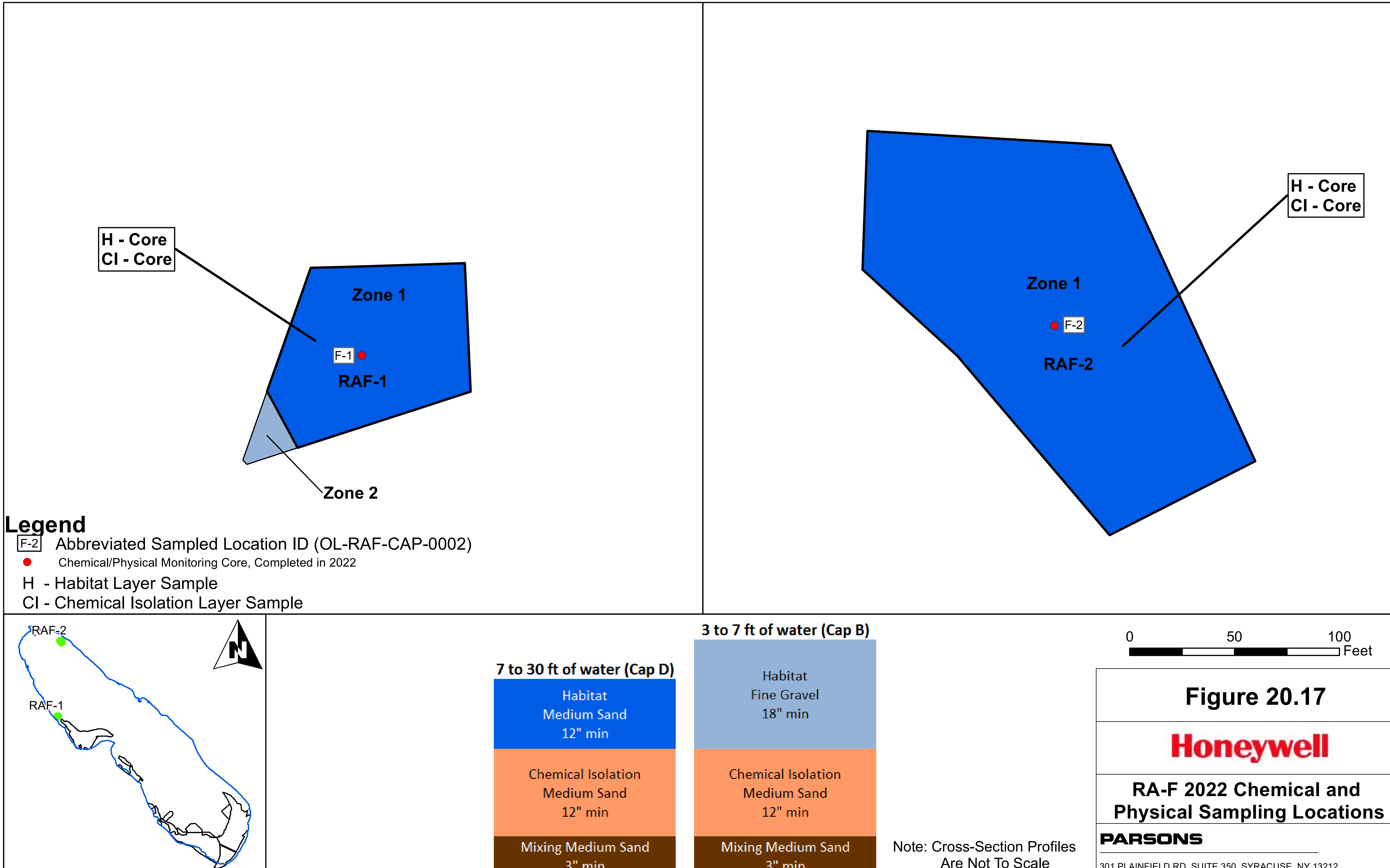


Figure 20.16

RA-E 2022 & 2023 Physical and Chemical Sampling Locations

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\Figure 6.16 - 2023 RAE Sample Locations.mxd
Plot Date: 5/2/2024   Plotted By: Joshua Domanski



H - Core
CI - Core
Zone 1
F-1
RAF-1
Zone 2
H - Core
CI - Core
Zone 1
F-2
RAF-2
Legend
F-2 Abbreviated Sampled Location ID (OL-RAF-CAP-0002)
Chemical/Physical Monitoring Core, Completed in 2022
H - Habitat Layer Sample
CI - Chemical Isolation Layer Sample
RAF-2
RAF-1
N
7 to 30 ft of water (Cap D)
Habitat
Medium Sand
12" min
Chemical Isolation
Medium Sand
12" min
Mixing Medium Sand
3" min
3 to 7 ft of water (Cap B)
Habitat
Fine Gravel
18" min
Chemical Isolation
Medium Sand
12" min
Mixing Medium Sand
3" min
Note: Cross-Section Profiles
Are Not To Scale
0
50
100
Feet
Figure 20.17
Honeywell
RA-F 2022 Chemical and
Physical Sampling Locations
PARSONS
301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

2022/2023 Assessment Area Summary and 2024 Recommendations

The 2022 coring locations are consistent with the coring locations specified in the OLMMP.

Zone 1

- Zone 1 is the deepest area of the cap and thus the least likely to be impacted by wind/wave action, and where underlying sediments are softest and most prone to settlement.
- All 2022 cores in Zone 1 met minimum cap thickness requirements defined in the OLMMP.

A1, A3, and A4

- Elevation change in these areas is similar to the elevation change in the Zone 2 and shallow Zone 1 areas previously demonstrated to be the result of settlement.
- Recommendation: Supplemental cores in 2024 to verify no significant loss of cap material.

A2

- Elevation change in this area is similar to that seen in 2019, as shown in Figure 6.20. All 2019 and supplemental cores in this area exceed minimum thickness requirements specified in the OLMMP, indicating that elevation change is a result of settlement and not loss of cap material.
- Recommendation: Supplemental core in 2024 to verify no significant loss of cap material.

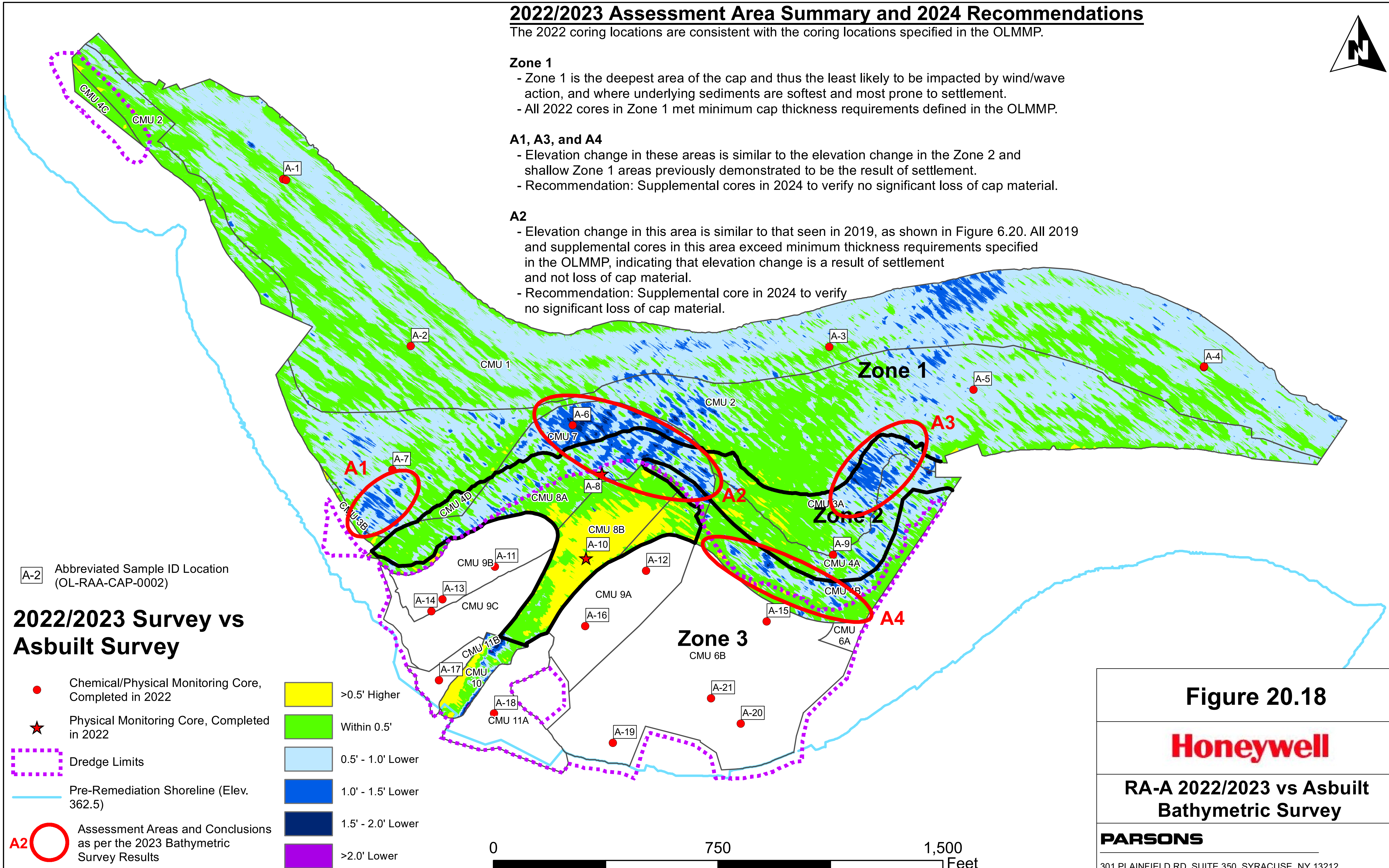


Figure 20.18

Honeywell

RA-A 2022/2023 vs Asbuilt Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plotted By: Domanski, Joshua

Plot Date: 5/1/2024

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.18 - RAA OMM Survey 2022&2023.mxd

2022/2023 Assessment Area Summary and 2024 Recommendations

A5 and A6

- As shown in Figure 6.20, the cap elevation in these areas was higher in 2019 than the asbuilt, likely due to interference from aquatic vegetation and/or sediments on top of the cap, which may have been lost subsequent to 2019. As noted in Figure 6.18, supplemental cores are recommended in these areas in 2024.

A7

- Cap bathymetry was lower in 2022 than 2019, but relatively consistent with post-construction bathymetry. The 2019 bathymetric survey showed an increase in elevation, likely due to interference from aquatic vegetation and/or sediment deposition. 2022 results indicate a return to asbuilt elevations.

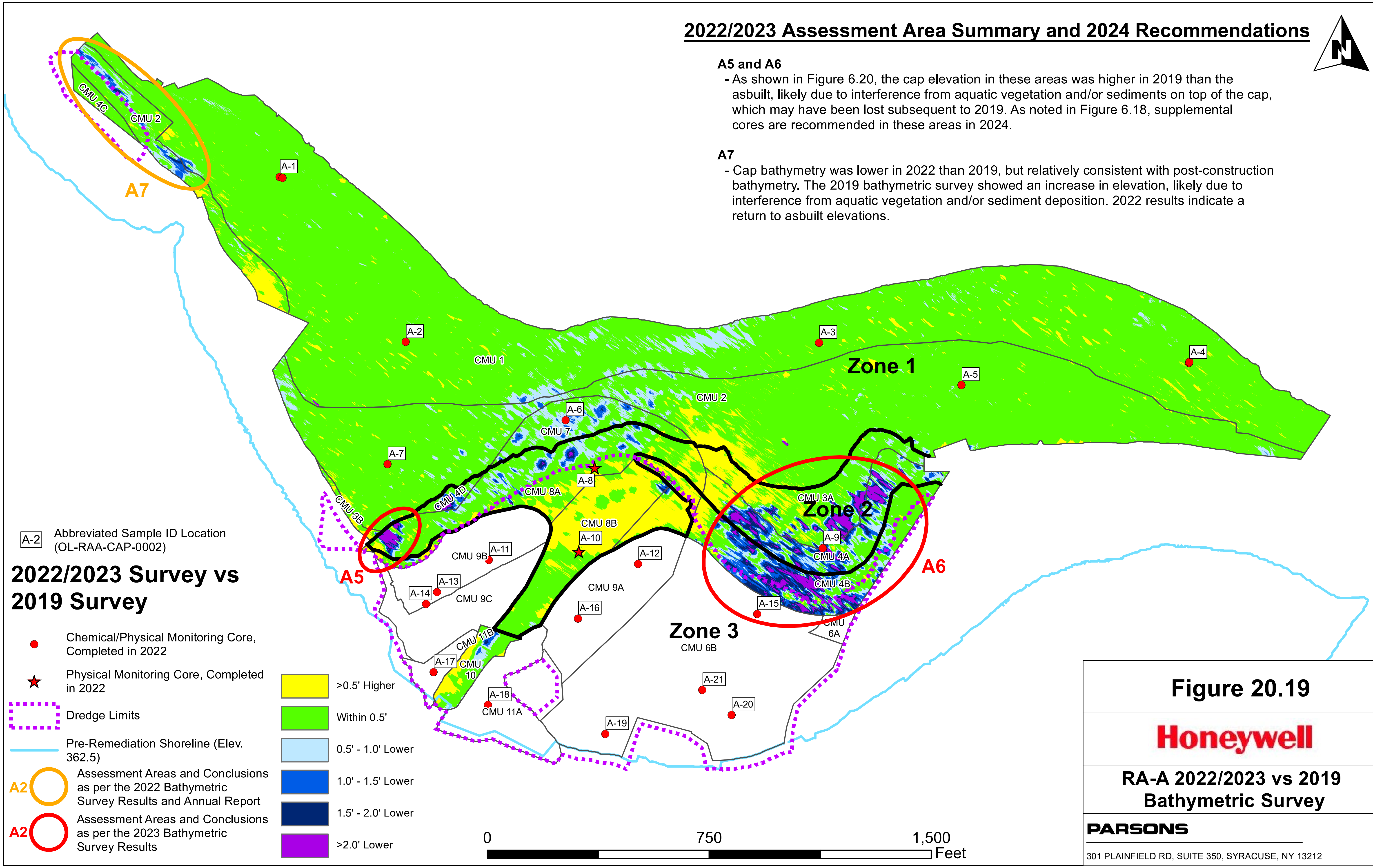


Figure 20.19

Honeywell

RA-A 2022/2023 vs 2019 Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plotted By: Domanski, Joshua

Plot Date: 4/30/2024

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.19 - RAA OMM Survey 22&23v2019.mxd

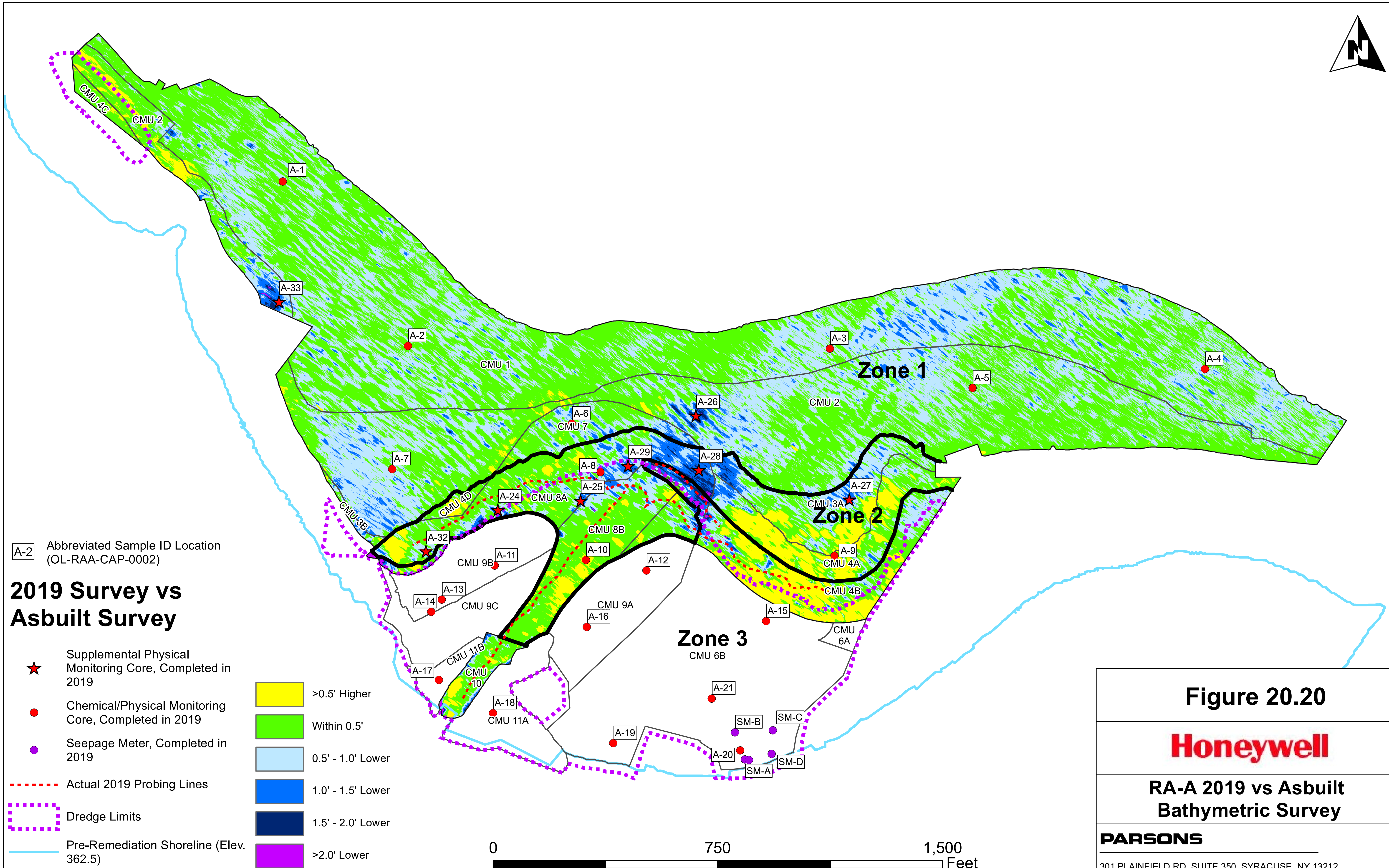


Figure 20.20

Honeywell

RA-A 2019 vs Asbuilt Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plot Date: 4/23/2024

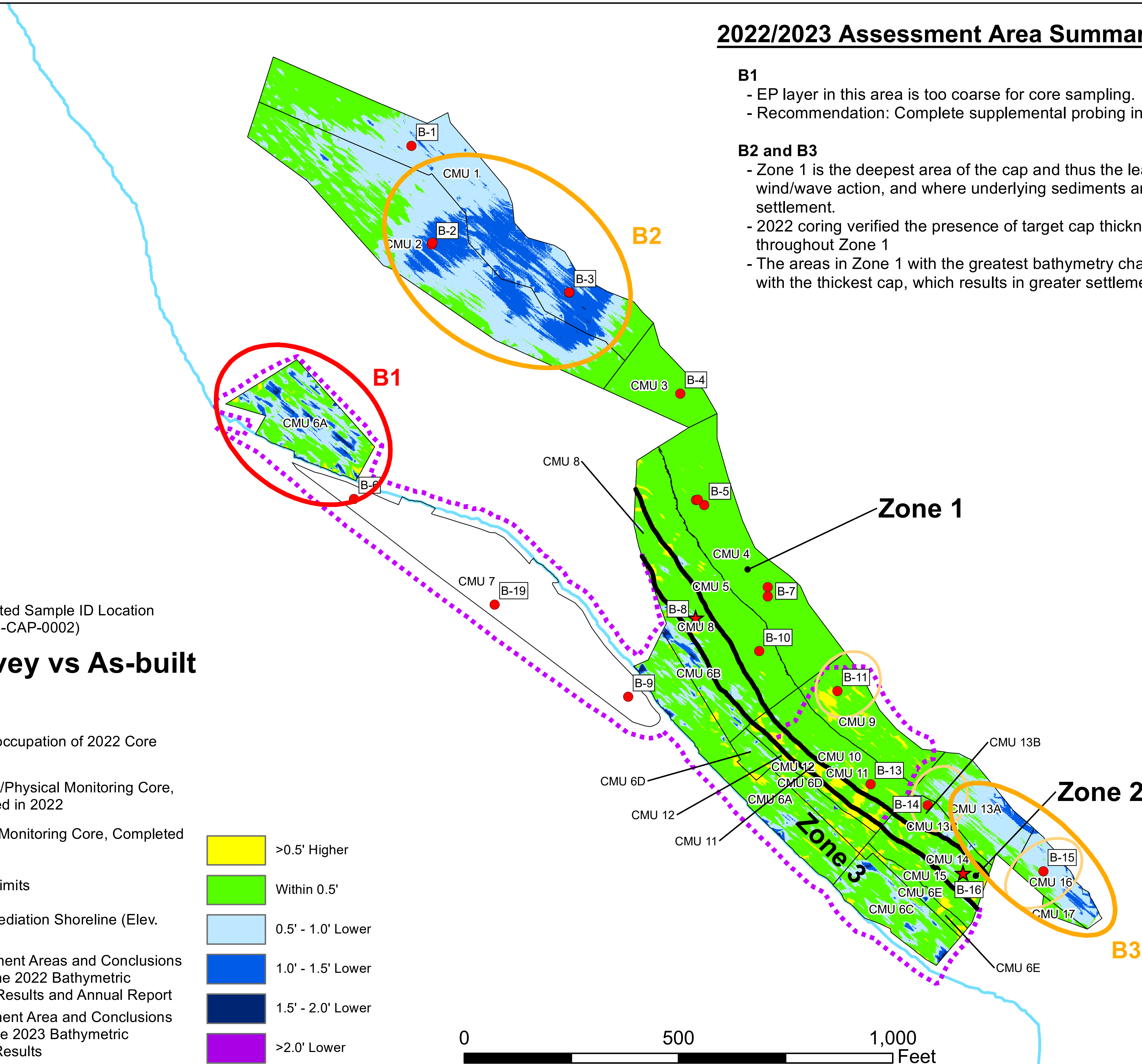
Plotted By: Domanski, Joshua

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.20 - RAA OMM Survey 2019.mxd

2022/2023 Assessment Area Summary and 2024 Recommendations

B1
- EP layer in this area is too coarse for core sampling.
- Recommendation: Complete supplemental probing in this area in 2024.

B2 and B3
- Zone 1 is the deepest area of the cap and thus the least likely to be impacted by wind/wave action, and where underlying sediments are softest and most prone to settlement.
- 2022 coring verified the presence of target cap thickness defined in the OLMMP throughout Zone 1
- The areas in Zone 1 with the greatest bathymetry change are generally the areas with the thickest cap, which results in greater settlement of the underlying sediments.



B-2 Abbreviated Sample ID Location (OL-RAB-CAP-0002)

2023 Survey vs As-built Survey

- 2023 Reoccupation of 2022 Core Location
- Chemical/Physical Monitoring Core, Completed in 2022
- Physical Monitoring Core, Completed in 2022
- Dredge Limits
- Pre-Remediation Shoreline (Elev. 362.5)
- B2 Assessment Areas and Conclusions as per the 2022 Bathymetric Survey Results and Annual Report
- B2 Assessment Area and Conclusions as per the 2023 Bathymetric Survey Results

- >0.5' Higher
- Within 0.5'
- 0.5' - 1.0' Lower
- 1.0' - 1.5' Lower
- 1.5' - 2.0' Lower
- >2.0' Lower

Plotted By: Domanski, Joshua

Plot Date: 5/22/2024

Figure 20.21

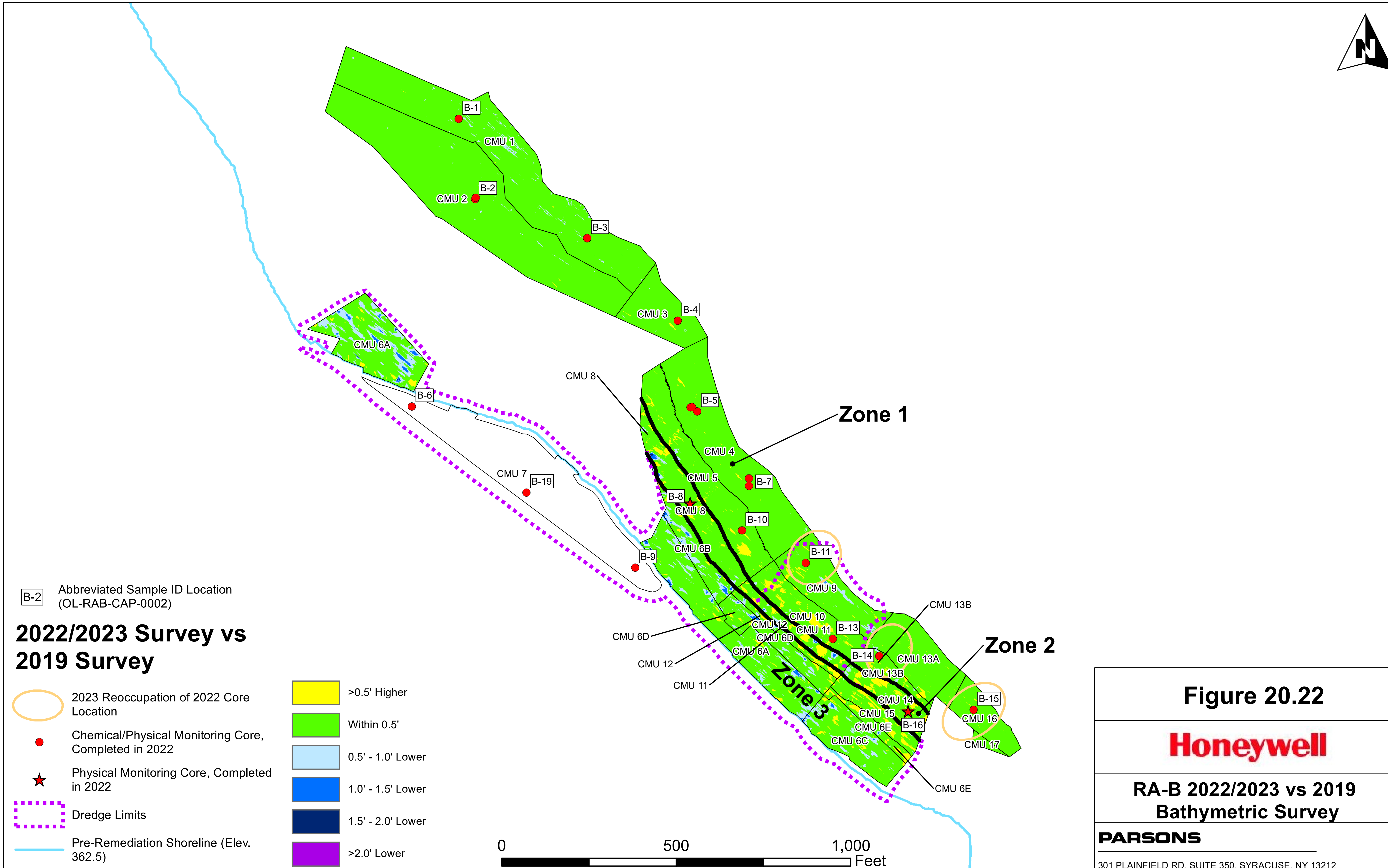
Honeywell

RA-B 2022/2023 vs As-built Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

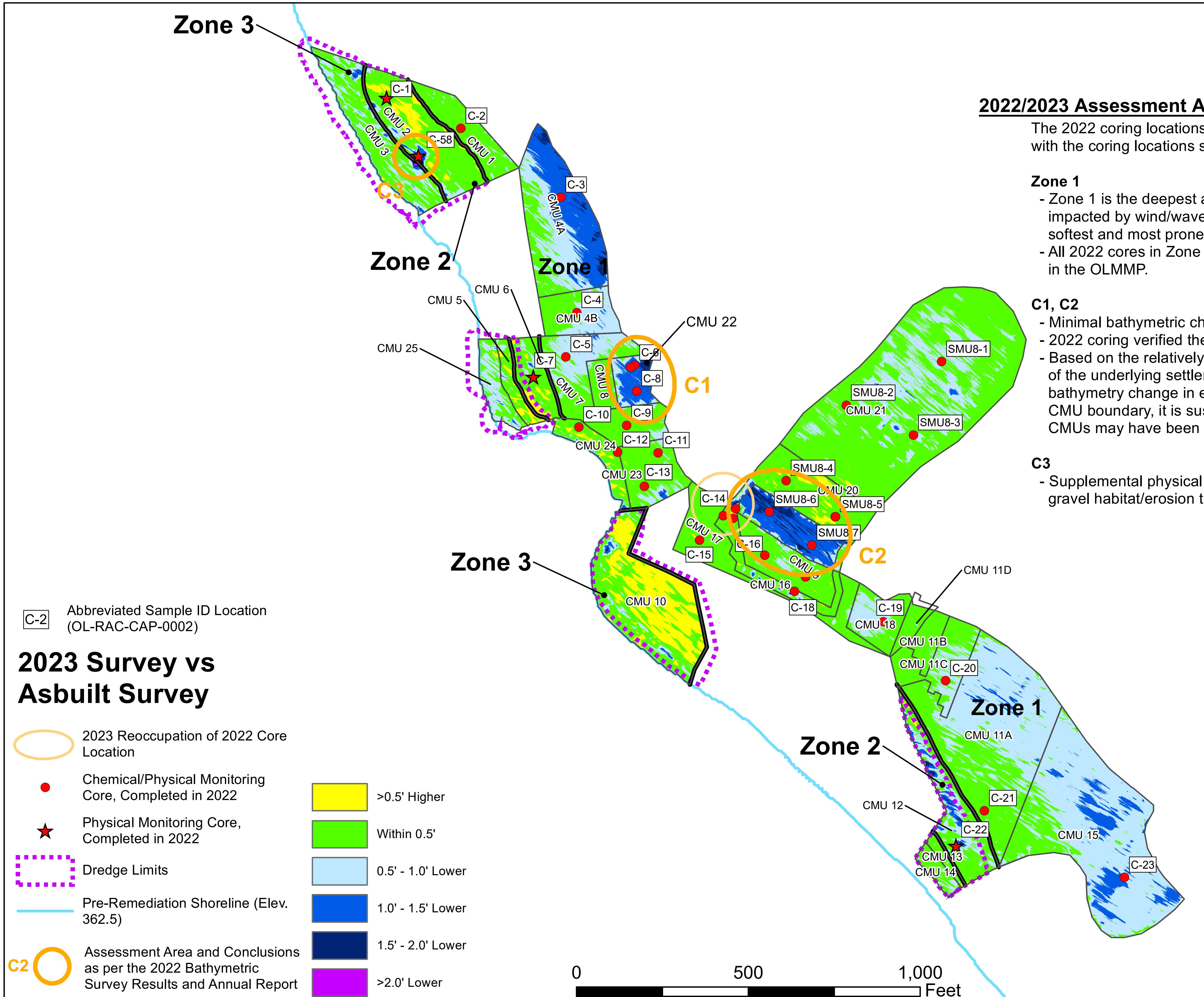
Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.21 - RAB OMM Survey 2022&2023.mxd



Plotted By: Domanski, Joshua

Plot Date: 5/22/2024

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.22 - RAB OMM Survey 22&23 v 2019.mxd



2022/2023 Assessment Area Summary and 2024 Recommendations

The 2022 coring locations (excluding supplemental coring) are consistent with the coring locations specified in the OLMMP.

Zone 1

- Zone 1 is the deepest area of the cap and thus the least likely to be impacted by wind/wave action, and where underlying sediments are softest and most prone to settlement.
- All 2022 cores in Zone 1 met minimal cap thickness requirements defined in the OLMMP.

C1, C2

- Minimal bathymetric change in these areas between 2019 and 2022.
- 2022 coring verified the presence of target cap thickness in these areas.
- Based on the relatively thin caps in these areas, significant settlement of the underlying settlement is unlikely. Given the area of significant bathymetry change in each area corresponds almost exactly with the CMU boundary, it is suspected that the as-built survey for these two CMUs may have been incorrect.

C3

- Supplemental physical monitoring core C-58 collected in 2022 met the gravel habitat/erosion target thickness in this area.

Figure 20.23

Honeywell

RA-C 2022/2023 vs As-built Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plotted By: Domanski, Joshua

Plot Date: 5/23/2024

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.23 - RAC OMM Survey 2022&2023.mxd

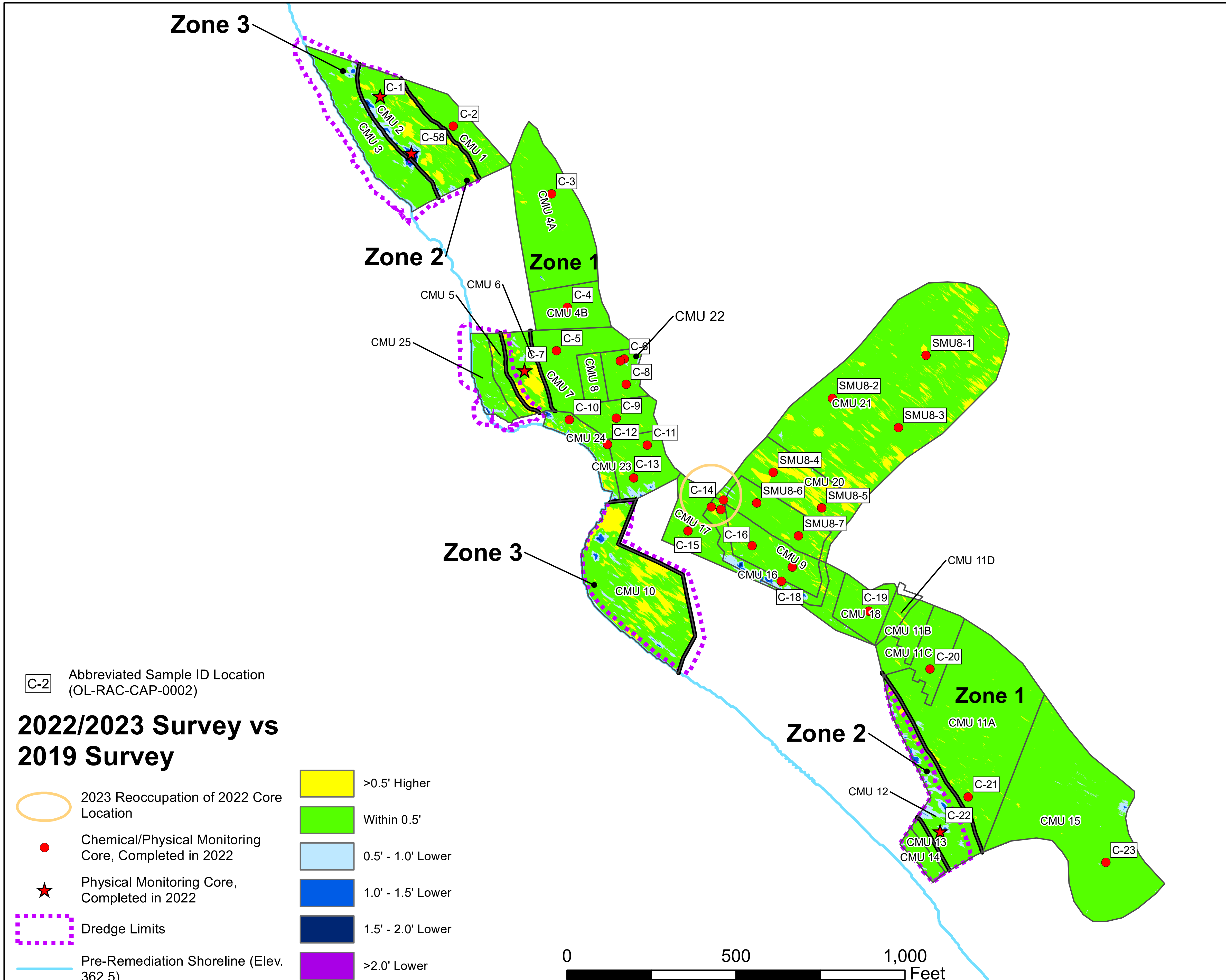


Figure 20.24

Honeywell

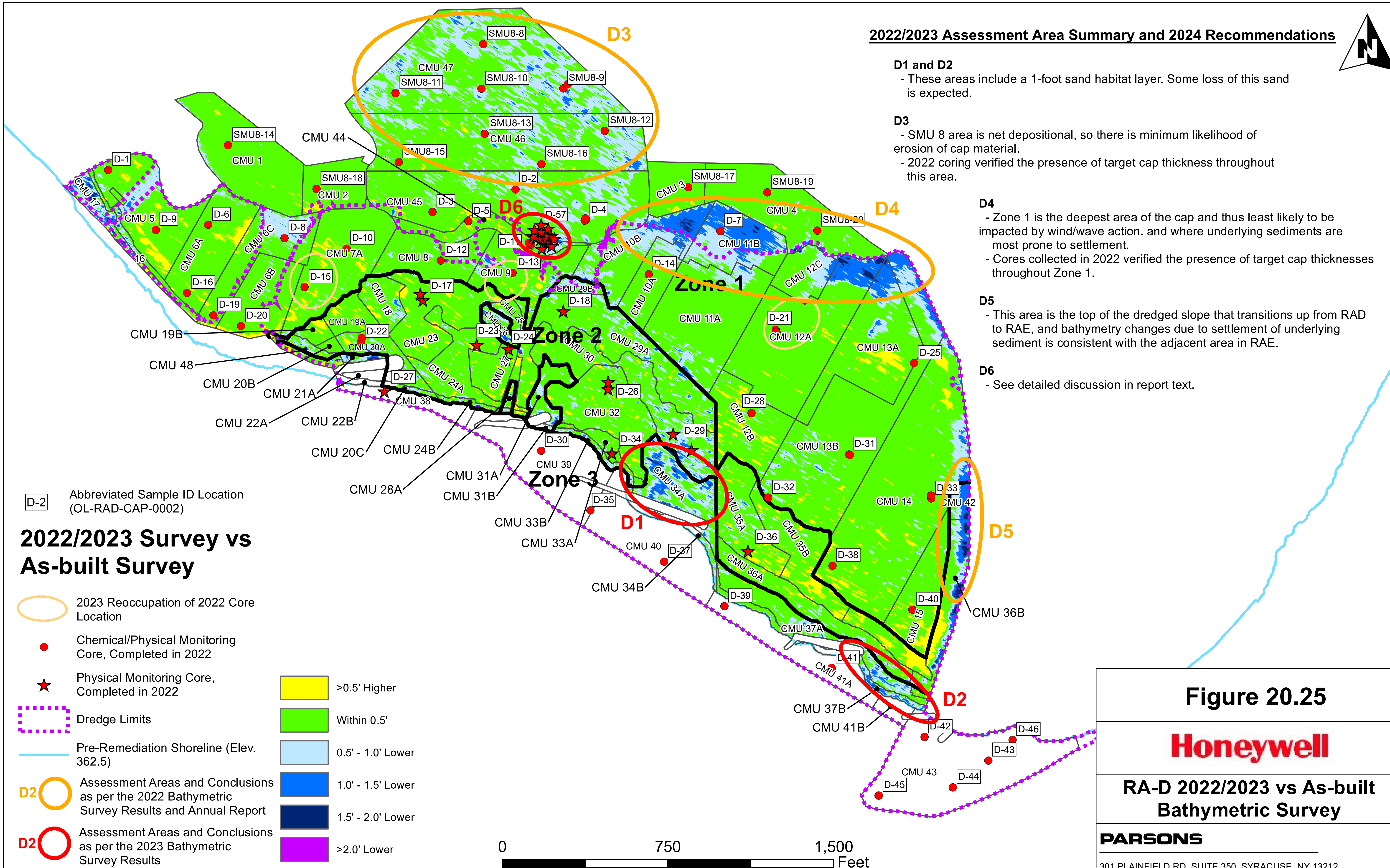
RA-C 2022/2023 vs 2019 Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plot Date: 4/25/2024 Plotted By: Domanski, Joshua

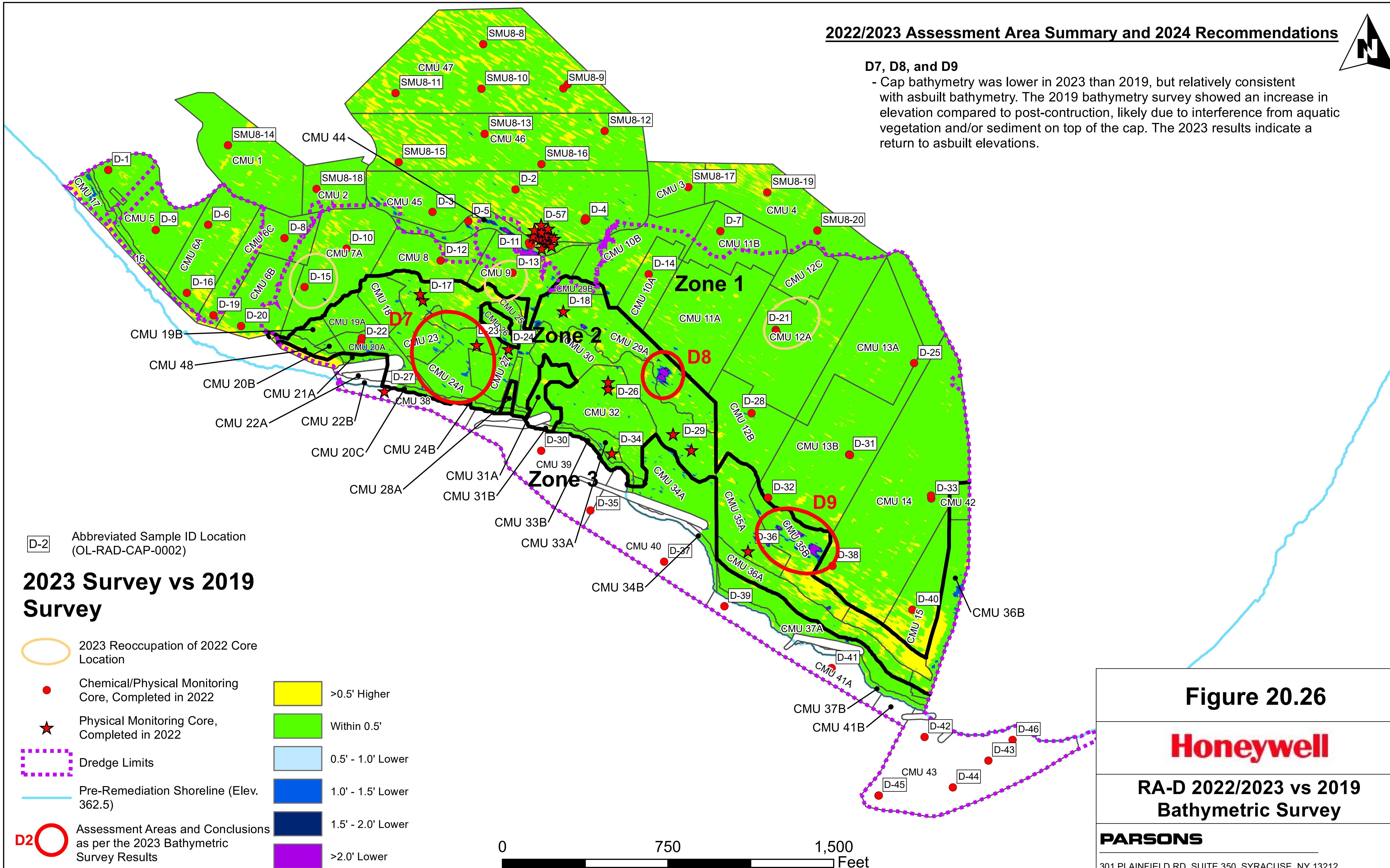
Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.24 - RAC OMM Survey 22&23 v 2019.mxd



Plotted By: Domanski, Joshua

Plot Date: 5/22/2024

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.25 - RAD OMM Survey 2022&2023.mxd



Plot Date: 5/22/2024 Plotted By: Domanski, Joshua

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.26 - RAD OMM Survey 22&23 v 2019.mxd

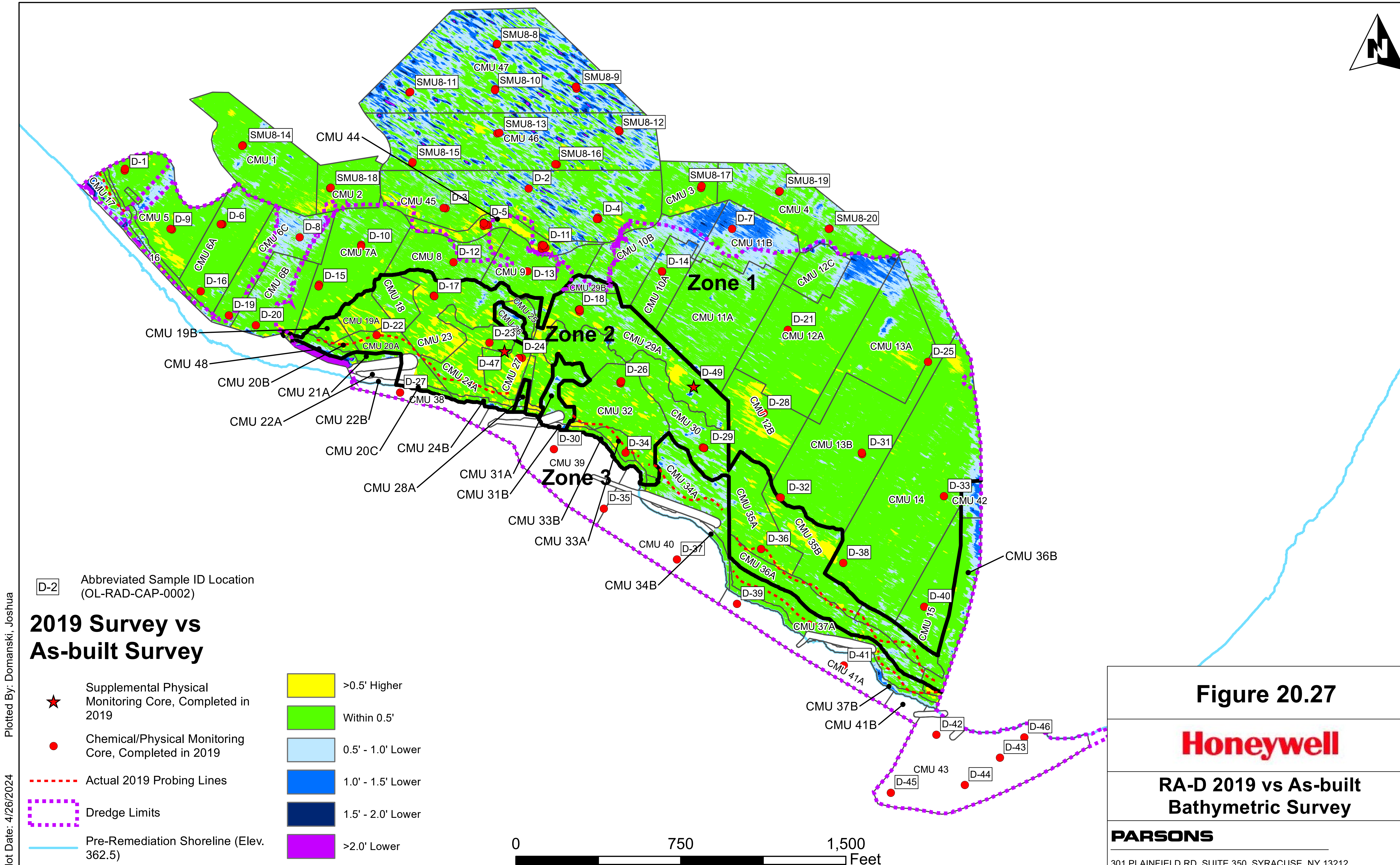


Figure 20.27

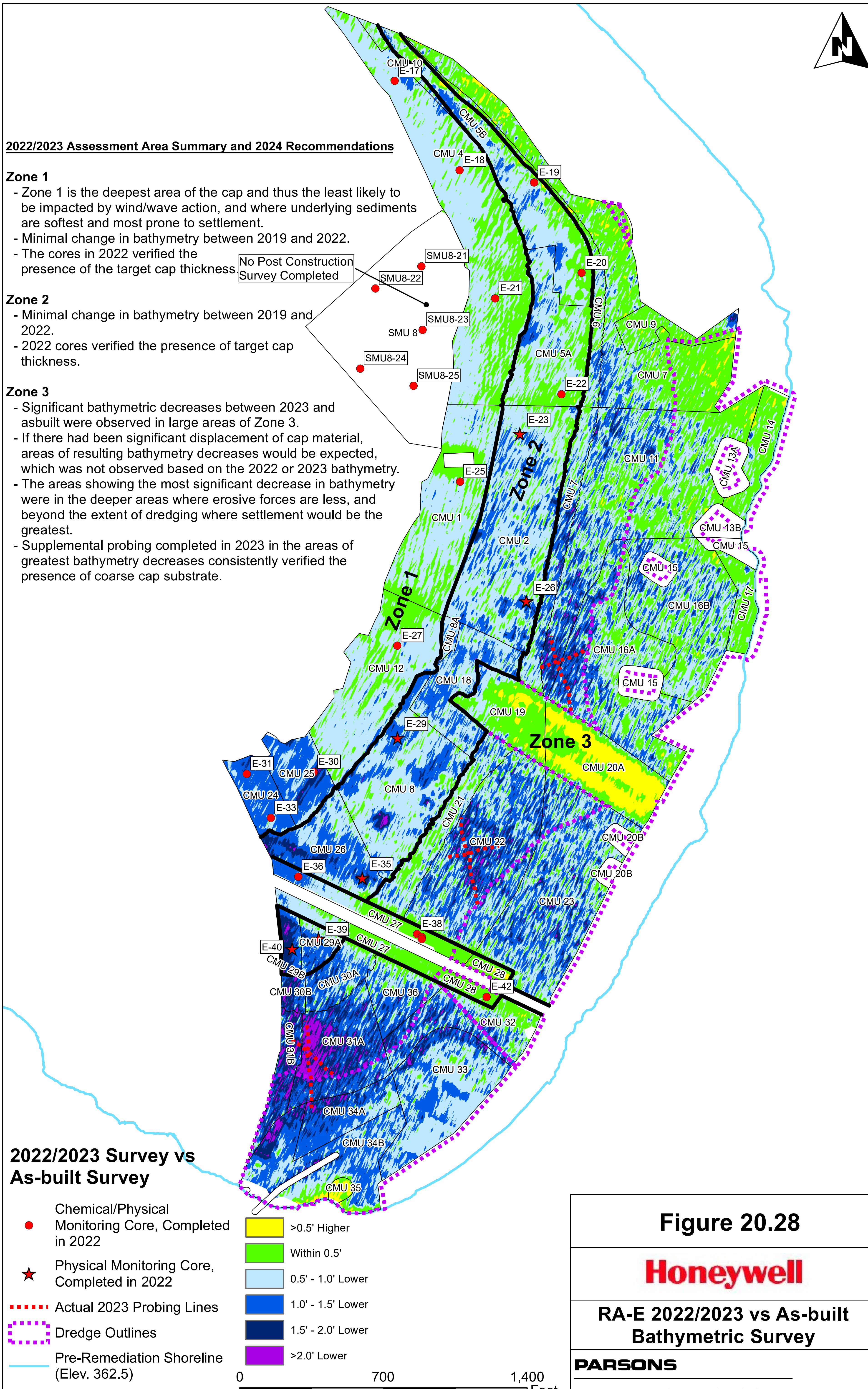
Honeywell

RA-D 2019 vs As-built Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.27 - RAD OMM Survey 2019.mxd



2022/2023 Assessment Area Summary and 2024 Recommendations

Zone 1
- Zone 1 is the deepest area of the cap and thus the least likely to be impacted by wind/wave action, and where underlying sediments are softest and most prone to settlement.
- Minimal change in bathymetry between 2019 and 2022.
- The cores in 2022 verified the presence of the target cap thickness.

Zone 2
- Minimal change in bathymetry between 2019 and 2022.
- 2022 cores verified the presence of target cap thickness.

Zone 3
- Significant bathymetric decreases between 2023 and asbuilt were observed in large areas of Zone 3.
- If there had been significant displacement of cap material, areas of resulting bathymetry decreases would be expected, which was not observed based on the 2022 or 2023 bathymetry.
- The areas showing the most significant decrease in bathymetry were in the deeper areas where erosive forces are less, and beyond the extent of dredging where settlement would be the greatest.
- Supplemental probing completed in 2023 in the areas of greatest bathymetry decreases consistently verified the presence of coarse cap substrate.

2022/2023 Survey vs As-built Survey

- ● Chemical/Physical Monitoring Core, Completed in 2022
- ★ Physical Monitoring Core, Completed in 2022
- Actual 2023 Probing Lines
- Dredge Outlines
- Pre-Remediation Shoreline (Elev. 362.5)

- >0.5' Higher
- Within 0.5'
- 0.5' - 1.0' Lower
- 1.0' - 1.5' Lower
- 1.5' - 2.0' Lower
- >2.0' Lower

Figure 20.28

Honeywell

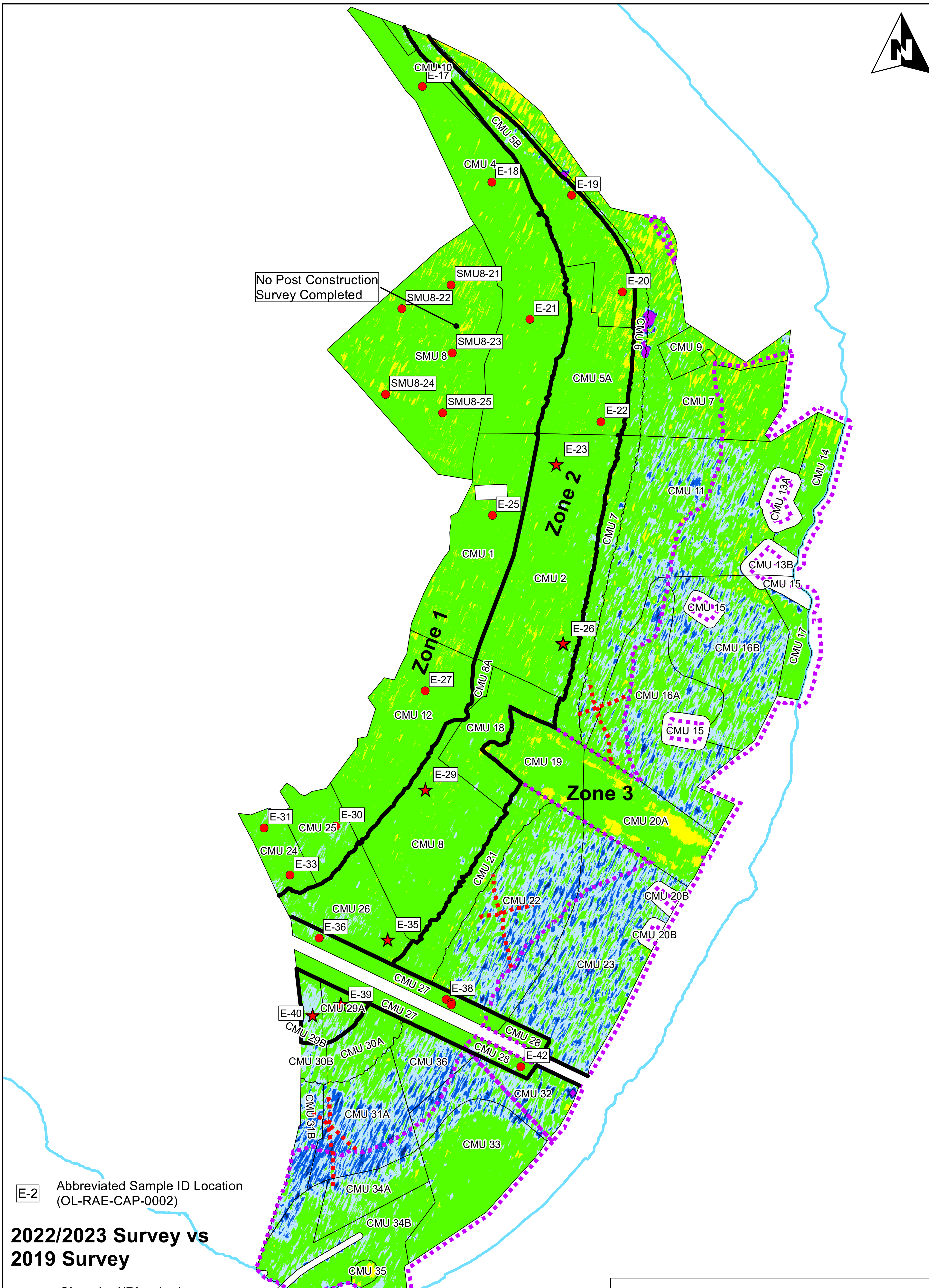
RA-E 2022/2023 vs As-built Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plot Date: 4/29/2024 Plotted By: Domanski, Joshua

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.28 - RAE OMM Survey 2022&2023B.mxd



E-2 Abbreviated Sample ID Location (OL-RAE-CAP-0002)

2022/2023 Survey vs 2019 Survey

- ● Chemical/Physical Monitoring Core, Completed in 2022
- ★ Physical Monitoring Core, Completed in 2022
- Actual 2023 Probing Lines
- Dredge Outlines
- Pre-Remediation Shoreline (Elev. 362.5)

- >0.5' Higher
- Within 0.5'
- 0.5' - 1.0' Lower
- 1.0' - 1.5' Lower
- 1.5' - 2.0' Lower
- >2.0' Lower

0 700 1,400 Feet

Plot Date: 4/30/2024 Plotted By: Domanski, Joshua

Figure 20.29

Honeywell

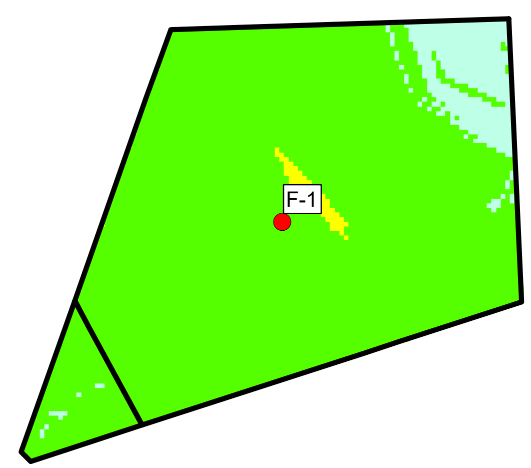
RA-E 2022/2023 vs 2019 Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

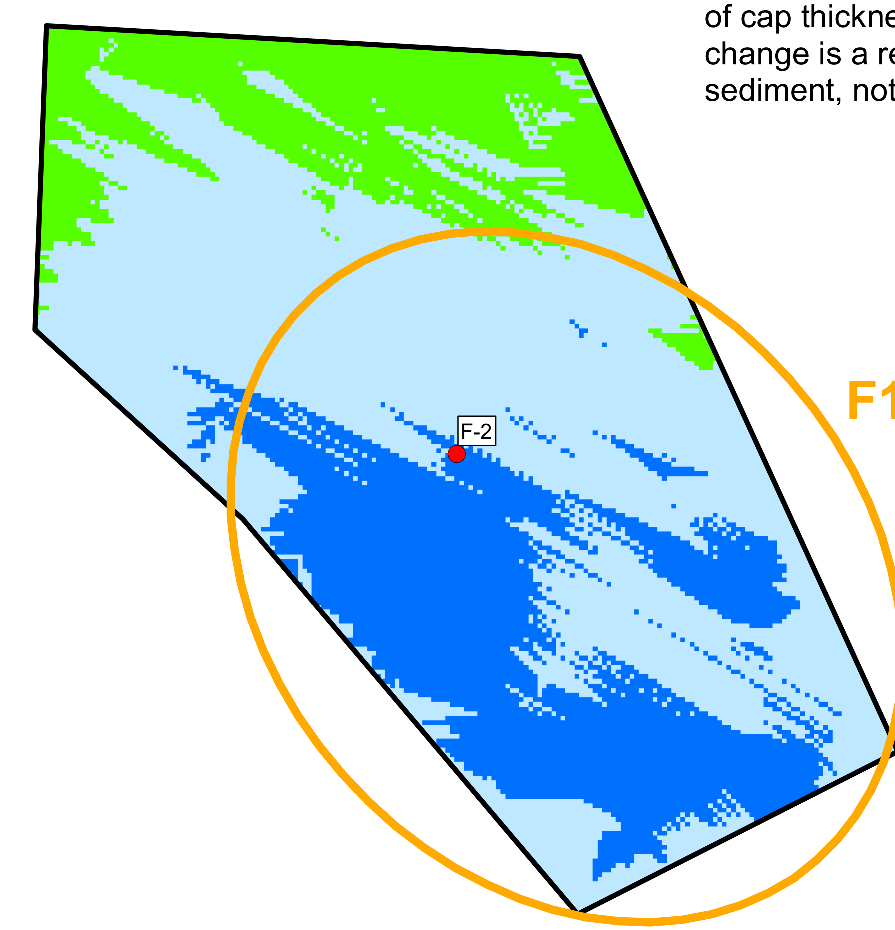
Document Path: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.29 - RAE OMM Survey 22&23 v 2019.mxd

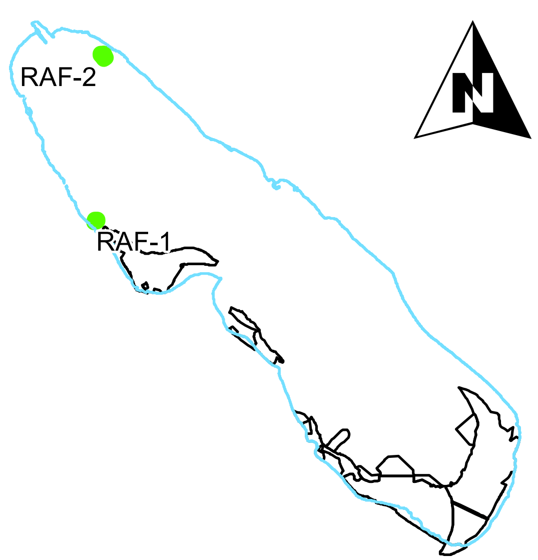
RA-F 1



RA-F 2

F1
- The 2022 core location verified presence of cap thickness, indicating bathymetry change is a result of settlement of underlying sediment, not the loss of cap material.





2022 Survey vs As-built

- Chemical/Physical Monitoring Core, Completed in 2022
- Pre-Remediation Shoreline (Elev. 362.5)
- F-2 Abbreviated Sample ID Location (OL-RAF-CAP-0002)
- F1 Assessment Areas and Conclusions as per the 2022 Bathymetric Survey Results and Annual Report

>0.5' Higher
Within 0.5'
0.5' - 1.0' Lower
1.0' - 1.5' Lower
1.5' - 2.0' Lower
>2.0' Lower

0 50 100 Feet

Figure 20.30

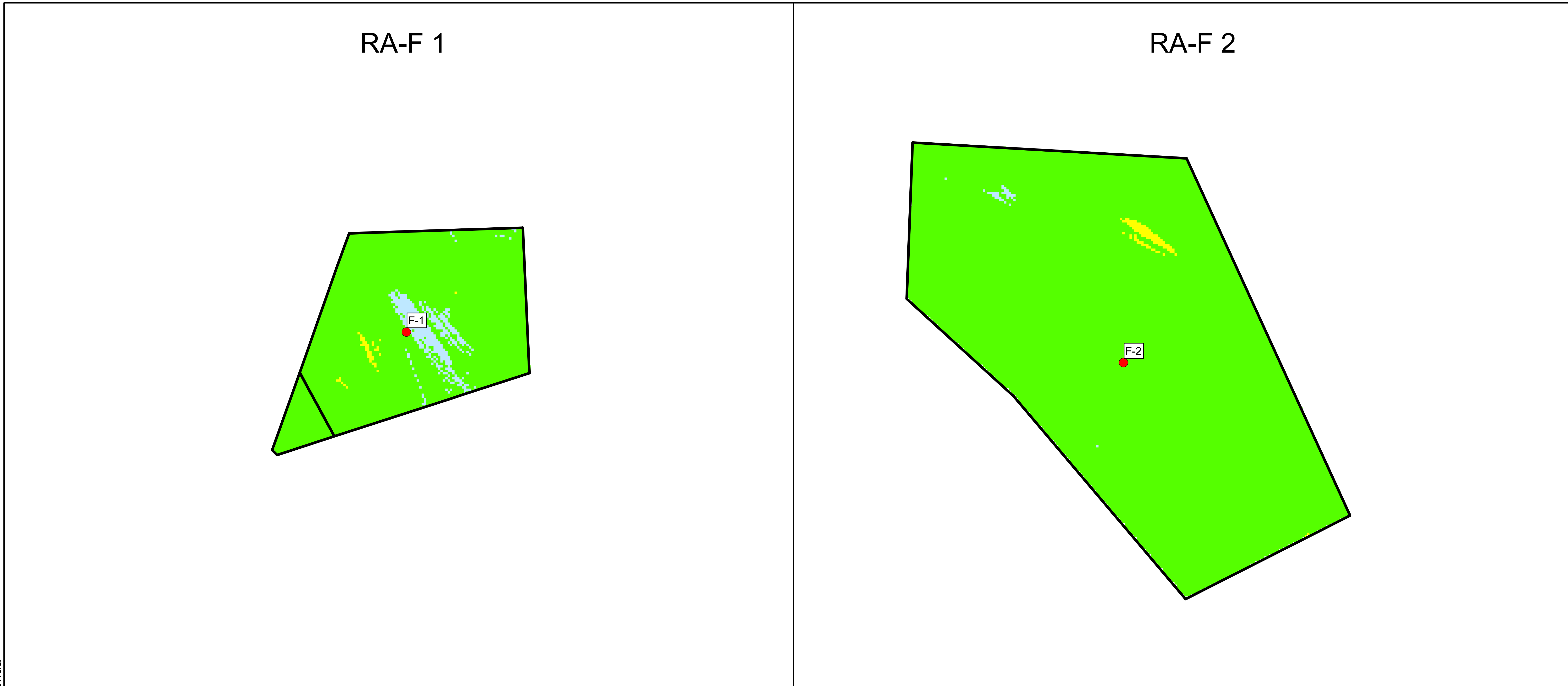
Honeywell

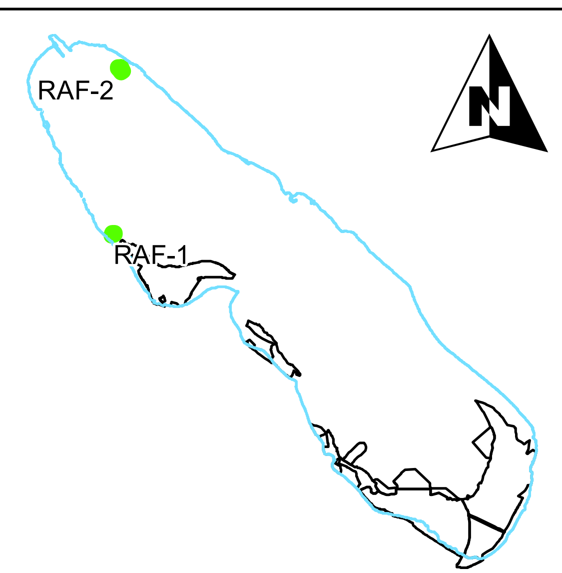
RA-F 2022 vs As-built Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.30 - RAF OMM Survey 2022.mxd
Plot Date: 4/30/2024 Plotted By: Domanski, Joshua





2022 Survey vs 2019 Survey

- ● Chemical/Physical Monitoring Core, Completed in 2022
- Pre-Remediation Shoreline (Elev. 362.5)
- F-2 Abbreviated Sample ID Location (OL-RAF-CAP-0002)

Legend
>0.5' Higher
Within 0.5'
0.5' - 1.0' Lower
1.0' - 1.5' Lower
1.5' - 2.0' Lower
>2.0' Lower

0 50 100 Feet

Figure 20.31

Honeywell

RA-F 2022 vs 2019 Bathymetric Survey

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

File Name: Q:\GIS\Hon_Syracuse\OLMMS\OMM Survey\2023 Survey\MXDs\Figure 6.31 - RAF OMM Survey 2019 v 2022.mxd
Plot Date: 4/30/2024 Plotted By: Domanki, Joshua

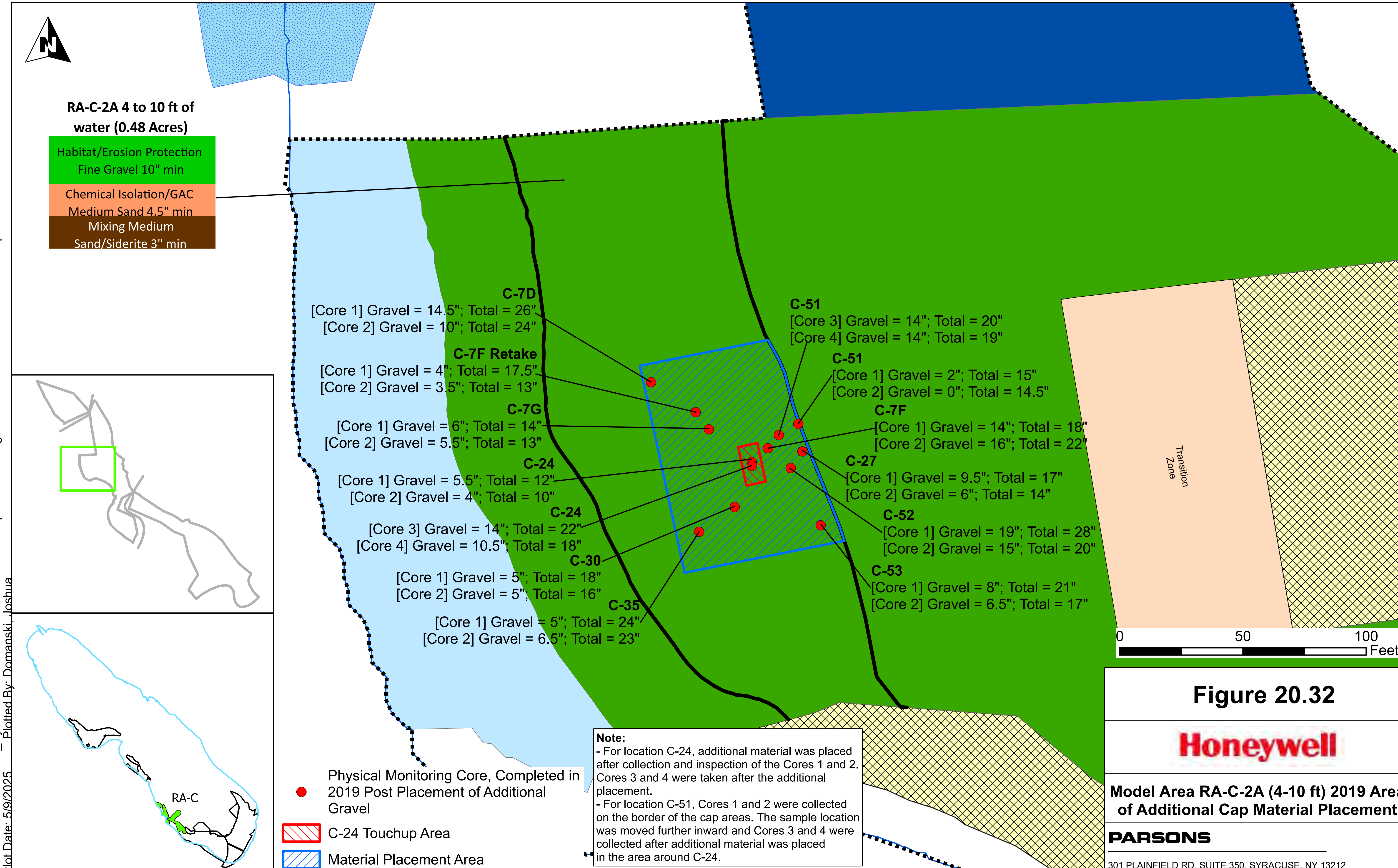
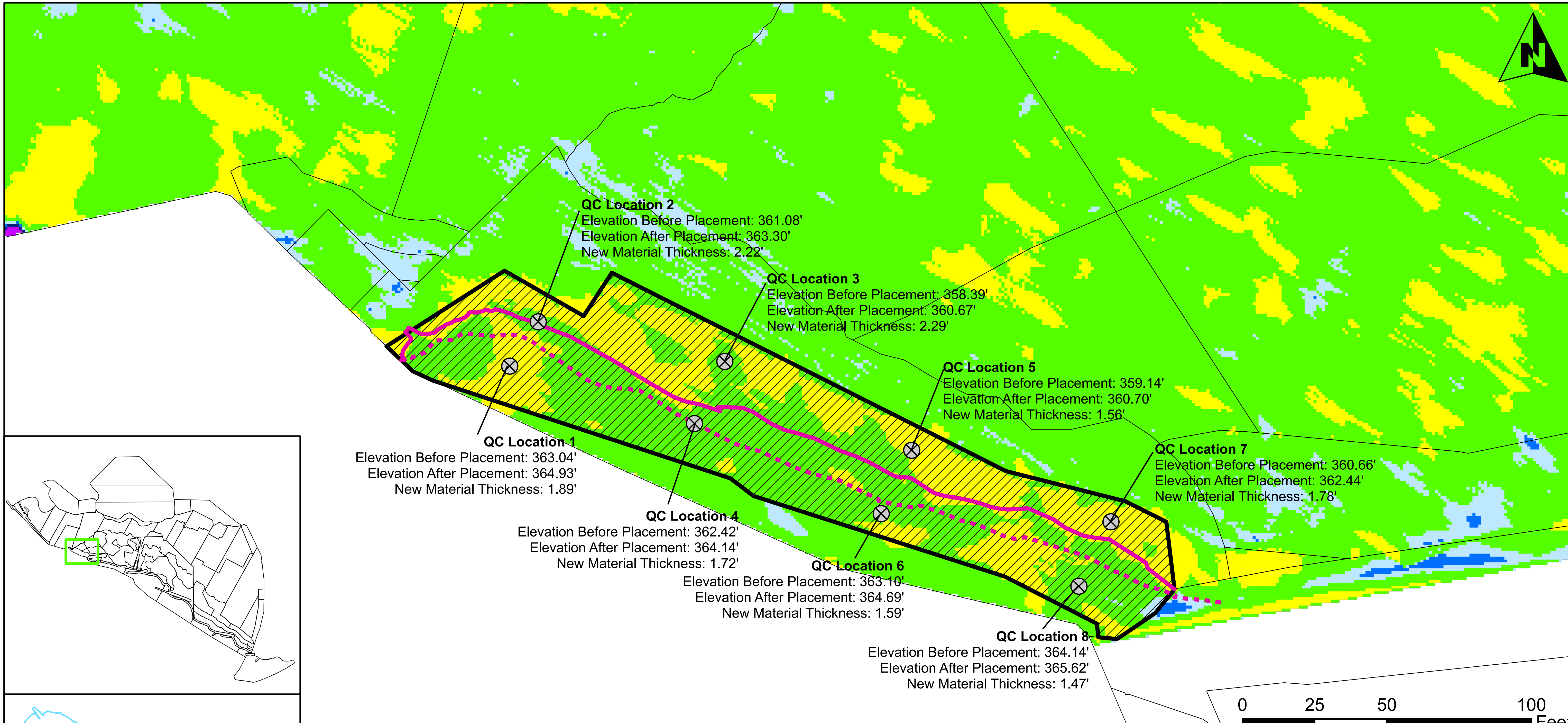


Figure 20.32

Model Area RA-C-2A (4-10 ft) 2019 Area of Additional Cap Material Placement

File Name: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\APRXs\Figure 6.32 - 2019 RAC Amendments.aprx
Plot Date: 5/9/2025 Plotted By: Domanski, Joshua



2019 Post-Amendment Survey vs As-built Survey

- Quality Control Point
- Elevation 362.5' from 2019 Survey
- Elevation 362.5' from Asbuilt Survey
- 2019 Material Placement Area
- Cap Management Units Outlines
- >0.5' Higher
- Within 0.5'
- 0.5' - 1.0' Lower
- 1.0' - 1.5' Lower
- 1.5' - 2.0' Lower
- >2.0' Lower

Notes:

1) The Material Placement Area was designated based on the results of the 2018 bathymetric survey and an investigation in spring 2019.
2) The fine gravel previously placed in this area was subject to erosion, therefore a larger coarse cobble was used to replace it.
3) Post-Construction survey was conducted with the bucket of an excavator. The accuracy was verified before this was conducted.
4) Material thickness was verified based on a comparison of pre-placement and post-placement elevations at eight locations throughout the placement area.

Figure 20.33

Honeywell

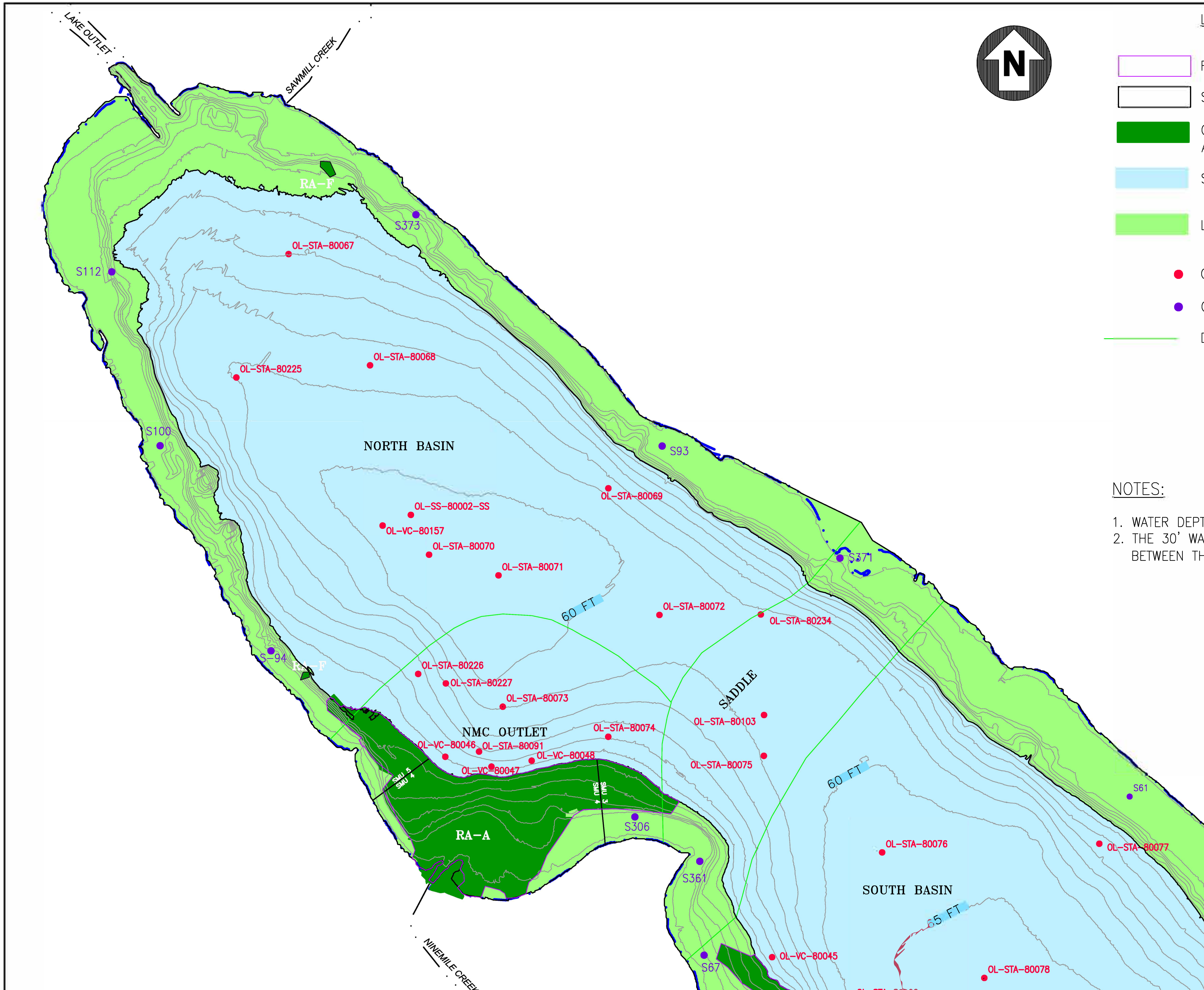
RAD Shoreline 2019 Area of Additional Cap Material Placement

PARSONS

301 PLAINFIELD RD, SUITE 350, SYRACUSE, NY 13212

Plot Date: 5/9/2025 Plotted By: Domanski, Joshua

Document Path: Q:\GIS\Hon_Syracuse\OLMMS\MXDs\2023 OLMM Report\APRXs\Figure 6.33 - RAD Shoreline 2019 Area of Additional Cap Material Placement.aprx



LEGEND:

- REMEDIATION AREA BOUNDARY
- SMU BOUNDARIES
- CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)
- SMU 8
- LITTORAL ZONE
- COMPLIANCE VERIFICATION SAMPLE LOCATIONS (SMU 8)
- COMPLAINCE VERIFICATION SAMPLE LOCATIONS (LITTORAL)
- DEMARCATION FOR BSQV SUBAREAS

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT.
2. THE 30' WATER DEPTH CONTOUR IS THE BOUNDARY BETWEEN THE LITTORAL ZONE (SMUs 1-7) AND SMU 8.

FIGURE 21

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

COMPLIANCE VERIFICATION SEDIMENT SAMPLE LOCATIONS IN NORTH HALF OF ONONDAGA LAKE

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\453531 2023 ONONDAGA LAKE PVM\10.0 TECHNICAL CATEGORIES\10.1 CAD\MNR\450102-MNR-004.DWG
PLOT DATE: 5/10/2024 9:05 AM PLOTTED BY: DOMANSKI, JOSHUA [US-US]

LEGEND:

REMEDIATION AREA BOUNDARY

SMU BOUNDARIES

CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)

SMU 8

LITTORAL ZONE

COMPLAINCE VERIFICATION SAMPLE LOCATIONS (SMU 8)

COMPLAINCE VERIFICATION SAMPLE LOCATIONS (LITTORAL)

DEMARCATION FOR BSQV SUBAREAS

SEDIMENT TRAP SAMPLE LOCATION

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT.
2. THE 30' WATER DEPTH CONTOUR IS THE BOUNDARY BETWEEN THE LITTORAL ZONE (SMUs 1–7) AND SMU 8.
3. SAMPLE LOCATIONS USED IN THE FINAL DESIGN REPORT (PARSONS AND ANCHOR QEA, 2012) THAT ARE NOW WITHIN CAPPED AREAS WILL BE SAMPLED UNDER THE CAP MONITORING PROGRAM. SEE SECTION 6 OF THE OLMMP FOR FURTHER DETAILS.

1200 600 0 1200 2400

SCALE: 1"=1200'

FIGURE 22

Honeywell

ONONDAGA LAKE
SYRACUSE, NEW YORK

COMPLIANCE VERIFICATION SEDIMENT SAMPLE LOCATIONS IN SOUTH HALF OF ONONDAGA LAKE

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\453531 2023 ONONDAGA LAKE PVM\10.0 TECHNICAL CATEGORIES\10.1 CAD\MNR\450102-MNR-004.DWG
PLOT DATE: 5/10/2024 9:15 AM PLOTTED BY: DOMANSKI, JOSHUA [US-US]

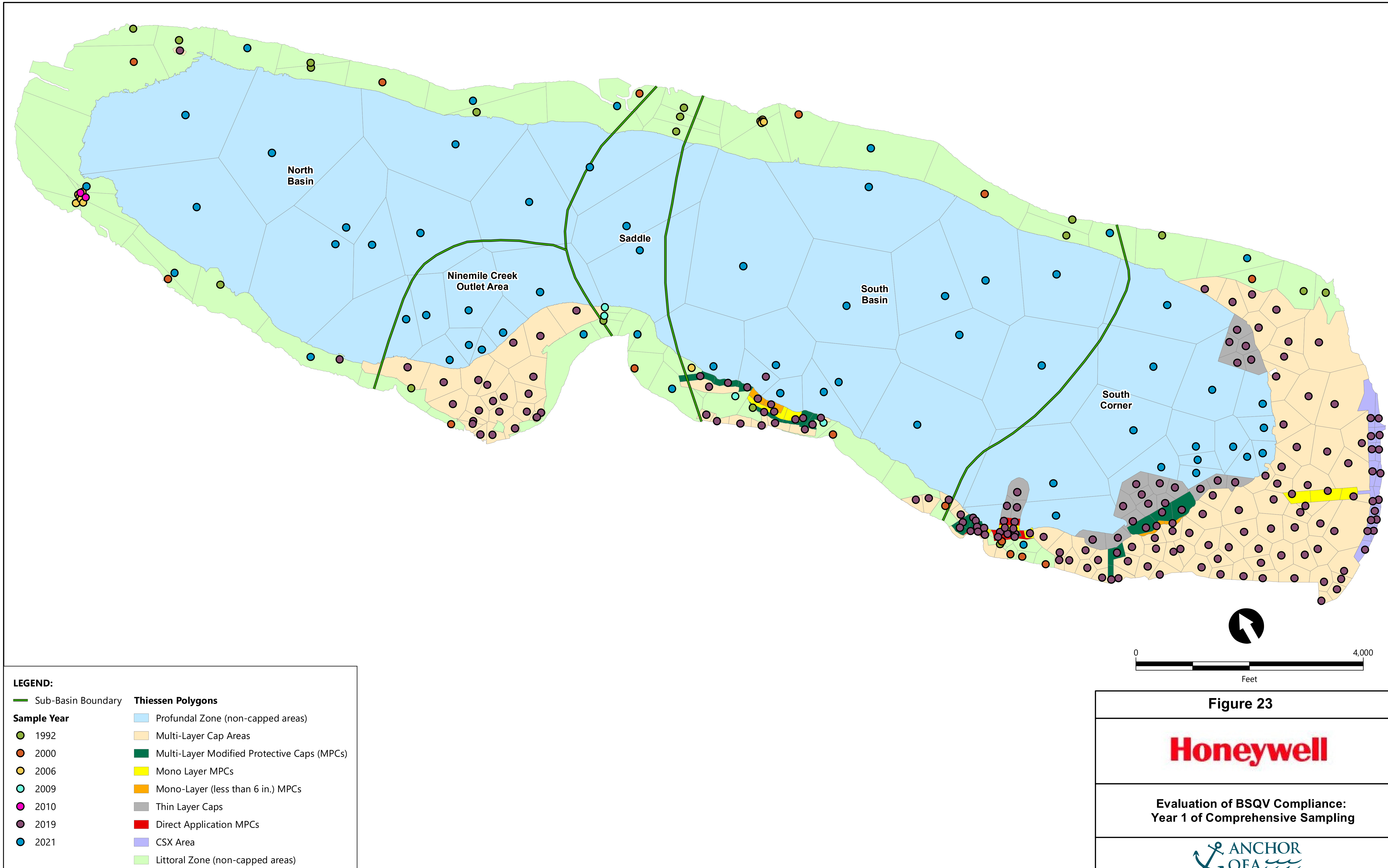


Figure 23

Honeywell

Evaluation of BSQV Compliance: Year 1 of Comprehensive Sampling

ANCHOR QEA

Publish Date: 2023/03/14, 8:07 AM | User: nwagner
Filepath: \\orcas\gis\Jobs\Honeywell_Intl_1102\OnondagaLake\Maps\SWAC\OL_Fig4.2_ThiessenAnalysis_SampleYear.mxd

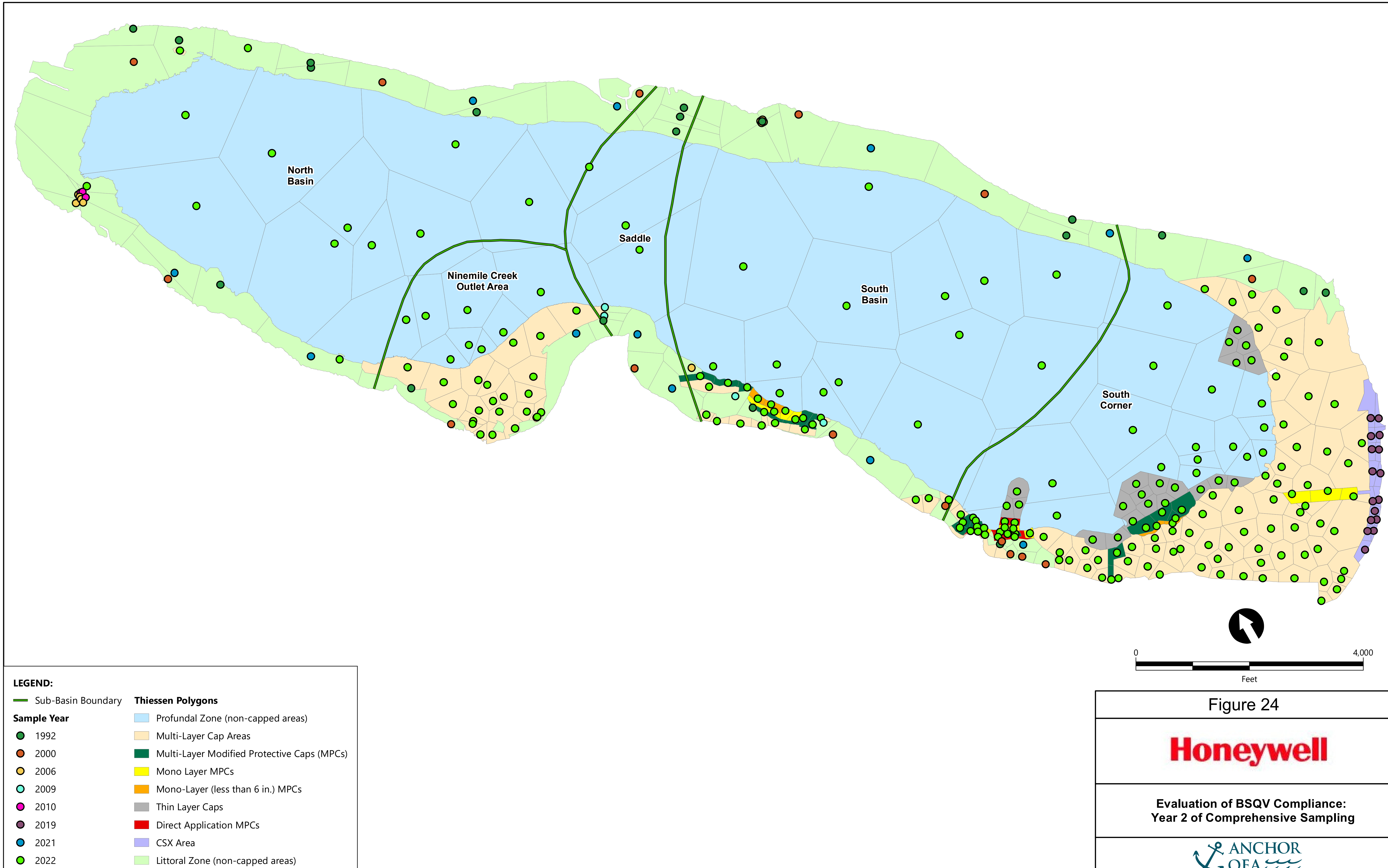


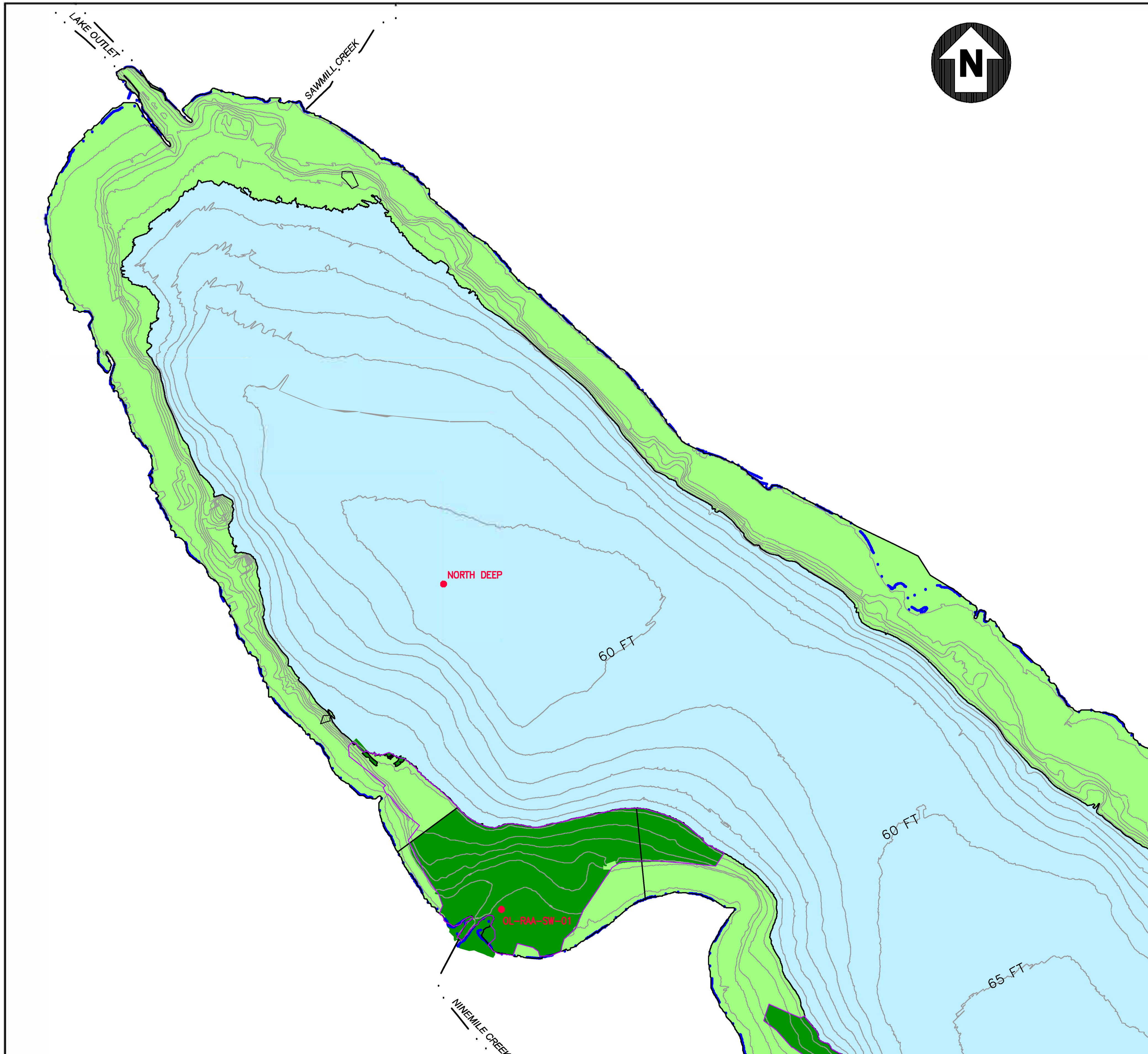
Figure 24

Honeywell

Evaluation of BSQV Compliance: Year 2 of Comprehensive Sampling

ANCHOR QEA

Publish Date: 2023/04/11, 11:00 AM | User: nwagner
Filepath: Q:\Jobs\Honeywell_Intl_1102\OnondagaLake\Maps\Monitoring\2022\OL_Fig4.2_HgMonitoring_2022.mxd



LEGEND:

- REMEDIATION AREA BOUNDARY
- SMU BOUNDARY
- CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)
- SMU 8
- LITTORAL ZONE
- SURFACE WATER SAMPLE LOCATIONS

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT (POST–REMEDIATION).
2. THE 30' WATER DEPTH CONTOUR IS THE BOUNDARY BETWEEN THE LITTORAL ZONE (SMUs 1–7) AND SMU 8.

1200 600 0 1200 2400

SCALE: 1"=1200'

FIGURE 25

Honeywell

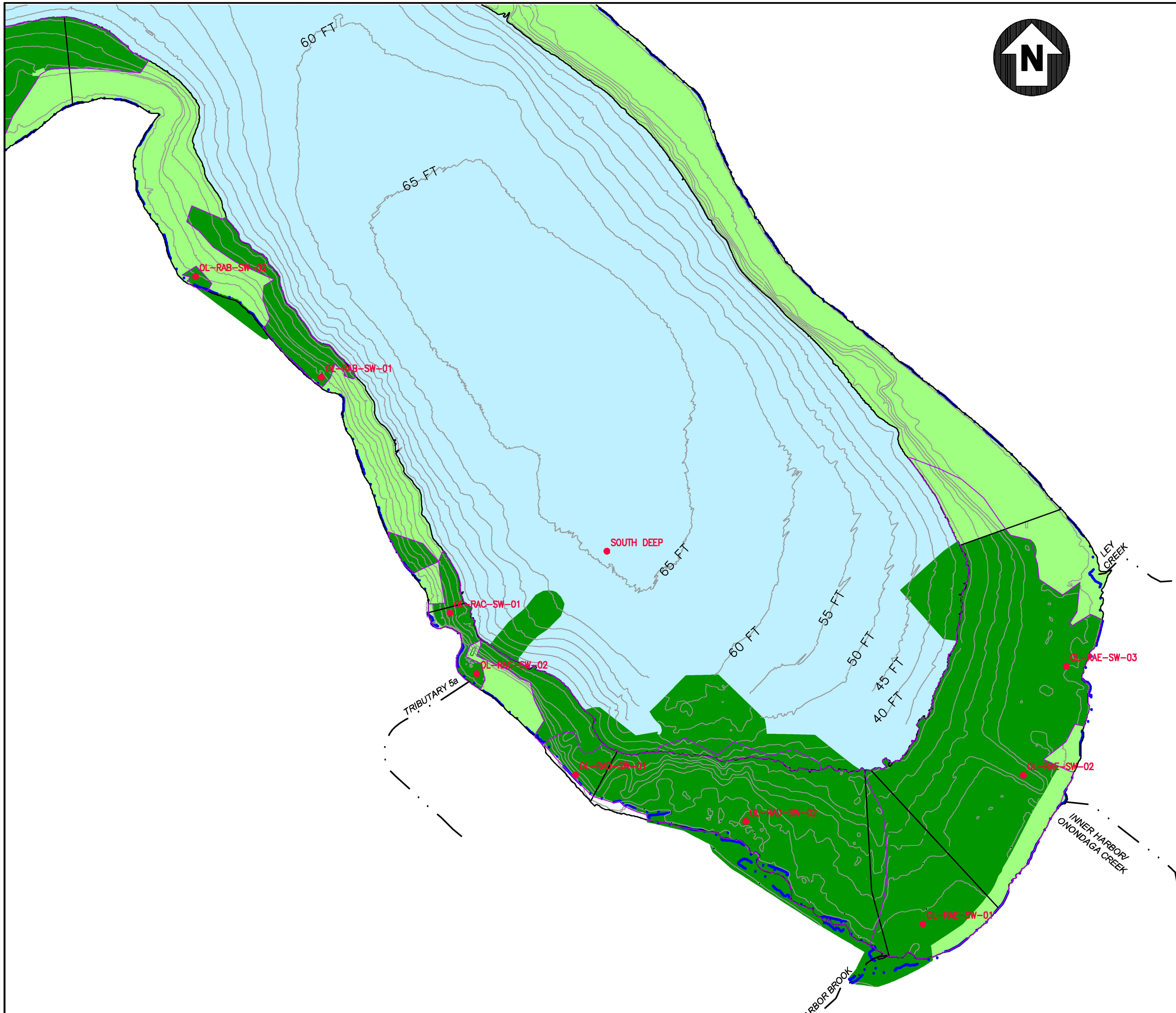
ONONDAGA LAKE
SYRACUSE, NEW YORK

SURFACE WATER COMPLIANCE SAMPLE LOCATIONS IN NORTH HALF OF ONONDAGA LAKE

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\450704 2017-2018 OL PVM\10 TECHNICAL CATEGORIES\10.1 CAD\2022 ANNUAL REPORT\450704-ANNUALRPT-2022-03.DWG
PLOT DATE: 4/18/2023 11:12 AM PLOTTED BY: RUSSO, JILL [US-US]



LEGEND:

- REMEDIATION AREA BOUNDARY
- SMU BOUNDARY
- CAPPED AREAS (INCLUDES ALL ISOLATION, THIN LAYER, AND MODIFIED PROTECTIVE CAPS)
- SMU 8
- LITTORAL ZONE
- SURFACE WATER SAMPLE LOCATIONS

NOTES:

1. WATER DEPTH CONTOUR INTERVAL IS 5 FT (POST–REMEDIATION).
2. THE 30' WATER DEPTH CONTOUR IS THE BOUNDARY BETWEEN THE LITTORAL ZONE (SMUs 1–7) AND SMU 8.

1200 600 0 1200 2400

SCALE: 1"=1200'

FIGURE 26

Honeywell

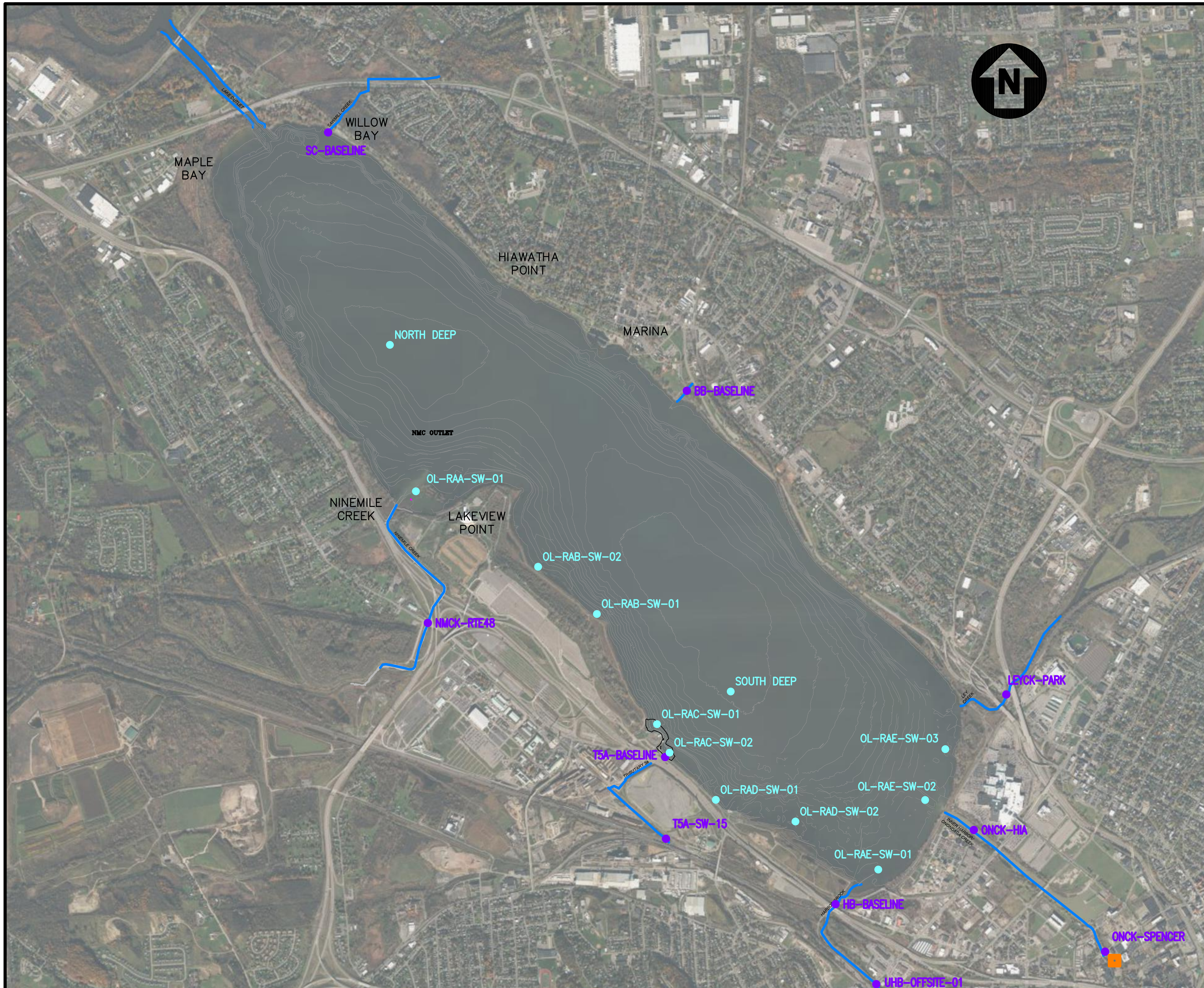
ONONDAGA LAKE
SYRACUSE, NEW YORK

SURFACE WATER COMPLIANCE SAMPLE LOCATIONS IN SOUTH HALF OF ONONDAGA LAKE

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\450704 2017-2018 OL PVM\10 TECHNICAL CATEGORIES\10.1 CAD\2022 ANNUAL REPORT\450704-ANNUALRPT-2022-03.DWG
PLOT DATE: 4/18/2023 11:03 AM PLOTTED BY: RUSSO, JILL [US-US]



LEGEND:

- TRIBUTARY SAMPLE LOCATION
- SURFACE WATER SAMPLE LOCATIONS
- ONONDAGA CREEK USGS GAGE

NOTE:

1. POST-REMEDY CONTOURS SHOWN.
2. LAKE SURFACE WATER SAMPLING LOCATIONS ARE CONSISTENT WITH THOSE UTILIZED FOR COMPLIANCE SAMPLING AS DESCRIBED IN THE ONONDAGA LAKE MONITORING AND MAINTENANCE PLAN (PARSONS ET AL 2018).
3. SAMPLING AND ANALYSES WILL BE CONDUCTED IN ACCORDANCE WITH THE QAPP.

2500 0 2500 5000

SCALE: 1"=2500'

FIGURE 27

Honeywell

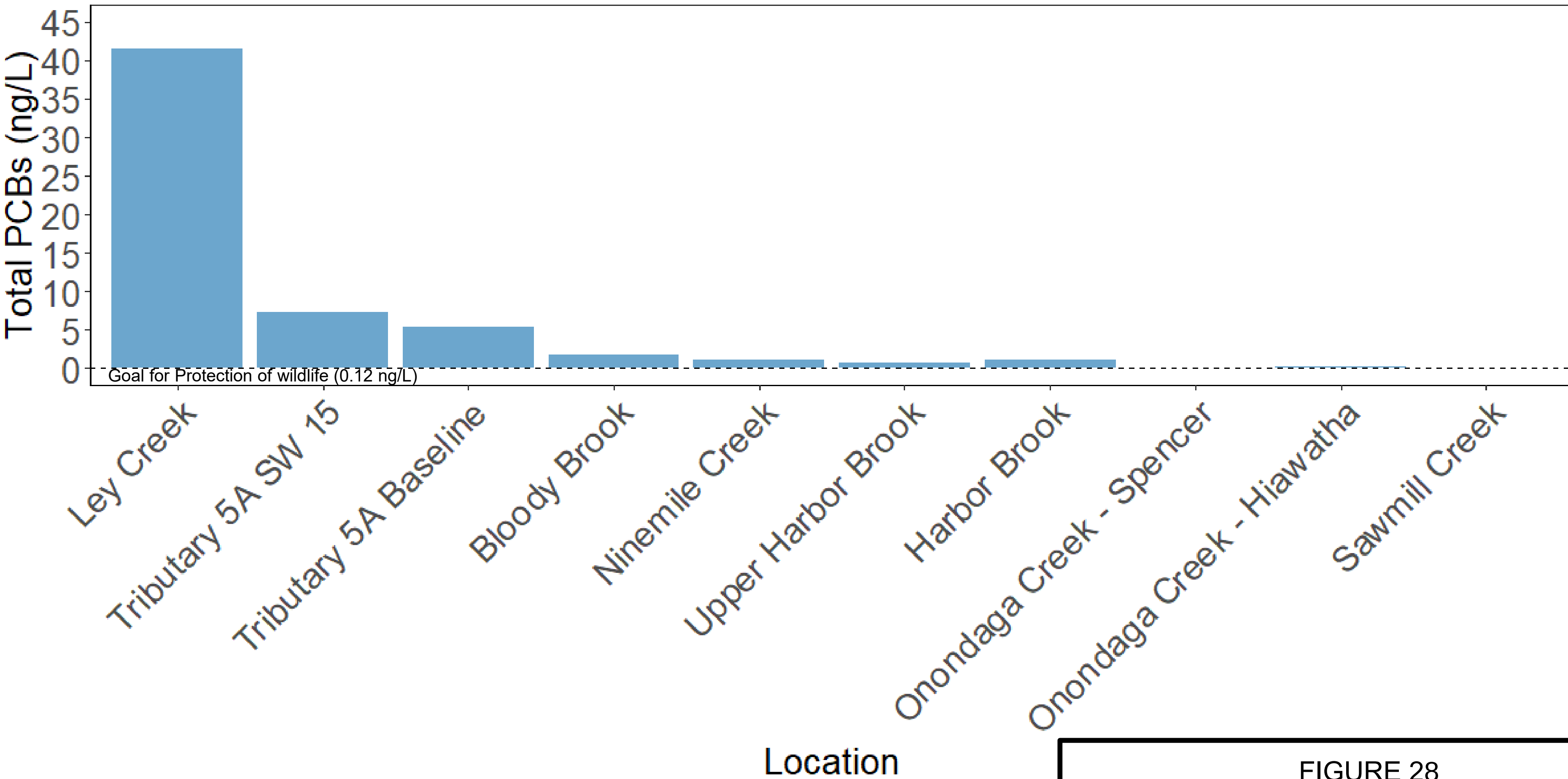
ONONDAGA LAKE
SYRACUSE, NEW YORK

SURFACE WATER SAMPLING LOCATIONS

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, N.Y. 13212, PHONE: 315-451-9560

FILE NAME: P:\HONEYWELL -SYR\452284 2020 ONONDAGA LAKE PVM\10 TECHNICAL CATEGORIES\CAD\452284-SK001-PRESENTATION.DWG
PLOT DATE: 6/3/2022 11:30 AM PLOTTED BY: RUSSO, JILL [US-US]



Note: Goal for Protection of Human Health (0.001 ng/L) not shown

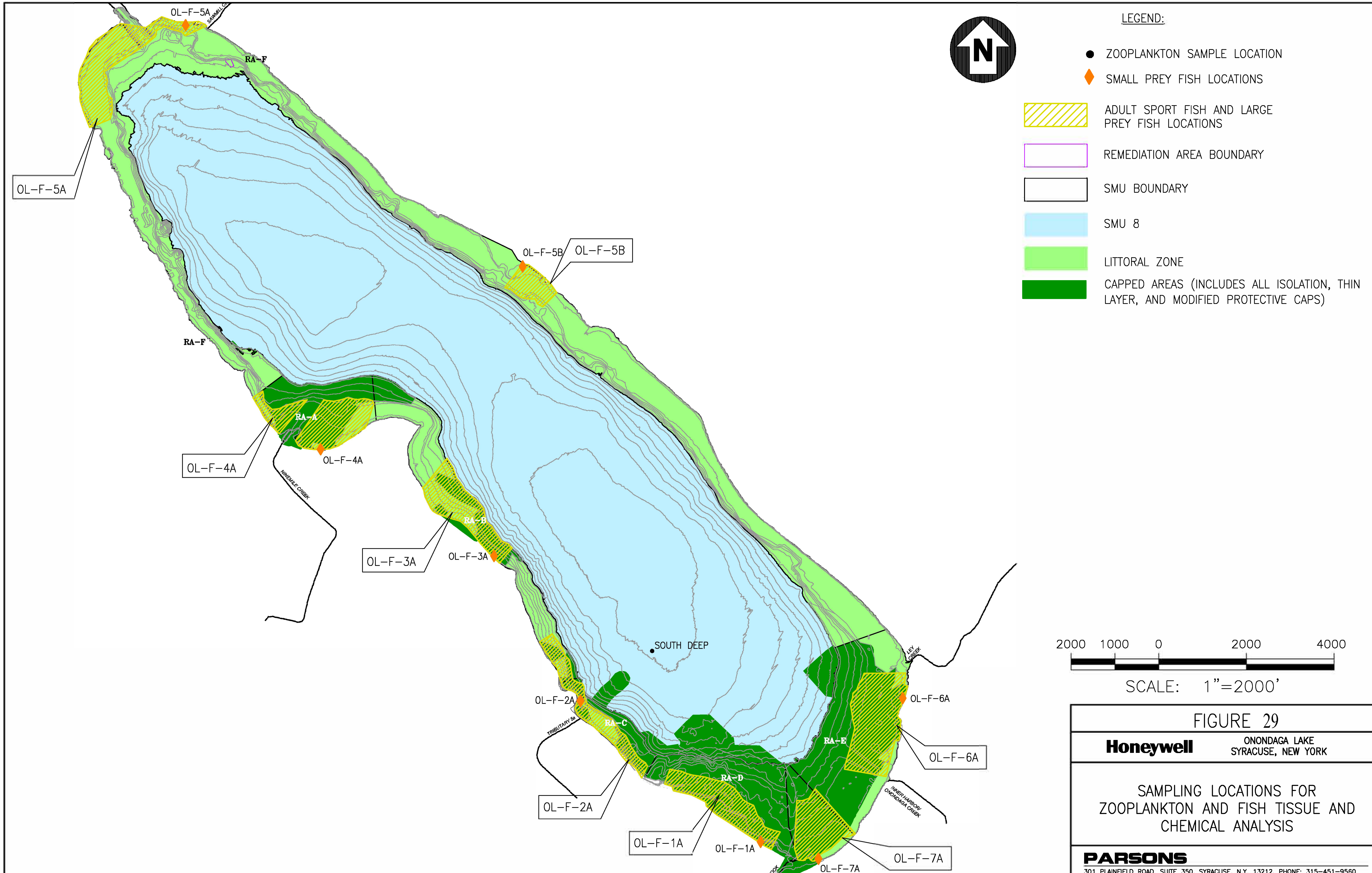
FIGURE 28

Honeywell

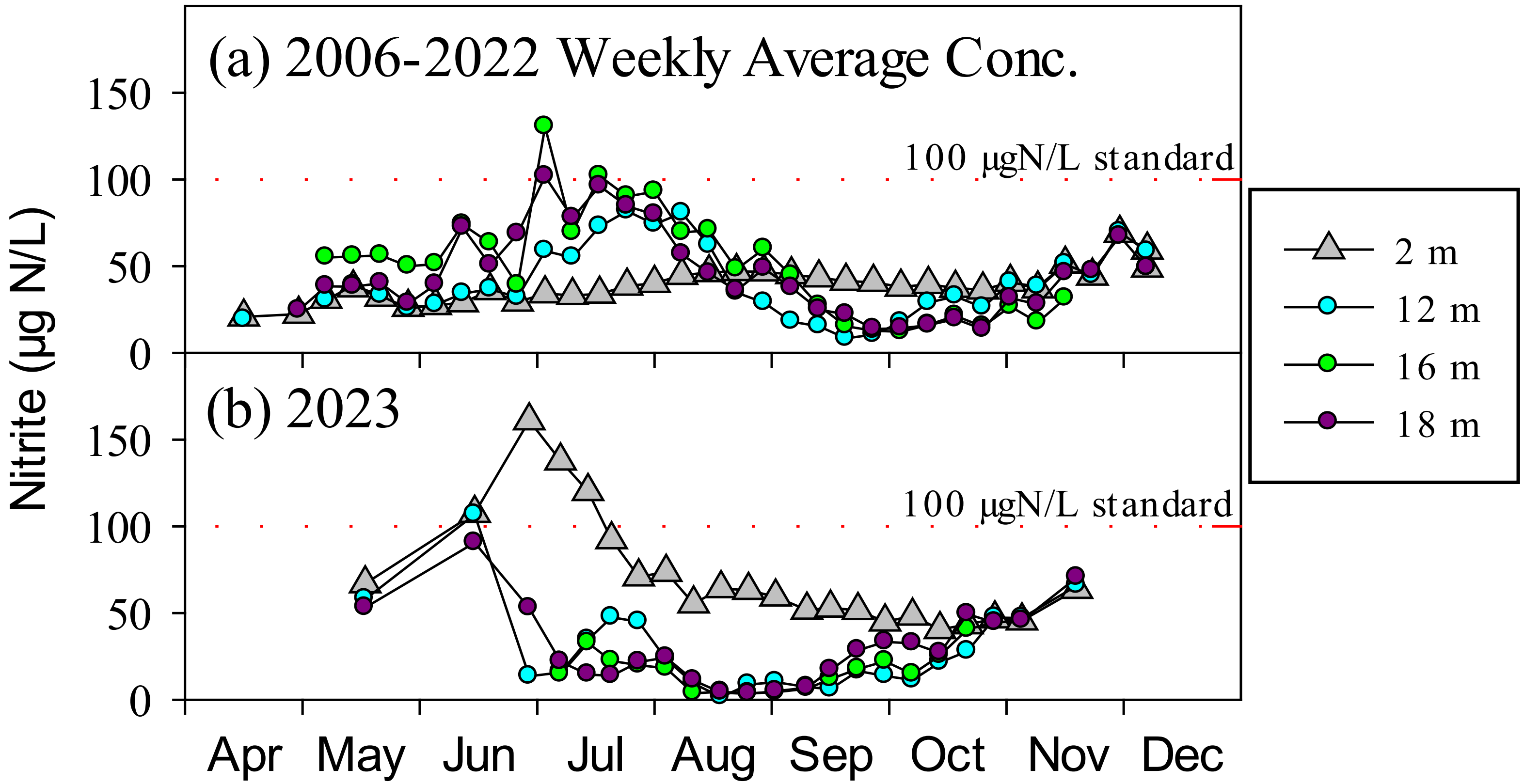
Onondaga Lake
Syracuse, New York

2021 Onondaga Lake Tributary Average Total PCB Concentrations

PARSONS
301 Plainfield Rd, Suite 350, Syracuse, NY, 13212, Phone 315-451-9560



FILE NAME: P:\HONEYWELL -SYR\450704 2017-2018 OL PVM\10 TECHNICAL CATEGORIES\10.1 CAD\2019 ANNUAL REPORT\450704-2019-ZOO-FISH.DWG
PLOT DATE: 6/18/2021 2:55 PM PLOTTED BY: RUSSO, JILL



a) weekly average concentration for 2006-2022 and (b) 2023 concentrations. Note: The ambient water quality standard for nitrite applicable to warm-water fisheries is 100 micrograms per liter (µgN/L) as nitrogen (red-dashed line)

FIGURE 30

Honeywell

Onondaga Lake
Syracuse, New York

Time Series of Nitrite-Nitrogen (NO2-N) for Onondaga Lake at South Deep for Four Water Depths

PARSONS

301 Plainfield Rd, Suite 350, Syracuse, NY, 13212, Phone 315-451-9560

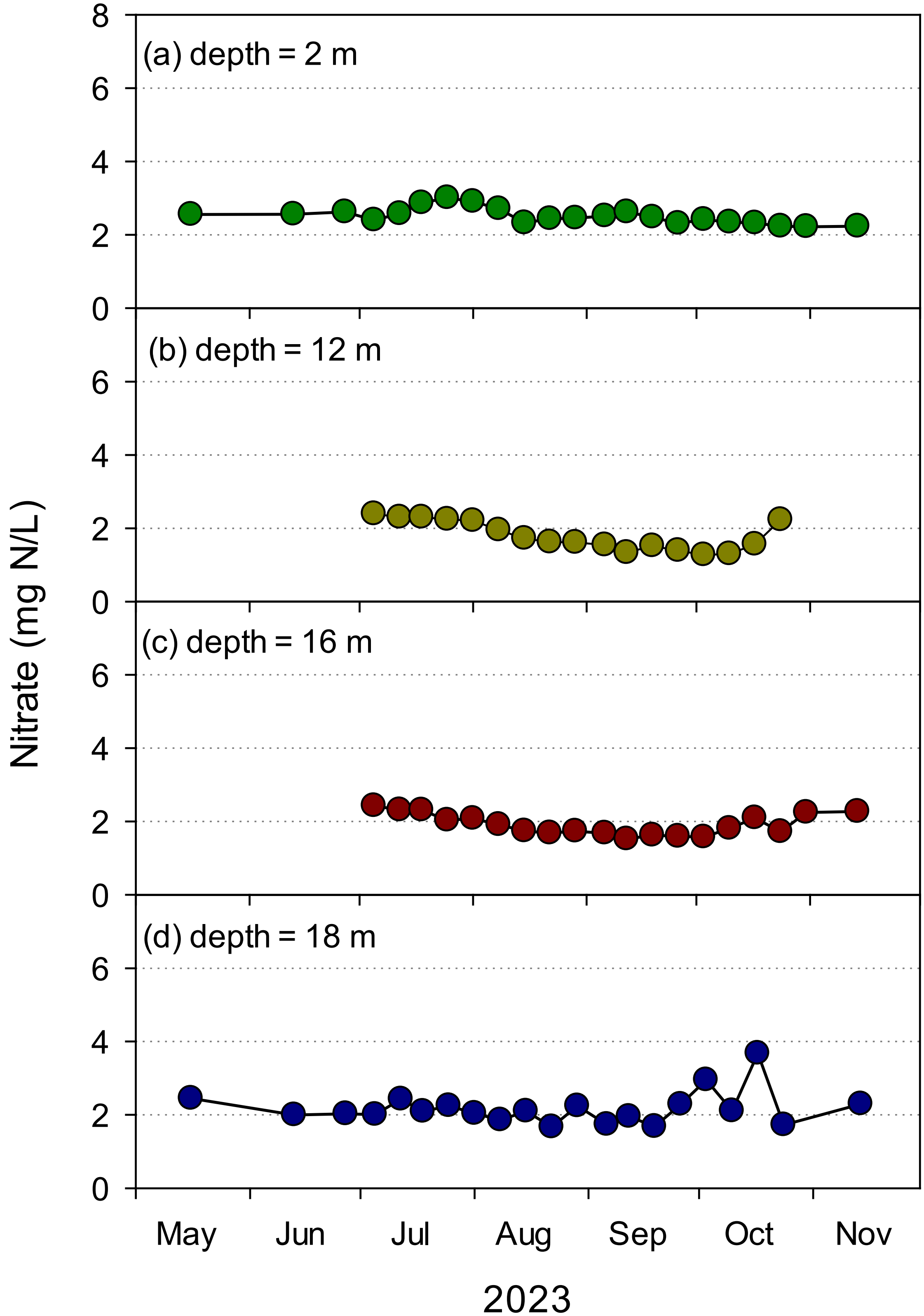


FIGURE 31

Honeywell

Onondaga Lake
Syracuse, New York

Laboratory Measurements of Nitrate at Onondaga Lake South Deep in 2023: (a) 2, (b) 12, (c) 16, and (d) 18-meter water depths

PARSONS
301 Plainfield Rd, Suite 350, Syracuse, NY, 13212, Phone 315-451-9560

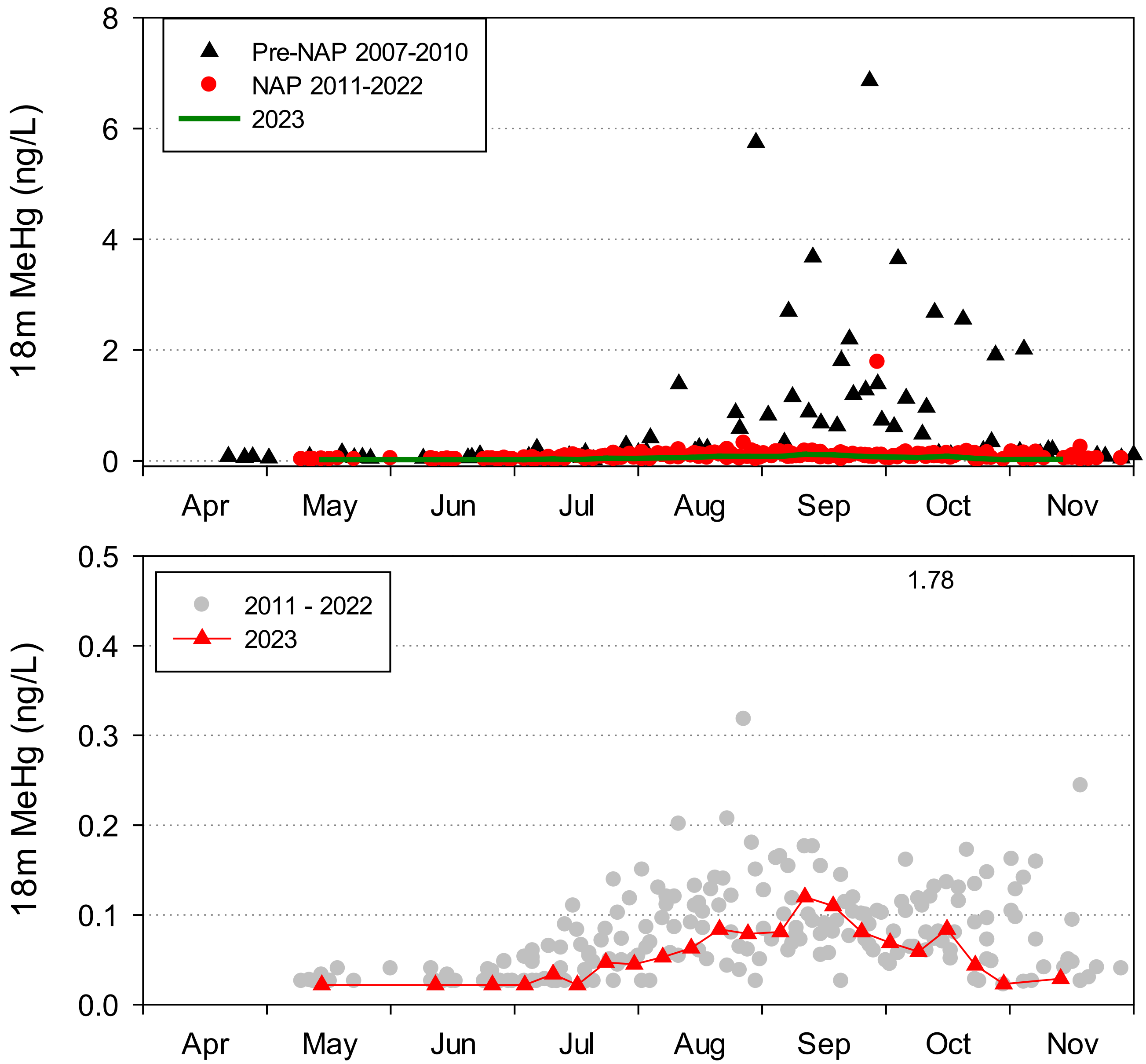


FIGURE 32

Honeywell

Onondaga Lake
Syracuse, New York

Time Series of Methylmercury Concentrations Measured at the 18-Meter Water Depth at the South Deep Location, 2007-2023

PARSONS

301 Plainfield Rd, Suite 350, Syracuse, NY, 13212, Phone 315-451-9560

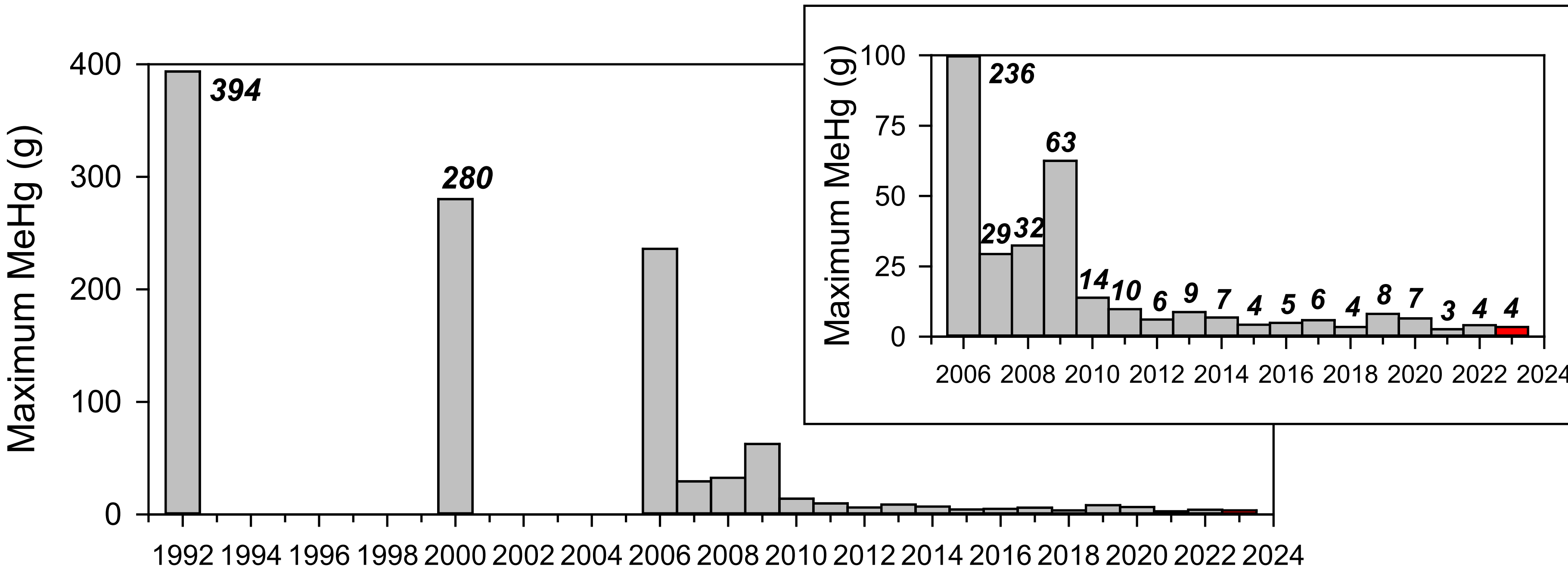


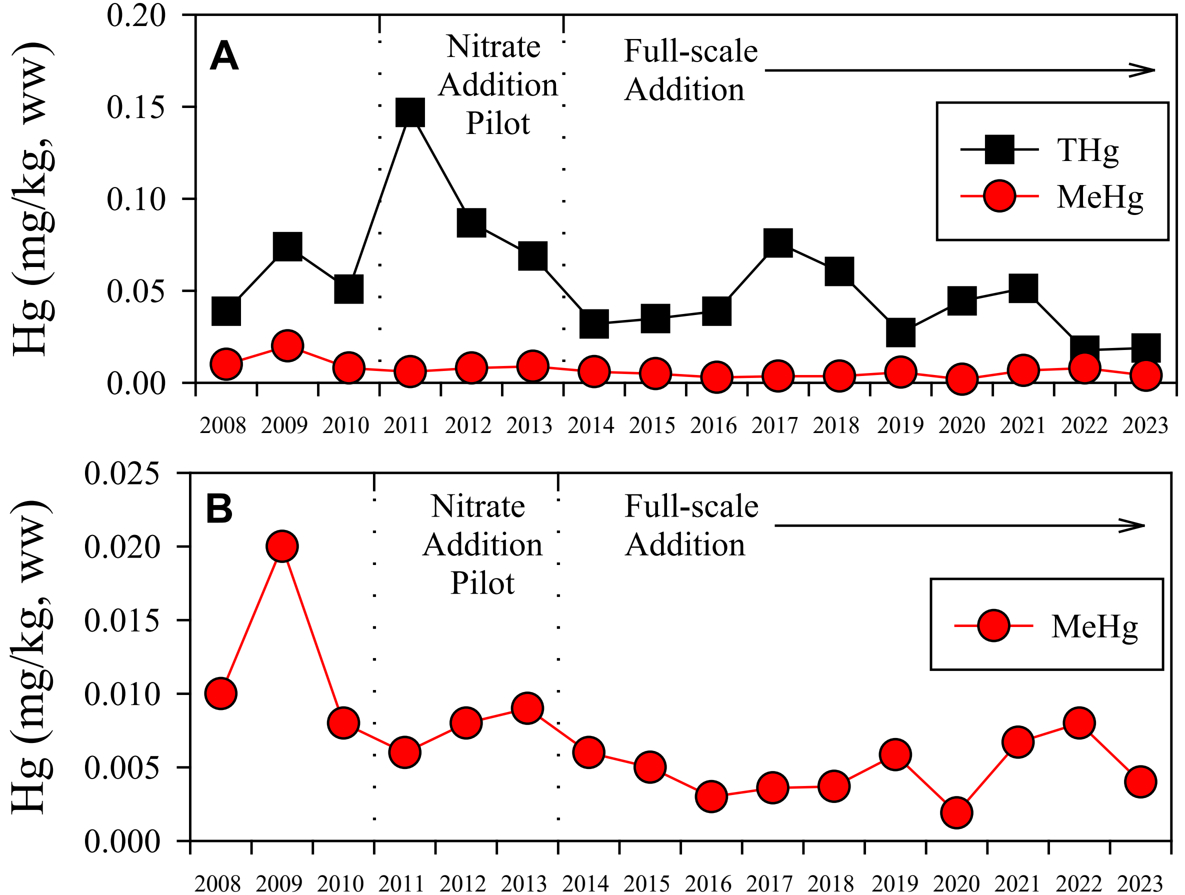
FIGURE 33

Honeywell

Onondaga Lake
Syracuse, New York

Annual Maximum Mass of Methylmercury in the Hypolimnion of Onondaga Lake from 1992 through 2023

PARSONS
301 Plainfield Rd, Suite 350, Syracuse, NY, 13212, Phone 315-451-9560



(A) total mercury and methylmercury concentrations and
(B) methylmercury concentrations presented with modified y-axis.

FIGURE 34

Honeywell

Onondaga Lake
Syracuse, New York

Annual Average Wet Weight Mercury Concentrations in Zooplankton (2008-2023)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

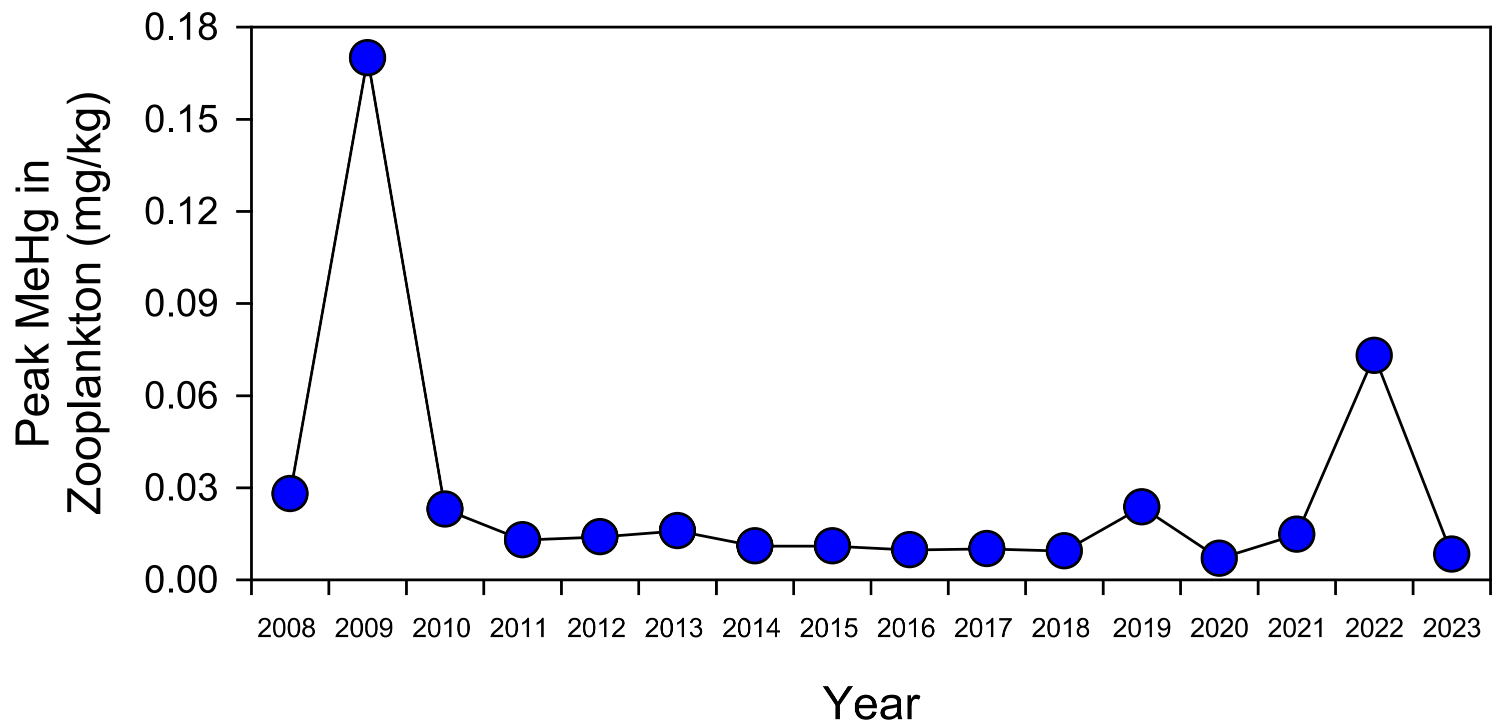


FIGURE 35

Honeywell

Onondaga Lake
Syracuse, New York

Annual Maximum Wet Weight Methylmercury Concentrations in Zooplankton (2008-2023)

PARSONS

301 PLAINFIELD ROAD, SUITE 350, SYRACUSE, NY 13212 PHONE: (315) 451-9560

Attachment 2 – Subsites Status

Onondaga Lake Site/Lake Bottom Subsite Third Five-Year Review

Status Update of Onondaga Lake Upland Operable Units/Subsites

The control of contamination migrating to Onondaga Lake from the various upland sites is an integral part of the overall cleanup of Onondaga Lake. To facilitate coordination of investigation and remedial activities, the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (EPA) have identified eleven subsites, as shown in Figure 1 of this attachment, which comprise the Onondaga Lake National Priorities List (NPL) site. These subsites are also considered to be operable units (OUs) of the NPL site by EPA, and actions at these subsites are being performed consistent with the Comprehensive Environmental Response, Compensation, and Liability Act requirements.

Remedial activities at the upland subsites have been or are being performed via various means (*e.g.*, as part of the remedy selected in a Record of Decision [ROD] for the upland area or as an interim remedial measure [IRM]). The status of the each of the upland OUs/subsites is discussed below.

LCP Bridge Street Subsite

The 20-acre LCP Bridge Street subsite, which was used for various industrial activities from 1953 to 1988, is located in Solvay, New York (Attachment 2, Figures 1 and 2). The chlor-alkali facility produced caustic soda (sodium hydroxide) and liquid chlorine using the mercury cell process, and, beginning in 1968, both the mercury cell and diaphragm cell processes were used. Between 1955 and 1969, hydrogen gas, generated as a by-product at the facility, was used to manufacture hydrogen peroxide. In 1979, the plant was sold to LCP Chemicals. LCP operated the plant until 1988, when manufacturing ceased. Various interim cleanup activities were performed prior to the ROD, including the removal of PCB-contaminated electrical equipment and mercury-contaminated equipment.

A ROD for this subsite was issued in 2000. Remedial construction, which commenced in 2004 and which was substantially completed in 2007, included removal of contaminated sediments from the West Flume, on-site ditches, and wetlands; restoration of wetlands; installation of a low-permeability cutoff wall; installation of an interim low-permeability cap; and capture of contaminated groundwater inside the cutoff wall. Some additional excavation work was performed at this subsite in 2011 and 2012. Remediation of the LCP Bridge Street subsite has controlled discharges of contaminants, mainly mercury, to the West Flume, some of which previously migrated to Onondaga Lake through Geddes Brook and Ninemile Creek. Construction of a final cap was completed in 2015. The subsite is undergoing long-term operation and maintenance (O&M). The fourth Five Year Review (FYR) for this subsite was completed in 2022.

Geddes Brook/Ninemile Creek Operable Unit of the Onondaga Lake Bottom Subsite

The Geddes Brook/Ninemile Creek system (Attachment 2, Figure 1) was impacted by dissolved and particulate loading from the LCP Bridge Street subsite and episodic loading that occurred when mercury-contaminated sediments in the creeks and floodplains were mobilized during high-flow periods. Analysis of surface water, sediment, and floodplain soils indicated that the West Flume was the main conduit of mercury contamination in the Ninemile Creek watershed.

Pursuant to a 2009 decision document issued by NYSDEC and EPA, and an Administrative Order on Consent (AOC) between NYSDEC and Honeywell, the principal potentially responsible party (PRP) for this and adjacent subsites, an IRM for the Geddes Brook portion of the site began in 2011 and was substantially completed in 2013. The IRM included the removal of approximately 102,400 cubic yards of contaminated sediments and floodplain soils/sediments over approximately 16 acres from Outfall 019, lower Geddes Brook, and the adjacent floodplain (Attachment 2, Figure 3).

NYSDEC/EPA issued two consecutive RODs addressing the Geddes Brook/Ninemile Creek operable unit of the Onondaga Lake Bottom subsite in 2009. The selected remedies included the dredging/excavation and removal of an estimated 120,000 cubic yards of contaminated channel sediments and floodplain soils/sediments in lower Ninemile Creek over approximately 30 acres. Pursuant to the RODs, remedial activities commenced in 2012 and were substantially completed in 2014.

Contaminated sediments and soils removed from Geddes Brook, Ninemile Creek, and the adjacent floodplains were placed at the LCP Bridge Street subsite containment system, which was designed and constructed pursuant to the requirements of the ROD for the LCP Bridge Street subsite. The subsite is undergoing long-term O&M. ICs need to be implemented before the remedy is considered complete. The second FYR for this subsite was completed in 2022.

Semet Residue Ponds Subsite

The Semet Residue Ponds subsite is in the Town of Geddes in an industrial area approximately 400 feet from the southern shore of Onondaga Lake (Attachment 2, Figure 1). It included five irregularly-shaped, man-made ponds used between 1917 and 1970 for the disposal of a tarry organic-based residue (Semet residue) generated by the acid washing of coke light oil during the production of benzene, toluene, naphthalene, xylene, and "motor benzol" at the Semet-Solvay Division of Allied Chemical & Dye Company's (a predecessor to Honeywell International, Inc.) BTX [Benzol] Plant and two small areas bordering the subsite that were built to contain leakage from the ponds.

Consistent with a 2002 ROD for the subsite and pursuant to an IRM stipulated in a 2002 AOC between Honeywell and New York State, construction of a 1,288-foot lakeshore barrier wall and groundwater collection system for the shallow and intermediate groundwater zones occurred between October 2006 and May 2007 (Attachment 2, Figure 4). The Semet Lakeshore barrier wall collection system has been operating since May 2007.

Consistent with the 2002 ROD and a 2004 AOC, potential groundwater impacts to an adjacent tributary, Tributary 5A, were mitigated using a shallow groundwater collection system constructed between 2010 and 2013. The construction of the groundwater collection system also necessitated sediment removal and liner installation along the length of the tributary, which mitigated the potential for contaminated sediment to migrate and re-contaminate the area of the Lake near the tributary. Groundwater collection system performance verification data obtained since its operation demonstrates hydraulic control of groundwater migrating to Tributary 5A. All groundwater collected by the Semet Lakeshore and Tributary 5A systems, and by the groundwater collection systems discussed below for the Willis Avenue, Wastebed B/Harbor Brook, and Wastebeds 1-8 subsites is conveyed to the nearby Willis Avenue Groundwater Treatment Plant (GWTP) where it is pretreated prior to its conveyance directly to Onondaga Lake or to the Onondaga County Metropolitan Wastewater Treatment facility (METRO) for additional treatment for ammonia. The effluent from METRO's wastewater treatment operations is discharged to Onondaga Lake.

In addition to achieving hydraulic control of contaminated groundwater at the subsite, the ROD remedy included excavation and reuse of the Semet residue material present in ponds constructed in the Solvay waste located on the subsite. The remedy specifically called for on-site processing of the Semet residue for use in the production of a soft tar product (RT-12). After the ROD was issued, it became necessary to re-evaluate remedial alternatives for the Semet residues due to a change in market conditions for RT-12. Treatability studies were performed to assess various remedial technologies. In 2017, an Explanation of Significant Difference (ESD) issued by NYSDEC and EPA modified the selected remedy to include the excavation of the Semet residue and off-site transport to a Resource Conservation and Recovery Act-permitted thermal processing facility for beneficial reuse. As part of a pilot demonstration program, which commenced in 2014, and consistent with the ESD, the tar material was excavated and transported off-site to thermal processing facilities (cement kilns) for beneficial reuse. By the end of 2019, all of the Semet residue that could be used at the off-site facilities had been removed from the subsite.

A second ROD for the Semet Residue Ponds subsite was issued by NYSDEC and EPA in 2019 to address the areas beneath the tar ponds and in other areas of the subsite. The selected remedy included in-situ treatment of any Semet residue remaining at the site that could not be beneficially reused consistent with the ESD, installation of an enhanced engineered cover system including an impermeable geomembrane cap and 18-inch clean soil cover over the former ponds and other Semet residue areas, and installation of a minimum one-foot soil cover in other areas of the site where soil concentrations were above commercial use soil cleanup objectives (SCOs) (Attachment 2, Figure 5). The targeted in-situ treatment of the residual Semet residue has been implemented and the pond areas have been backfilled. The site cover was completed in 2021, and portions of the subsite are currently used to provide additional parking areas for the New York State Fair. ICs need to be implemented before the remedy is considered complete. The third FYR was completed in 2025 for this subsite.

<u>Willis Avenue Subsite</u>

The Willis Avenue subsite is a former chlor-alkali and chlorinated benzene plant located at the corner of Willis Avenue and State Fair Boulevard in Geddes, New York (Attachment 2, Figure 1). Plant operations, including loading and unloading of material took place near the plant as well as on the lakeshore. The chlor-alkali plant operated from 1918 until 1977, producing chlorine and other chemicals and utilized both diaphragm and mercury cells for chlorine production. Chlorinated benzenes were also produced at this facility between 1918 and 1977. Operations also resulted in impacts to two smaller areas, the Chlorobenzene Hot-Spot Area and the Petroleum Storage Area, located to the south of the Willis Plant Area. The Willis Avenue subsite was a significant source of mercury and chlorinated compounds to Onondaga Lake through groundwater and surface runoff via the East Flume. The construction of the lakeshore barrier wall/collection system and East Flume IRM activities have mitigated this discharge.

Pursuant to the 2002 AOC noted in the discussion above for the Semet Residue Ponds subsite, construction of 1,612 linear feet of barrier wall and groundwater collection system for the shallow and intermediate groundwater zones occurred between 2008 and 2009 (Attachment 2, Figure 6). Subsequent to this work and the initiation of the construction of the collection system, a tie-back anchorage system to mitigate deflection of the barrier wall in areas with deep water present outboard of the wall was completed in 2012. The hydraulic containment system is meeting the design goals (*i.e.*, groundwater levels are below Onondaga Lake level, indicating that hydraulic capture and an inward hydraulic gradient are being achieved). On occasion, groundwater levels have been recorded above lake levels, however, these conditions typically occurred during high lake levels over short periods of time and are not indicative of overall system performance. Also, under this IRM, remediation was implemented to address groundwater influences on the eastern and western storm drain systems related to Interstate Route I-690 (I-690) downgradient of the Willis Avenue and Semet Ponds Subsites. To date, measures implemented in the storm drain systems in four separate phases have mitigated potential impacts to Onondaga Lake.

An IRM was also implemented to address chlorobenzene dense non-aqueous-phase liquid (DNAPL) contamination along the Lakeshore. The system was initiated in 1993 and expanded in 1995 and 2002 to include additional collection wells. In 2012, the system was again expanded, and the system further upgraded and optimized. The DNAPL collection system was shut down between 2017 and 2019 for system optimization, well redevelopment, and implementation of additional modifications. The modifications included relocation of existing DNAPL recovery system facilities and utilities from the DNAPL storage building to the Groundwater Pump Station and Willis Avenue GWTP, demolition of the storage building, repair and maintenance of existing recovery well vault facilities and electrical structures, and decommissioning of eight existing DNAPL wells that demonstrated little or no production.

A ROD for the Willis Avenue subsite was issued by NYSDEC and EPA in 2019. The remedy included the installation of a one-foot thick cover system, in-situ treatment and/or excavation of mercury hot spots associated with the floor trenches in the Former Mercury Cell Building, installation of a vertical barrier hydraulic containment system to isolate contaminated shallow and intermediate groundwater in the vicinity of the Former Mercury Cell Building, evaluation and recovery/treatment of separate phase liquids (if present), continued operation and maintenance related to IRMs that have been implemented at the Subsite, and monitored natural attenuation of shallow/intermediate groundwater at the Waste Management Area point of compliance (POC) for the Willis Avenue subsite and the POC for the adjacent Semet Residue Ponds subsite (Attachment 2, Figure 7). A 95% Remedial Design Report (RDR) and Remedial Design / Remedial Action Work Plan (RD/RA WP) have been approved for the site cover portion of the selected remedy and the cover work was completed in September 2025. A treatability study related to In-Situ Stabilization (ISS) of mercury hot spots has been completed, a Summary Report approved; and the ISS work was completed in August of 2025. IC's need to be implemented before the remedy is considered complete.

Wastebed B/Harbor Brook Subsite

The 90-acre subsite is located to the north and south of I-690 in the City of Syracuse and Town of Geddes, Onondaga County (Attachment 2, Figure 1). The subsite includes three main areas: Lakeshore Area (which includes Wastebed B), Penn-Can Property, and Railroad Area (Attachment 2, Figure 8). Wastebed B is a former Solvay wastebed, which received Solvay waste between approximately 1898 and 1926. Wastebed B covers approximately 54 acres and was engineered to receive waste by construction of a bulkhead into Onondaga Lake. The Penn-Can Property was historically used for the production and storage of asphalt products. The Railroad Area is situated to the south of the Penn-Can Property and is bounded to the north, south and east by railroad tracks. Two additional areas of study (AOS #1 and AOS #2) located east of Harbor Brook were also included in the investigations/studies conducted for the subsite.

Pursuant to an IRM stipulated in a 2003 AOC between Honeywell and New York State, construction associated with a 4,656 linear ft barrier wall and groundwater collection system along the Onondaga Lake shoreline of Wastebed B, a separate groundwater collection system upstream along the west bank of Harbor Brook, and realignment and replacement of a culvert in the lower reach of Harbor Brook were conducted from 2009 to 2012 (Attachment 2, Figure 9).

The Wastebed B/Harbor Brook Lakeshore barrier wall collection system has been operating since 2012. The hydraulic containment system is meeting design goals (*i.e.*, groundwater levels are below lake level, indicating that hydraulic capture and an inward hydraulic gradient are achieved). On occasion, groundwater levels have been above Onondaga Lake levels, however, these conditions typically occurred over short periods of time during high lake levels and are not indicative of overall system performance.

Potential groundwater impacts to Upper Harbor Brook were mitigated via the operation of a groundwater collection system for shallow groundwater constructed in 2012 and 2013. This work also included sediment removal, isolation layer installation, sealing of leaks in the culverts, and ditch/stream/wetland restoration. Consistent with the design goals, groundwater elevations in Upper Harbor Brook collection trenches have been maintained below the surface water elevation in Harbor Brook since 2014.

Consistent with a 2012 decision document issued by NYSDEC and EPA, and an AOC between Honeywell and New York State, an IRM for a 16-acre strip of land that lies in the outboard area between the Wastebed B/Harbor Brook Lakeshore barrier walls and Onondaga Lake (including the mouth of Harbor Brook and areas of wetlands along the shoreline) commenced in 2013 (Attachment 2, Figures 9 and 10) in conjunction with the Onondaga Lake remediation. The Outboard Area IRM included excavation and/or dredging of approximately 200,000 cubic yards of contaminated soil and sediment located between the Wastebed B/Harbor Brook barrier walls and Onondaga Lake. With the completion of the soil/sediment removal, an isolation cap was installed to physically isolate the contaminated soil/sediment from the environment. The Outboard

Area has been restored and enhanced as a wetland habitat including a pike spawning wetland in a portion of the Outboard Area in the vicinity of the mouth of Harbor Brook.

Discharges of storm water from upstream areas to the East Flume via conveyance and sewer pipes have been addressed under an IRM pursuant to a 2002 AOC between Honeywell and NYSDEC. The Upper East Flume was filled in during the installation of the Lakeshore barrier wall and groundwater collection systems. The Lower East Flume was addressed under the Wastebed B/Harbor Brook Outboard Area IRM.

A ROD for the Wastebed B/Harbor Brook Subsite was issued by NYSDEC and EPA in 2018. The selected remedy included the installation of vegetated soil covers or a soil/granular cover (or maintained paved surfaces and buildings), construction/restoration of an approximately 1-acre wetland (including the installation of a low permeability liner system beyond the wetland footprint within an area of impacted soil/fill material), in situ stabilization in the Penn Can Area where surficial tar material was present, and continued operation and maintenance associated with the IRMs that have been implemented at the subsite (Attachment 2, Figure 10). Remedy construction was implemented in 2020 and 2021. Operation and maintenance of the IRMs and long-term maintenance activities are ongoing.

A wetland area, designated SYW-12 (Attachment 2, Figures 1 and 8 for location), is also part of the Wastebed B/Harbor Brook Subsite but is being addressed under a separate OU. A ROD for SYW-12 was issued by NYSDEC and EPA in 2023. The selected remedy (Figure 11) includes placement of a two-foot-thick soil cover and restoration of select non-forested wetland and upland areas of the Site; periodic groundwater and biota monitoring to evaluate remedy effectiveness and assess protectiveness for ecological receptors; and ICs in the form of environmental easements and/or restrictive covenants to limit land use to commercial (including passive recreational), as appropriate, prevent the use of groundwater without approved treatment, and require that any intrusive activities on the Subsite be conducted in accordance with an approved site management plan. Remedial Design is pending. PRP negotiations are currently underway.

Wastebeds 1-8 Subsite

Wastebeds 1-8 is a 404-acre site that includes eight irregularly shaped wastebeds that extend roughly 1.5 miles along the southwest side of Onondaga Lake (Attachment 2, Figure 1) that were used for Solvay Process waste disposal from 1926 until 1944. The underlying groundwater is primarily contaminated with benzene, toluene, ethylbenzene, and xylenes (BTEX).

Pursuant to a 2011 decision document issued by NYSDEC and EPA and an AOC between Honeywell and NYSDEC, an IRM commenced in 2011 and was completed in 2016. The IRM included the collection and treatment of groundwater and seeps along Ninemile Creek and the shoreline of Onondaga Lake, the placement of a vegetative cover over a 14.4-acre area along the eastern lakeshore, sediment removal from the lower reach of Ditch A, a surface water drainage ditch, rehabilitation of water conveyance pipes at the upper reach of Ditch A, and stabilization of the lakeshore soils. Additional components incorporated into the IRM included mitigation wetlands, and installation of a shallow groundwater, geosynthetic lining systems, and seep aprons in the middle and lower reaches of Ditch A (Attachment 2, Figures 12 and 13). The IRM was designed to prevent the continued migration of contaminants into Ninemile Creek and Onondaga

Lake and reduce groundwater upwelling velocities that may impact the isolation cap placed in Onondaga Lake Sediment Management Unit 4. The eastern shoreline, northern shoreline, and Ditch A control systems are undergoing performance verification with oversight by and ongoing coordination with NYSDEC.

A ROD which addresses the OU1 portion of the Wastebeds 1-8 subsite and includes Solvay waste and contaminated soil/fill materials was issued in 2014. The selected remedy included various cover systems depending on site use.

Design and construction of the Lakeview Amphitheater and related buildings, sidewalks, cover systems, retention basins, and other surface and subsurface features were implemented in 2015 consistent with the OU1 remedy.

The soil cover portion of the remedy was implemented in five phases because of cover material availability, material placement productivity rates, planting seasons for the optimal establishment of vegetation enhancements, and site usage (Attachment 2, Figure 13). Between 2015 and 2019 (phases 1, 2, and 3), approximately 52 acres of vegetative enhancement cover, nine acres of one-foot vegetative structural fill cover (subsequently paved over as part of the Orange Parking Lot), and five acres of one-foot vegetative cover were placed on the subsite. Since then, approximately 49 acres of cover material was placed (field modification 4 to phase 3, phase 4, and phase 5). approximately two acres of one-foot-thick vegetated soil cover (passive recreational areas), 12 acres of two-foot-thick vegetated soil cover (ecological resource areas), 30 acres of vegetation enhancement cover, and five acres of one-foot-thick stone cover. ICs need to be implemented before the OU1 remedy is considered complete.

An FS for the OU2 portion of the Wastebeds 1-8 subsite, which will consider additional measures to address impacted shallow, intermediate, and deep groundwater, is in progress. The second FYR for this subsite was completed in 2025.

Niagara Mohawk-Hiawatha Boulevard-Syracuse Former Manufactured Gas Plant (MGP) Subsite

The 20-acre Niagara Mohawk–Hiawatha Boulevard manufactured gas plant (MGP) subsite is located south of the Barge Canal on West Hiawatha Boulevard, and borders Onondaga Lake and Onondaga Creek (Attachment 2, Figures 1 and 14). The Barge Canal is part of Onondaga Creek. The MGP operated from 1925 to 1958. In the mid-1970s, a 16-acre parcel of the area of concern was used in the expansion of METRO. The remaining four acres were acquired by Onondaga County for the recent expansion of METRO. The MGP used coal from 1925 to 1947 and partially switched to a carbureted water gas process in 1941. Wastes associated with the MGP include clinker waste containing heavy metals; coal tar, which contains PAHs, BTEX, and phenols; oil sludge; and purifier waste, which contains cyanides.

NYSDEC and National Grid/Niagara Mohawk entered into multi-site consent orders in 1992 and 2003 obligating it to investigate and remediate 21 former MGP sites across the State, including this subsite.

Under an IRM conducted in 2001 and 2002 to support the construction of an ammonia removal/phase 2 phosphorus treatment facility associated with METRO, approximately 73,000 cubic yards of impacted soil in the construction zone were removed and disposed of at permitted solid waste disposal facilities. Soils were excavated to a depth of approximately 15 feet throughout the footprint and to a depth of approximately 20 feet in an area where stained soils and non-aqueous phase liquid lenses and globules were observed in deeper soil samples (Attachment 2, Figure 14).

A ROD for the Niagara Mohawk–Hiawatha Boulevard Former MGP subsite was issued in 2010. The selected remedy called for in-situ solidification (ISS) of contaminated soil in the northeastern portion of the subsite and treatment of groundwater along the northern perimeter of the subsite using enhanced bioremediation. The ISS portion of the remedy was completed in 2014. A pilot study for enhanced bioremediation of groundwater was completed and the remedial design was finalized in 2018. Construction of the groundwater enhanced bioremediation component of the remedy was completed in 2018. The site is under long term O&M, which includes annual groundwater sampling. The SMP and will likely be finalized in 2026 when the environmental easement is issued. The second FYR for this subsite was completed in 2022.

<u>General Motors–Inland Fisher Guide Subsite</u>

The GM-IFG subsite includes two OUs. OU1 covers the former GM Syracuse plant property (located south of Ley Creek on Town Line Road in the Town of Salina) and the groundwater beneath and emanating from the former plant property and OU2 addresses the floodplains and sediments downstream of the plant property (see below and Attachment 2, Figures 1 ,15, and 16). The facility began operating in 1952, initially as a plating facility and later for the manufacture of plastic automotive components. Some of the wastes from the plant were discharged to Ley Creek. Manufacturing operations at the facility ceased in 1993.

Between 2002 and 2004, three large-scale IRMs were performed on the plant property pursuant to AOCs between GM, the principal PRP for this subsite and some adjacent subsites, and NYSDEC to mitigate contaminant migration from the subsite to Ley Creek; the Former Landfill IRM, the Former Drainage Swale IRM and the State Pollutant Discharge Elimination System (SPDES) Treatment System IRM. Under the Former Landfill IRM, hot spots in an on-site industrial landfill containing chromium- and PCB-contaminated materials were excavated and the landfill was capped to prevent contaminants from leaching into the groundwater. The Former Drainage Swale IRM involved the removal of more than 26,000 tons of PCB-contaminated soil from a former discharge swale that was used in the 1950s and 1960s as a conduit for the discharge of liquid process waste to Ley Creek. The SPDES Treatment System IRM included the construction of a retention pond and associated water treatment system to collect all water that accumulates on the GM-Inland Fisher Guide property in any of the storm sewers or abandoned process sewers. The pond water is then sent through the treatment plant to meet permitted discharge limits prior to discharge to Ley Creek. The IRM was designed to stop the intermittent discharge of PCBs and other contaminants that occurred during storm events.

NYSDEC and EPA issued a ROD for OU1 of the GM-Inland Fisher Guide subsite in 2023. The selected remedy includes in-situ treatment of residual source areas; perimeter deep groundwater extraction with treatment at the existing treatment plant; soil excavation and disposal with restoration to existing grade; an evaluation of the existing sub slab depressurization system for potential upgrade to a soil vapor extraction system; development of a site management plan; implementation of institutional controls; and long-term operation and maintenance for the above-noted remedy components and previously implemented IRMs (Attachment 2, Figure 15) The OU1 remedial design is currently underway.

Ley Creek Deferred Media

OU2 of the GM-Inland Fisher Guide subsite (Attachment 2, Figure 1 and 17), also known as Ley Creek Deferred Media (LCDM), includes Ley Creek channel sediments; surface water; and floodplain soils/sediments in the reach from Townline Road to the Route 11 Bridge. LCDM also includes an adjacent wetland and roadway shoulders near the facility and on the northern side of Factory Avenue in the vicinity of LeMoyne Avenue. A remedy for LCDM, which includes excavating approximately 25,000 cubic yards of PCB-contaminated sediment and soil from impacted media, was documented in a ROD issued in March 2015. Excavation and offsite disposal of PCB-contaminated soil from residential properties (located adjacent to the creek) was conducted in 2016 and remediation of the Factory Avenue and National Grid Wetland soils was conducted in 2018. In 2009, GM filed for bankruptcy and in 2011, administration of the remedial activities at the Subsite was taken over by the RACER Trust (RACER). RACER performed pre-RD investigation activities at LCDM, which resulted in the identification of expanded areas of soil contamination along upper Ley Creek. An ESD was issued by EPA and NYSDEC in September 2022 to modify the soil remedy to include excavation and off-site disposal of floodplain soils and reflect increased soil volumes and associated remedial costs, consistent with current and reasonably anticipated future land use. The 2022 ESD did not address a 13.9-acre Forested Area because an alternative in-situ remedial approach was being evaluated for this area at that time. That evaluation was completed, and an ESD for the Forested Area documenting the decision to maintain the remedy selected in the ROD for the Forested Area was issued in April 2023. The estimated volume of contaminated soils requiring excavation and off-site disposal for LCDM increased significantly from an estimate of approximately 15,000 to 144,000 cubic yards.

The major components of the selected remedy in the 2015 ROD, as modified by the 2022 and 2023 ESDs, include excavating, disposing of and backfilling about 144,000 cubic yards of contaminated soil from the floodplains, and excavating and disposing of about 9,600 cubic yards of contaminated sediment from the bottom of Ley Creek. It is anticipated that construction will begin in 2027.

Lower Ley Creek Subsite

The Lower Ley Creek subsite consists of sediments and floodplain soils located along the lower two miles of Ley Creek beginning at and including the Route 11 bridge and ending downstream at Onondaga Lake, as well as the sediments and floodplain soils associated with the "Old Ley Creek Channel" (Attachment 2, Figure 1, Figure 17).

A ROD for this subsite was issued in September 2014. The selected remedy includes excavation and capping of contaminated soil and excavation of contaminated sediment in Lower Ley Creek and disposal of the excavated soil and sediment. The remedial design is in progress. A remedial action order is currently being negotiated with the PRP group.

Ley Creek PCB Dredgings Subsite

The Ley Creek PCB Dredgings subsite includes areas along the banks of Ley Creek where PCB-contaminated dredge spoils removed from the creek were placed (Attachment 2, Figures 1 and 15). A ROD for this subsite was issued in 1997 and remedial construction activities were completed in 2001. The ROD remedy included the consolidation and covering of PCB-contaminated dredge spoils along a portion of Ley Creek. Approximately 8,400 cubic yards of PCB-contaminated material above 50 mg/kg was excavated and disposed of off-site. The subsite is undergoing long-term maintenance and monitoring. Groundwater at this subsite is being addressed under GM-Inland Fisher Guide OU1. The fourth FYR for this subsite was conducted in 2022.

Town of Salina Landfill Subsite

The 55-acre Town of Salina Landfill is located in the Town of Salina, New York (Attachment 2, Figures 1 and 18). Because of flooding events, in 1970, the adjacent Ley Creek was widened, deepened, and rerouted through the Town of Salina Landfill, splitting the landfill into a 50-acre main landfill north of Ley Creek and a five-acre landfill south of Ley Creek.

In 1997, the Town of Salina entered into an AOC with NYSDEC to perform investigatory and remediation work at the subsite.

The Town of Salina Landfill subsite ROD was issued in 2007. The selected remedy included capping the landfills north and south of Ley Creek, with leachate collection and treatment. In 2010, NYSDEC and EPA executed a ROD amendment calling for the excavation and consolidation of municipal waste from the five-acre landfill onto the main landfill. Construction of all components of the remedy was completed in 2015. The subsite is undergoing long-term O&M. The second FYR for this subsite was completed in 2020.

Onondaga Lake Third Five Year Review

Attachment 2

Figures

Figure 1: Onondaga Lake Subsites

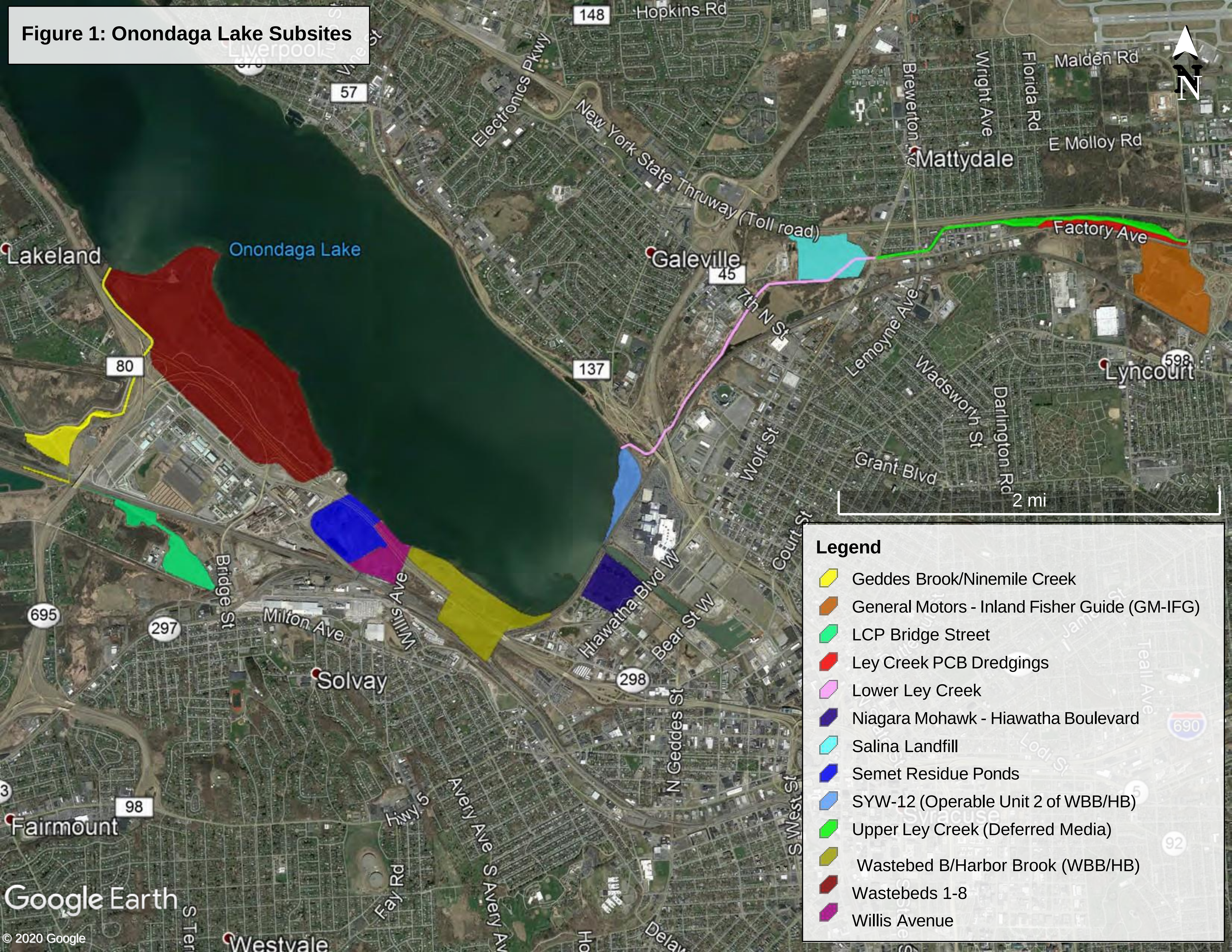
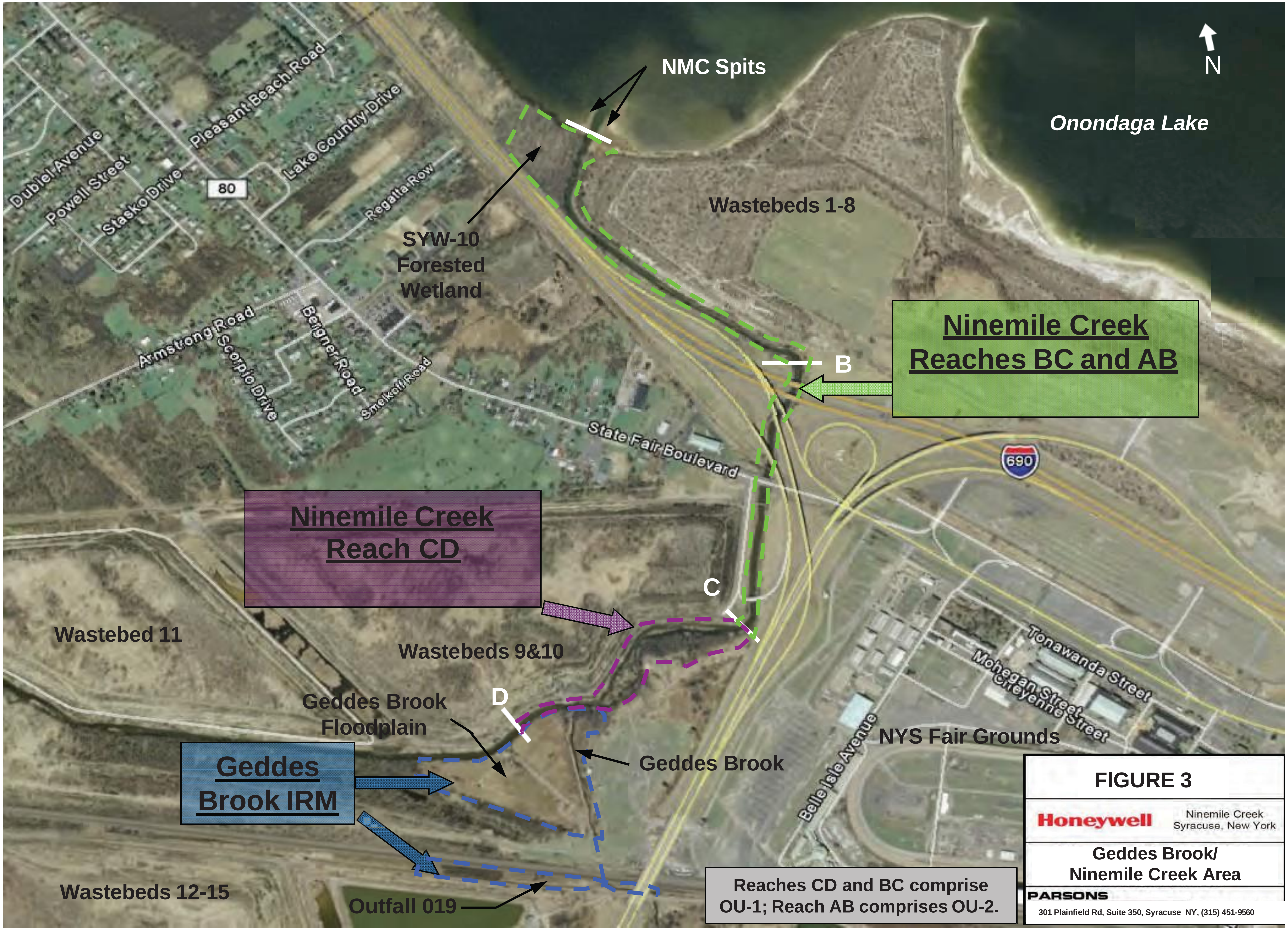


Figure 2: LCP Site Plan



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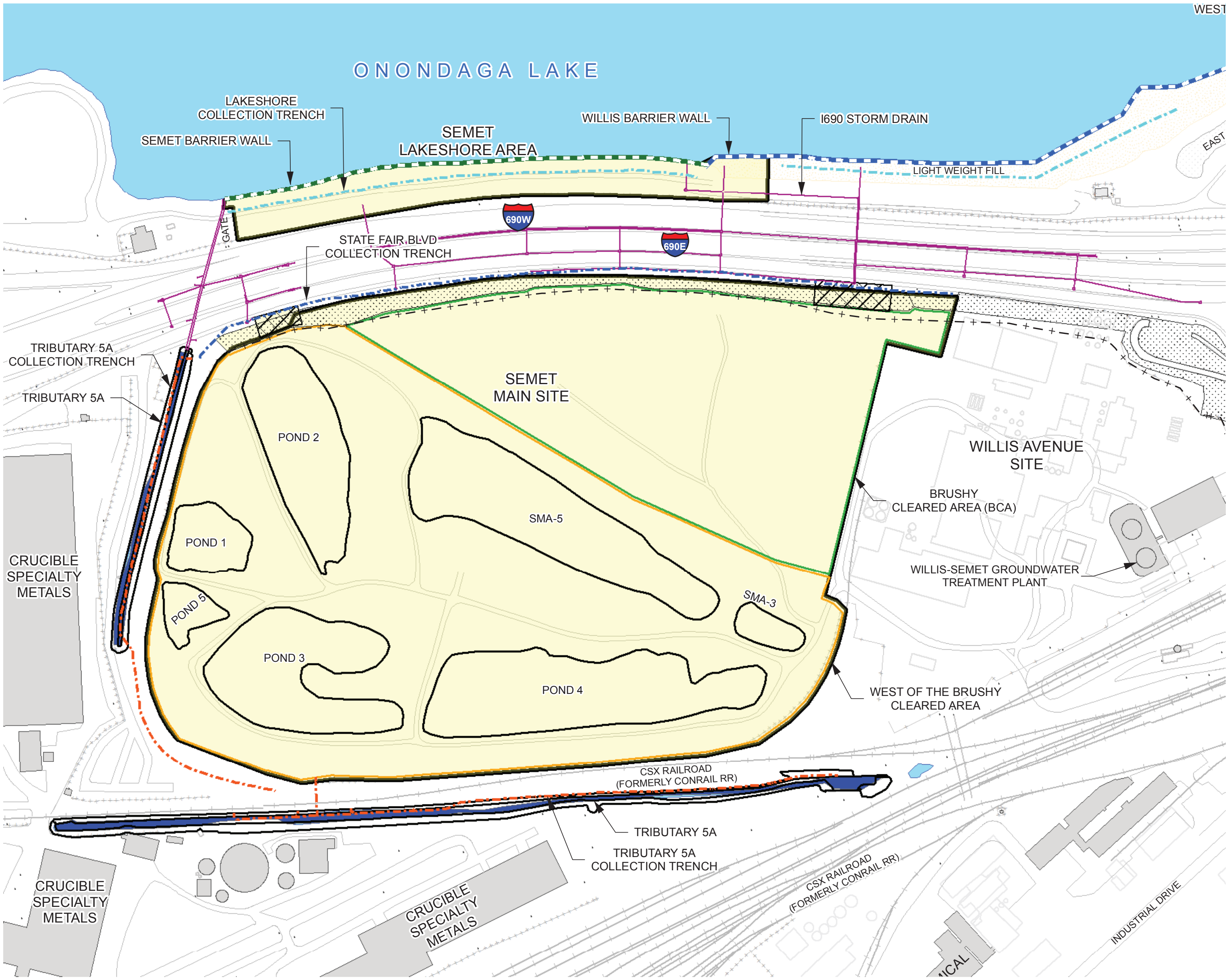
Onondaga Lake
NMC Spits
Wastebeds 1-8
SYW-10
Forested
Wetland
Pleasant Beach Road
Lake Country Drive
Dubiel Avenue
Powell Street
Stasko Drive
80
Regatta Row
Armstrong Road
Scorpio Drive
Bergner Road
Smelkoff Road
State Fair Boulevard
Ninemile Creek
Reaches BC and AB
B
690
Ninemile Creek
Reach CD
C
Wastebed 11
Wastebeds 9&10
Geddes Brook
Floodplain
D
Geddes Brook
Geddes
Brook IRM
Tonawanda Street
Mohegan Street
Cheyenne Street
NYS Fair Grounds
Belle Isle Avenue
Wastebeds 12-15
Outfall 019
Reaches CD and BC comprise
OU-1; Reach AB comprises OU-2.
FIGURE 3
Honeywell
Ninemile Creek
Syracuse, New York
Geddes Brook/
Ninemile Creek Area
PARSONS
301 Plainfield Rd, Suite 350, Syracuse NY, (315) 451-9560

FIGURE 4



N

LEGEND

SEMET RESIDUE PONDS SITE

INTERIM REMEDIAL MEASURES

WILLIS - SEMET HYDRAULIC CONTAINMENT SYSTEM

LAKESHORE COLLECTION TRENCH

SEMET BARRIER WALL

WILLIS BARRIER WALL

I-690 STORM DRAINAGE SYSTEM INVESTIGATION AND REHABILITATION IRM

I-690 STORM DRAIN

STATE FAIR COLLECTION TRENCH

WILLIS - SEMET BERM SITE IMPROVEMENTS PROJECT

BALLFIELD / WILLIS / SEMET BERM AREA

SOIL REMOVAL AREA

OU1 REMEDY

SEMET RESIDUE REMOVAL

FORMER POND AREAS - OU1

SEMET PONDS SHALLOW GROUNDWATER REMEDIAL ACTION (TRIBUTARY 5A)

TRIBUTARY 5A SEDIMENT REMOVAL

TRIBUTARY 5A COLLECTION TRENCH

SEMET RESIDUE PONDS

GEDDES, NEW YORK

SEMET RESIDUE PONDS INTERIM REMEDIAL MEASURES AND REMEDIAL ACTIONS

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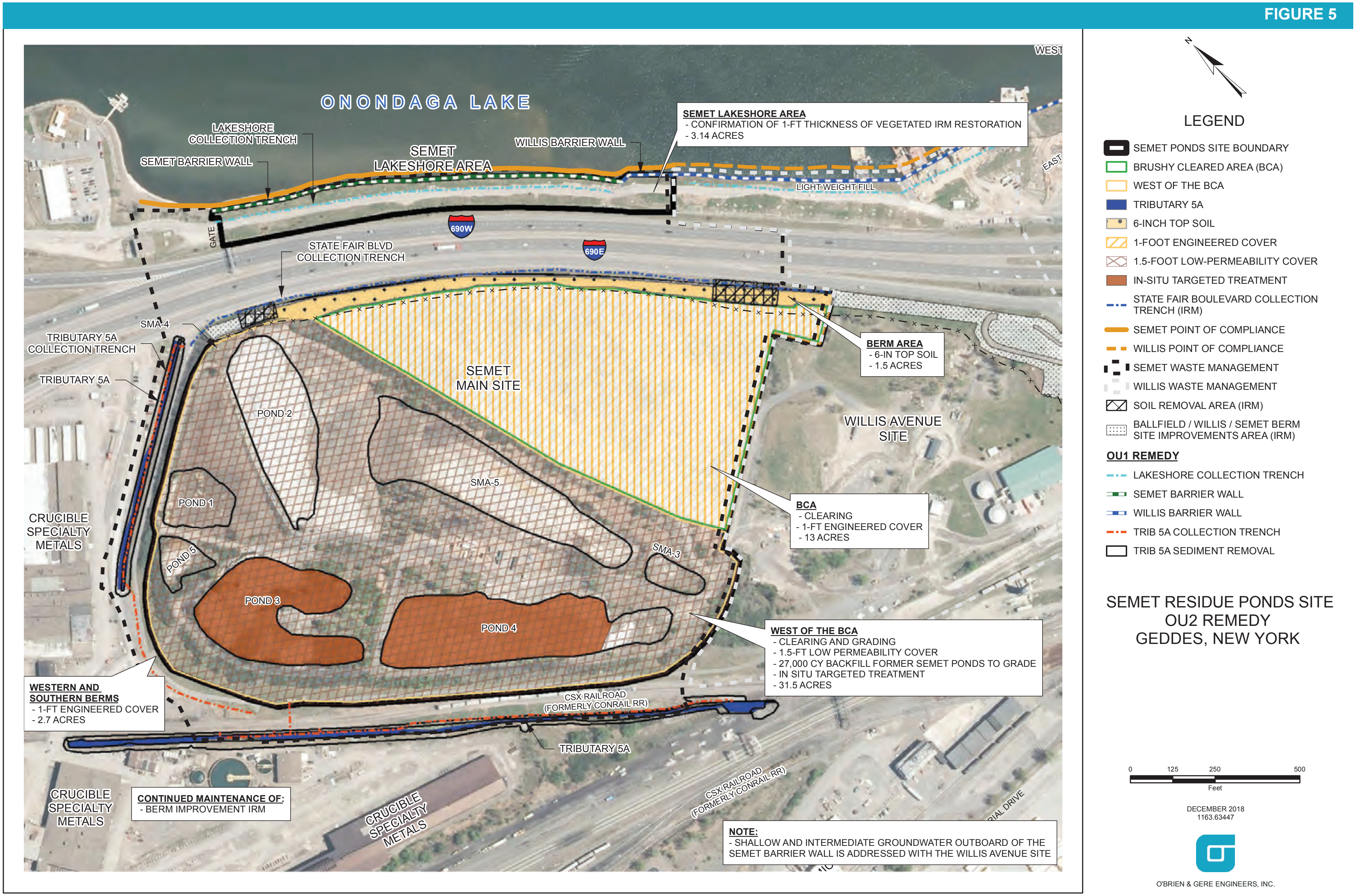

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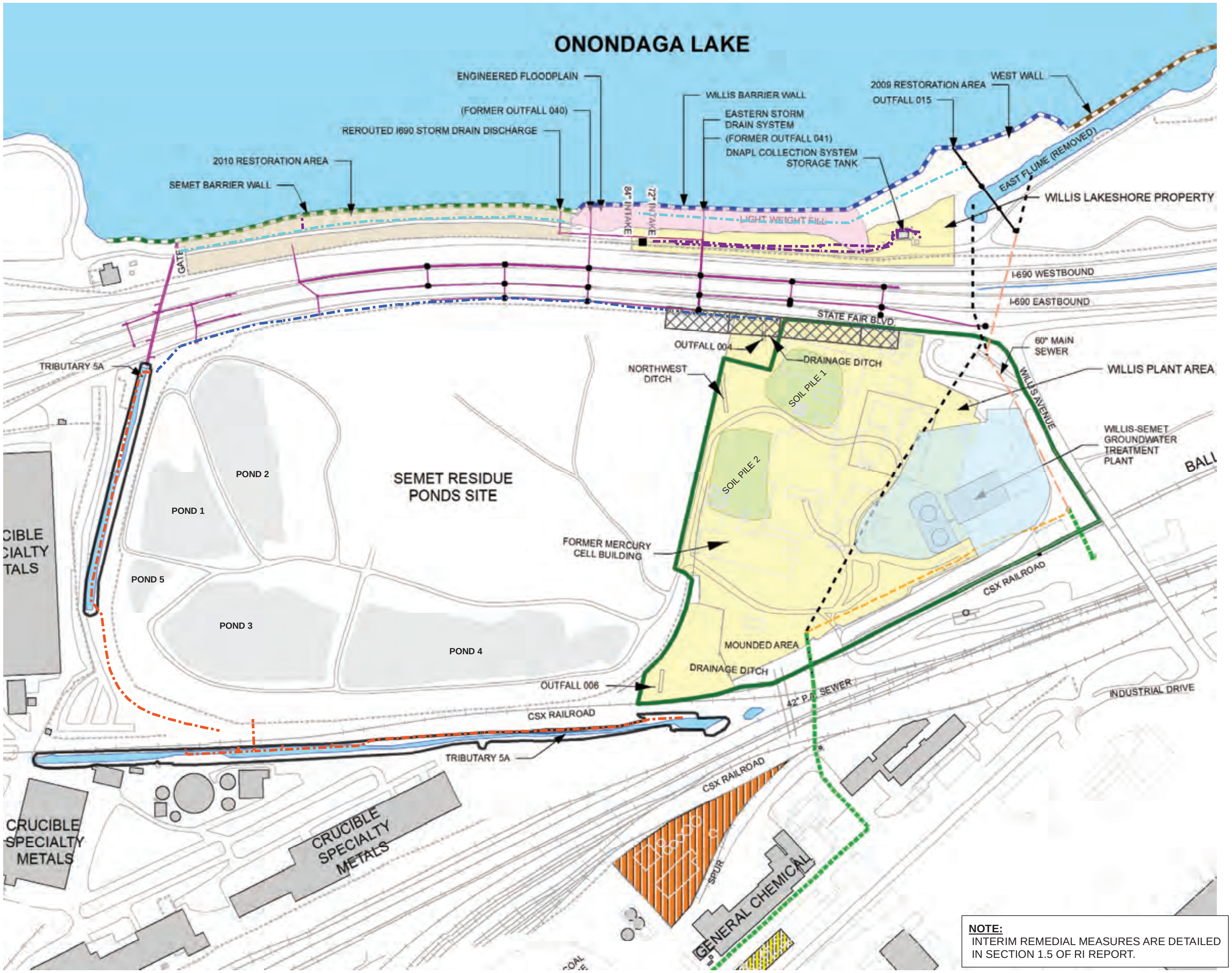

N

LEGEND

- LAKESHORE COLLECTION TRENCH
- STATE FAIR COLLECTION TRENCH
- TRIB 5A COLLECTION TRENCH AND CAP
- DNAPL RECOVERY SYSTEM
- SLIP LINED PIPE
- 24" HDPE FORCE MAIN
- EXISTING SEWER PIPE
- NEW 48" STEEL PIPE
- ABANDONED PA SEWER PIPE
- WILLIS-SEMET BERM SITE IMPROVEMENTS
- TRIB 5A SEDIMENT REMOVAL
- WILLIS-SEMET GROUNDWATER TREATMENT PLANT FOOTPRINT
- WILLIS AVENUE PLANT BOUNDARY

EXISTING IRM COVER

- ENGINEERED FLOODPLAIN
- 2009 RESTORATION AREA
- 2010 RESTORATION AREA

STUDY AREA

- WILLIS PLANT AREA
- PETROLEUM STORAGE AREA
- CHLOROBENZENE HOT-SPOTS AREA
- TRIBUTARY 5A

WILLIS AVENUE SUBSITE

INTERIM REMEDIAL MEASURES AND REMEDIAL ACTIONS

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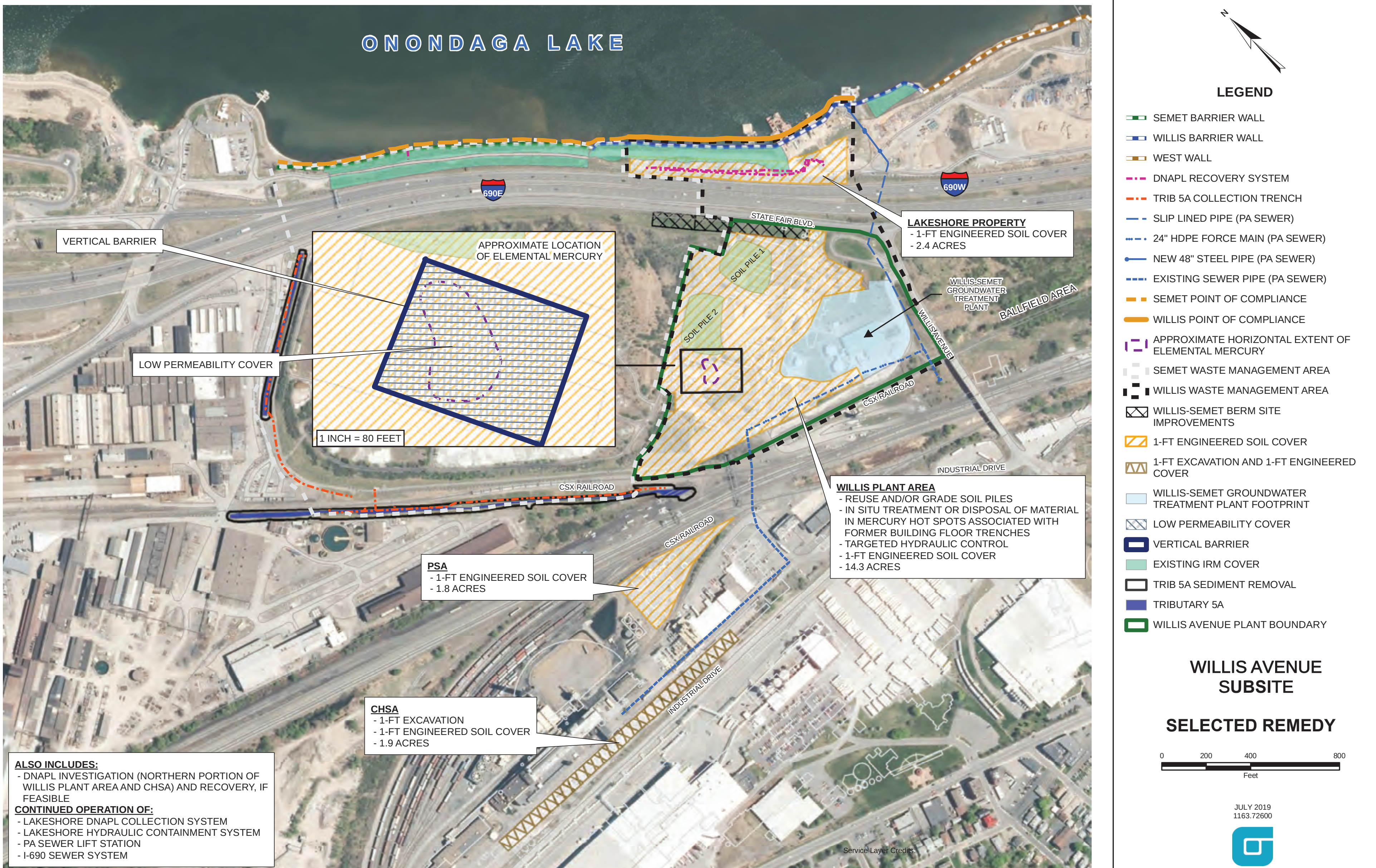

WILLIS AVENUE SUBSITE

SELECTED REMEDY

JULY 2019
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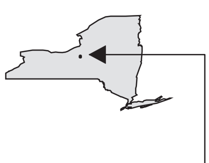
I:\Honeywell.1163\70277.Semet-2018-Ou-2\Docs\DWG\MXD\PRAP\FIGURE 9.mxd

WASTEBED B / HARBOR BROOK SUBSITE

SITE PLAN



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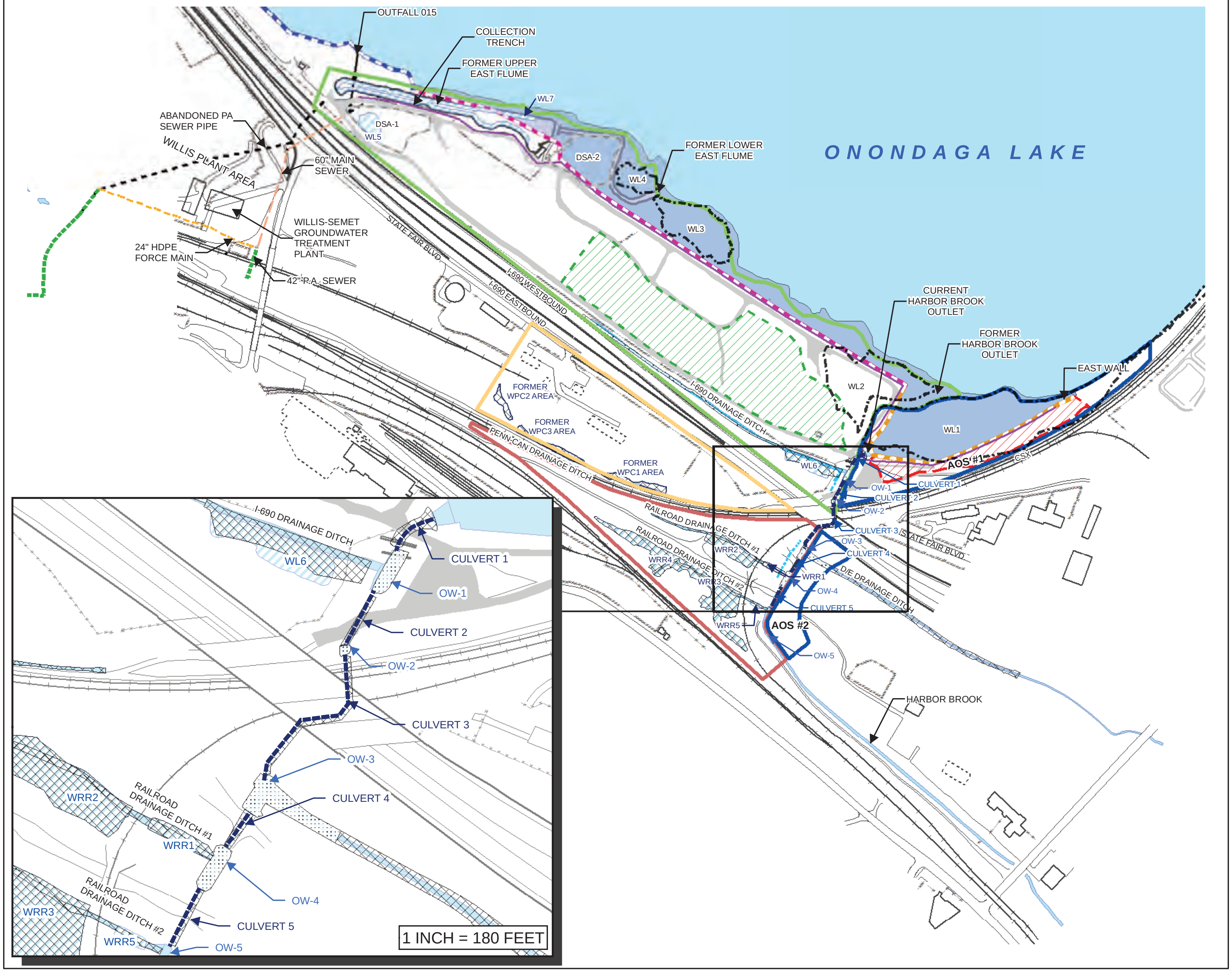
O'BRIEN & GERE ENGINEERS, INC.

FIGURE 9



N

LEGEND

IRM FEATURES
- COVER AREA
- STAGED MATERIAL
- SEDIMENT REMOVAL
- SEDIMENT REMOVAL WITH LINER
- OUTBOARD WETLAND TRANSITIONAL ZONE
- EAST WALL
- WEST WALL
- WILLIS BARRIER WALL
- COLLECTION TRENCH
- UPPER HARBOR BROOK COLLECTION TRENCH
- CULVERT

SITE FEATURES
- ACCESS PATHWAYS
- DELINEATED WETLAND
- BUILDING

HISTORIC FEATURES
- HISTORIC/FORMER BUILDING
- DREDGE SPOIL AREA BOUNDARY
- FORMER WETLANDS

SITE BOUNDARIES
- RAILROAD AREA BOUNDARY
- LAKESHORE AREA BOUNDARY
- PENN-CAN PROPERTY BOUNDARY
- ADDITIONAL AREA OF STUDY BOUNDARY

WASTEBED B / HARBOR BROOK SUBSITE INTERIM REMEDIAL MEASURES

0 250 500 1,000
Feet

SEPTEMBER 2018
1163.61858

O'BRIEN & GERE ENGINEERS, INC.

PLOTDATE: 06/13/18 12:53:59 PM stantosa

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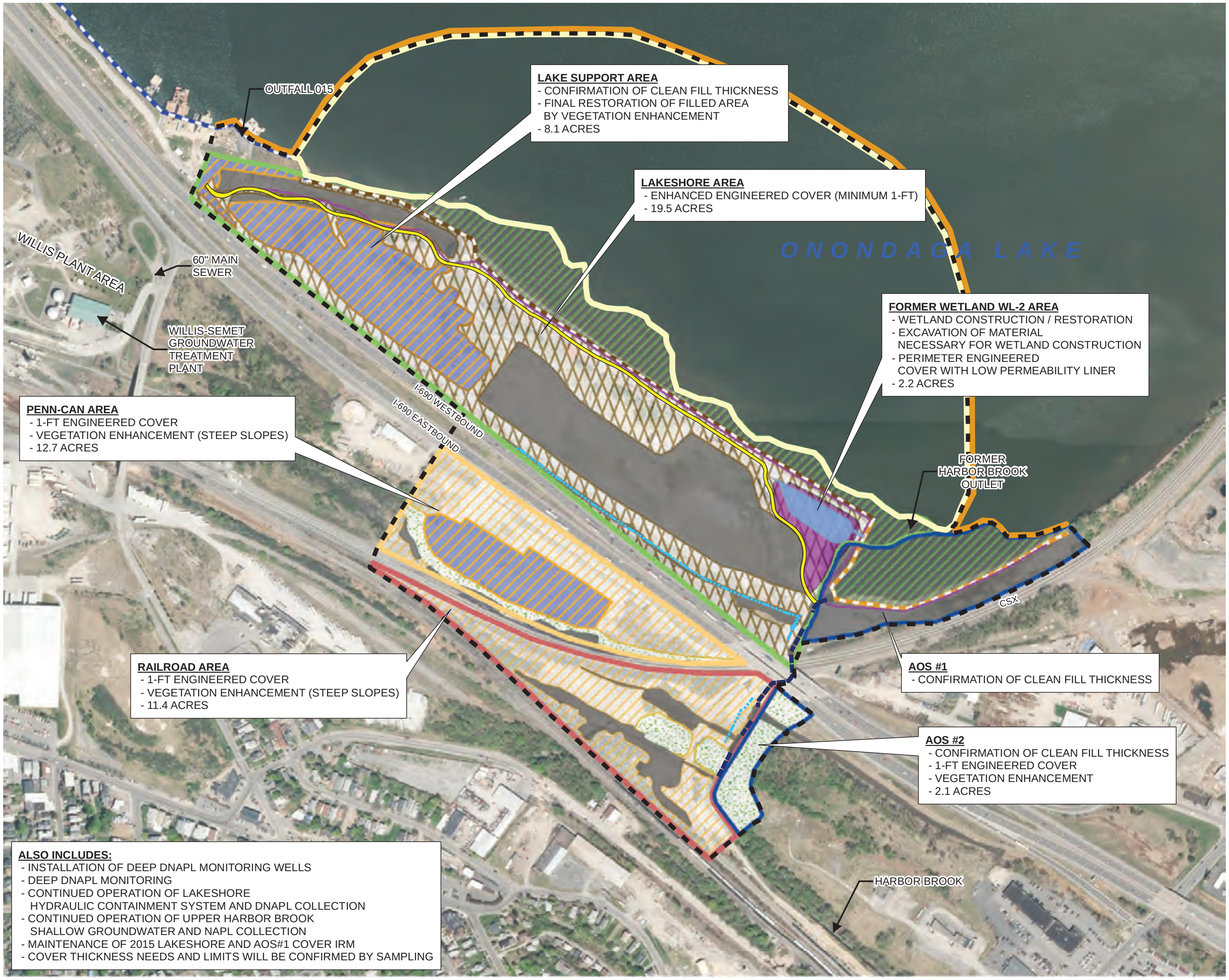
FIGURE 10



N

LEGEND

- EAST WALL
- WEST WALL
- WILLIS BARRIER WALL
- CULVERT
- UPPER HARBOR BROOK COLLECTION TRENCH
- COLLECTION TRENCH
- POINT OF COMPLIANCE (IN-LAKE POINT OF COMPLIANCE WOULD BE EXISTING LAKE BOTTOM)
- IN-LAKE WASTE DEPOSIT
- WASTE MANAGEMENT AREA
- IRM AREA
- CONCEPTUAL ONONDAGA COUNTY WEST SHORE TRAIL (PROPOSED BY OTHERS)
- ENHANCED ENGINEERED COVER
- 1-FT ENGINEERED COVER
- AREA ADDRESSED BY EXISTING FILL
- VEGETATION ENHANCEMENTS
- AREA ADDRESSED BY LAKE REMEDY / IRM
- LOW PERMEABILITY LINER BELOW COVER
- WETLAND CONSTRUCTION / RESTORATION

SITE BOUNDARIES

- RAILROAD AREA BOUNDARY
- LAKESHORE AREA BOUNDARY
- PENN-CAN PROPERTY BOUNDARY
- ADDITIONAL AREA OF STUDY BOUNDARY

WASTEBED B/HARBOR BROOK SUBSITE OU1 REMEDY

0 225 450 900
Feet

SEPTEMBER 2018
1163.61858

O'BRIEN & GERE ENGINEERS, INC.

POTENTIAL FUTURE TRAIL EXTENSION
PLANNED RECREATIONAL TRAIL ALIGNMENT
UPLAND VEGETATED SOIL COVER (0.7 AC)
PERCHED WETLAND COVER (7.5 AC)
SITE BOUNDARY
POTENTIAL ADDITIONAL REMEDIAL AREAS (E.G., BASED ON SOIL SAMPLING, TREE SURVEY)

0 125 250 Feet

SYW-12 ALTERNATIVE 2

ENGINEERED COVER ON PERIMETER AREA (8.2 ACRES), WETLAND RESTORATION / CREATION, BIOTA MONITORING, AND MNA

HONEYWELL INTERNATIONAL INC.

SYW-12 PROPOSED REMEDIAL ACTION PLAN
SYRACUSE, NEW YORK

FIGURE 11

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT: 1940065696 | DATED: 3/4/2022 | DESIGNER: MONETANT

I:\Honeywell.1163\65696.Syw-12-Fs\Docs\DWG\MXD\DEVELOPMENT OF ALTERNATIVES\FS ALTERNATIVES JULY 2021

FIGURE 12

N

LEGEND

- DITCH A IRM
- SEEP COLLECTION TRENCH
- GROUNDWATER COLLECTION TRENCH
- ACCESS PATHWAYS
- REVETMENT
- SEEP APRON
- VEGETATIVE COVER / RESTORED AREA / SHORELINE STABILIZATION / WET SWALE
- MITIGATION WETLAND
- BIOSOLIDS AREA
- WASTEBEDS 1-8 SITE

WASTEBEDS 1- 8
GEDDES, NEW YORK

WASTEBEDs 1-8 IRM COMPONENTS

0 350 700 1,400
Feet

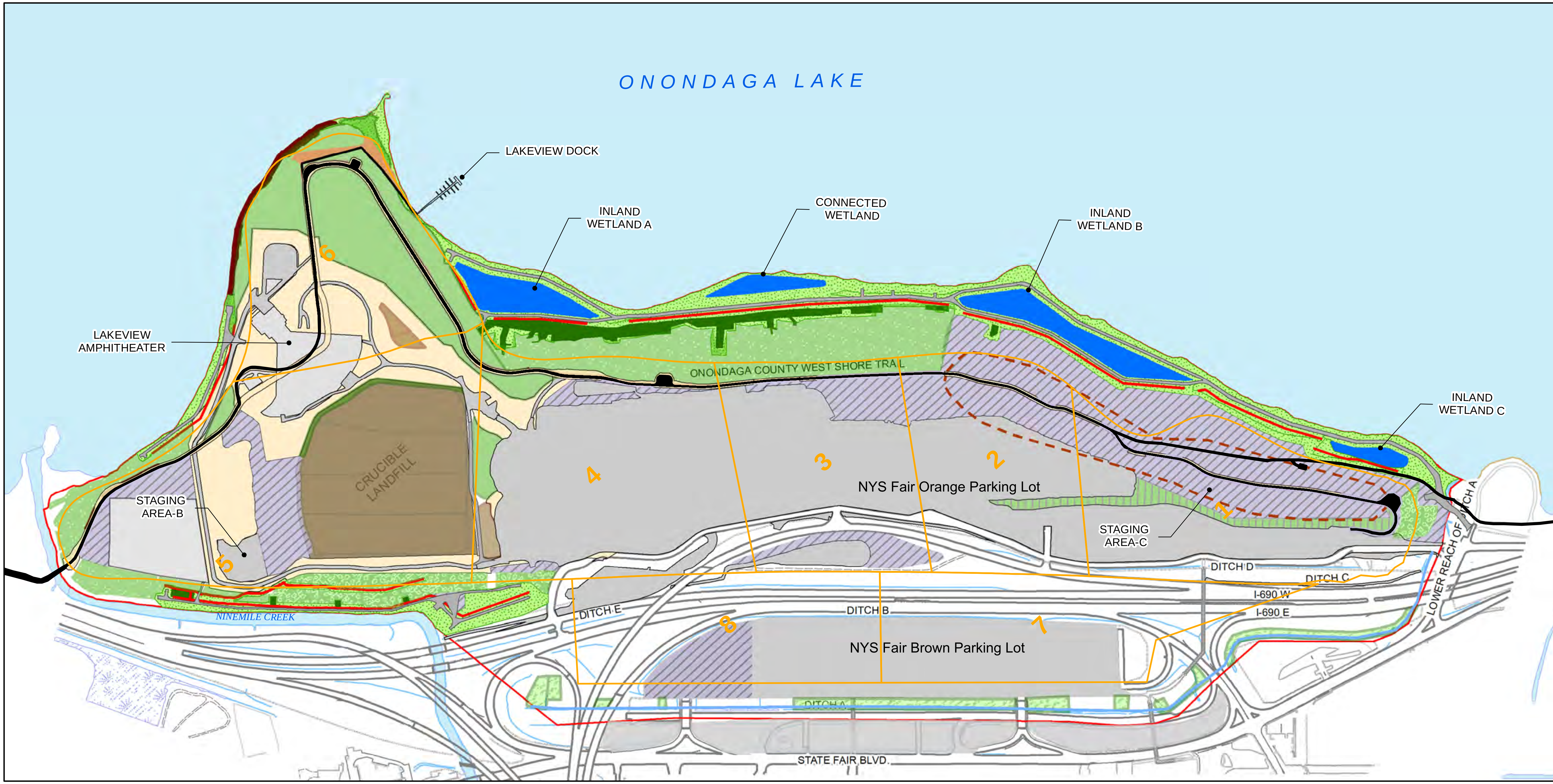
DECEMBER 2016
1163.45176

O'BRIEN & GERE ENGINEERS, INC.

PLOTDATE: 09/28/16 10:46:48 AM reidis

\\Syrna01\projects\Honeywell.1163\45176.Wb-1-8-Site-Wd\Docs\DWG\MXD\OU2 FS\2016_revs\Overall_Plan_Rev1.mxd

FIGURE 13



LEGEND

- ACCESS PATHWAYS
- ONONDAGA COUNTY AMPHITHEATER FOORPRINT
- CRUCIBLE LANDFILL
- ONONDAGA COUNTY WEST SHORE TRAIL
- BIOSOLIDS AREA FOOTPRINT
- LAKEVIEW DOCK ACCESS CONSTRUCTION BOUNDARY

PV PROJECT AREAS

- MITIGATION WETLANDS
- VEGETATIVE COVER / SHORELINE ENHANCEMENT AREAS/ VEGETATED WET SWALE
- REVETMENT
- SEEP APRON
- APPROXIMATE LOCATION OF VEGETATED WET SWALE
- PHASE 1 VEGETATED SOIL COVER
- PHASE 1VEGETATION ENHANCEMENT COVER
- PHASE 2 STRUCTURAL FILL PARKING AREA
- PHASE 2 VEGETATION ENHANCEMENT COVER
- PHASE 3 VEGETATION ENHANCEMENT COVER (2018)
- PHASE 3 VEGETATION ENHANCEMENT COVER (2017)
- PHASE 3 STABILIZED VEGETATED SOIL COVER (2018)
- PHASE 3 1-FT VEGETATED SOIL COVER (2017)
- Addendum DP#4 Cover
- COVER REMAINING[1]

NOTES:
1. COVER REMAINING EXTENTS ARE FROM THE SELECTED REMEDY IN THE DECEMBER 2014 RECORD OF DECISION AND MAY BE MODIFIED AS PART OF FUTURE REMEDIAL DESIGNS.

0 250 500 1,000 1,500 2,000
Feet

N

HONEYWELL INTERNATIONAL
WASTEBEDS 1-8
SYRACUSE, NEW YORK

SITE PLAN WITH COVER TYPES AND EXTENT

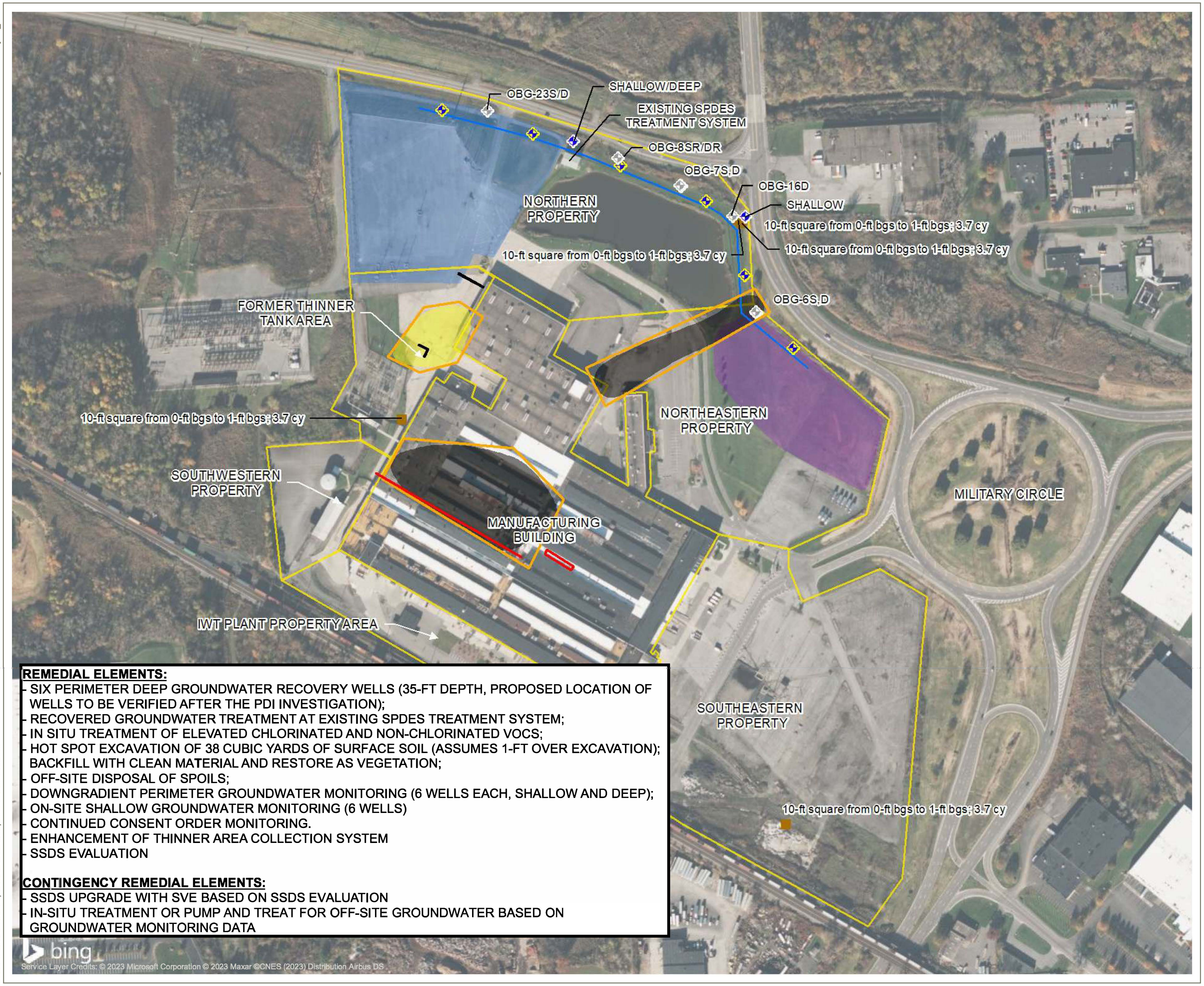
1163.71536
MARCH 2020

O'BRIEN & GERE ENGINEERS, INC.

Figure 14: Niagara Mohawk Hiawatha Blvd Former MGP Subsite

Figure 15: Ley Creek Deferred Media and Areas of Interest

FIGURE 16



REMEDIAL ELEMENTS:
- SIX PERIMETER DEEP GROUNDWATER RECOVERY WELLS (35-FT DEPTH, PROPOSED LOCATION OF WELLS TO BE VERIFIED AFTER THE PDI INVESTIGATION);
- RECOVERED GROUNDWATER TREATMENT AT EXISTING SPDES TREATMENT SYSTEM;
- IN SITU TREATMENT OF ELEVATED CHLORINATED AND NON-CHLORINATED VOCS;
- HOT SPOT EXCAVATION OF 38 CUBIC YARDS OF SURFACE SOIL (ASSUMES 1-FT OVER EXCAVATION); BACKFILL WITH CLEAN MATERIAL AND RESTORE AS VEGETATION;
- OFF-SITE DISPOSAL OF SPOILS;
- DOWNGRADIENT PERIMETER GROUNDWATER MONITORING (6 WELLS EACH, SHALLOW AND DEEP);
- ON-SITE SHALLOW GROUNDWATER MONITORING (6 WELLS)
- CONTINUED CONSENT ORDER MONITORING.
- ENHANCEMENT OF THINNER AREA COLLECTION SYSTEM
- SSDS EVALUATION

CONTINGENCY REMEDIAL ELEMENTS:
- SSDS UPGRADE WITH SVE BASED ON SSDS EVALUATION
- IN-SITU TREATMENT OR PUMP AND TREAT FOR OFF-SITE GROUNDWATER BASED ON GROUNDWATER MONITORING DATA

LEGEND
- EXISTING MONITORING WELL
- PROPOSED MONITORING WELL
- PROPOSED DEEP GROUNDWATER RECOVERY WELL
- DEEP GROUNDWATER DISCHARGE PIPING
- PROPOSED EXCAVATION AREA
- APPROXIMATE LOCATION OF EXISTING THINNER TANK TRENCH
- SSDS
- APPROXIMATE LIMITS OF EXISTING LANDFILL IRM
- APPROXIMATE LIMITS OF EXISTING SOIL STAGING AREA IRM
- ELEVATED CHLORINATED VOCs AREA IN SITU TREATMENT - APPROXIMATE
- ELEVATED NON-CHLORINATED VOCs AREA IN SITU TREATMENT - APPROXIMATE
- PROPERTY AREA LIMITS

RACER TRUST
GENERAL MOTORS -
INLAND FISHER GUIDE SUBSITE
SYRACUSE, NEW YORK

ALTERNATIVE 4

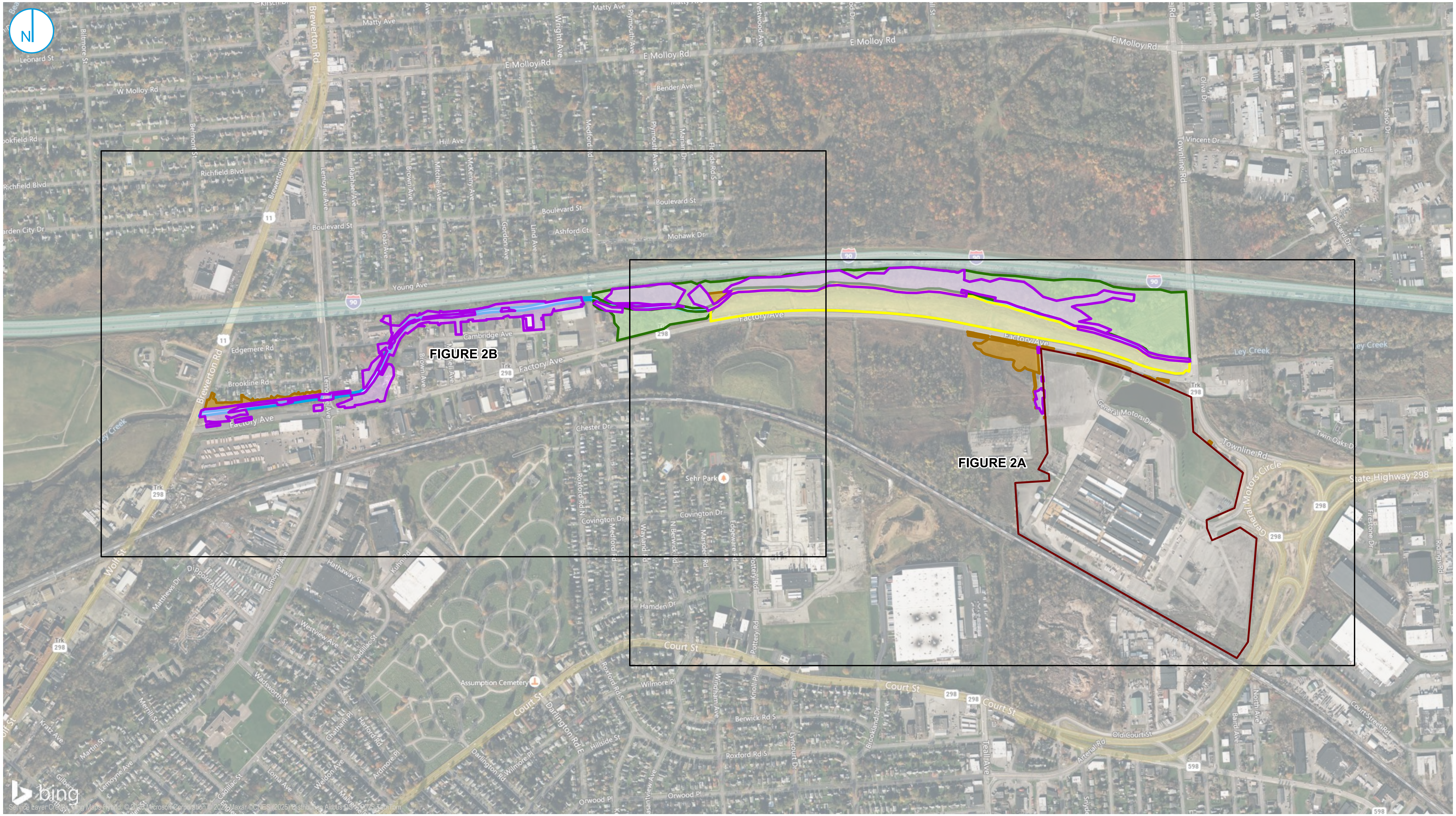
0 100 200 400 600 Feet

1940101904
MAY 2023

RAMBOLL AMERICAS ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT: 1940101904 | DATED: 5/11/2023 | DESIGNER: SSOULE



FORMER IFG FACILITY (OU1)
LEY CREEK
STUDY AREA
PREVIOUSLY EXCAVATED/REMEDIATED AREA
LEY CREEK PCB DREDGINGS SUBSITE
FORESTED AREA

0 400 800 Feet

NOTE
THERE WERE PREVIOUS EXCAVATIONS PERFORMED AS PART OF THE LEY CREEK PCB DREDGINGS SITE REMEDY. ADDITIONALLY, REMEDIATION HAS BEEN COMPLETED IN 19 RESIDENTIAL BACKYARDS, THE NATIONAL GRID WETLAND AREA AND ALONG FACTORY AVENUE.

LEY CREEK DEFERRED MEDIA PORTION OF GENERAL MOTORS-INLAND FISHER GUIDE SUBSITE OPERABLE UNIT 2 (OU2) - KEY MAP
LEY CREEK DEFERRED MEDIA PORTION OF GENERAL MOTORS-INLAND FISHER GUIDE SUBSITE OPERABLE UNIT 2 (OU2)

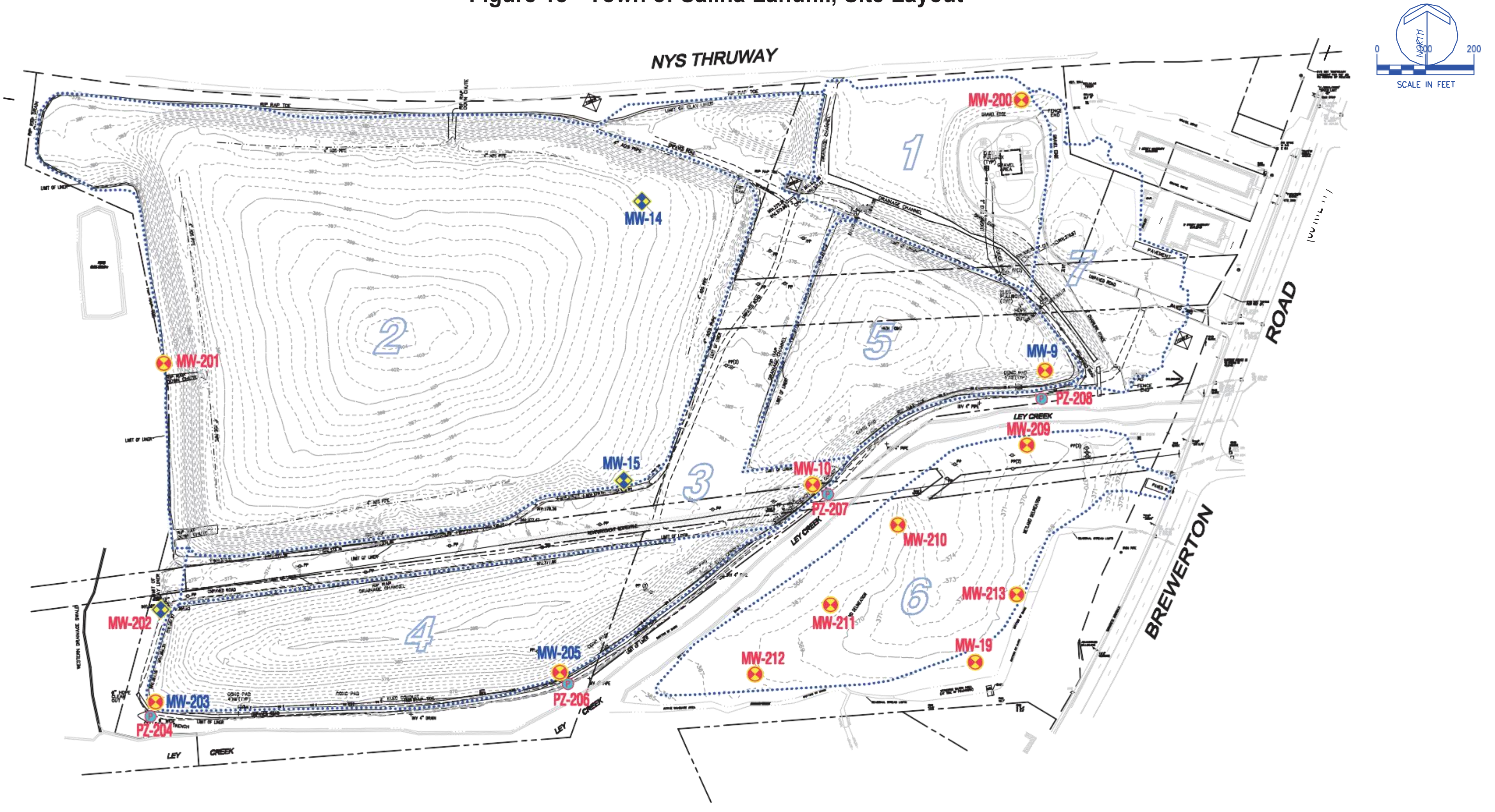
ONONDAGA LAKE SUPERFUND SITE
SYRACUSE, NEW YORK

FIGURE 17

HDR OBG a joint venture

PROJECT: 194011323 | DATED: 9/9/2025 | DESIGNER: KAUFMADR

Figure 18 - Town of Salina Landfill, Site Layout



Attachment 3 - Fish Tissue Data Tables and Figures

Onondaga Lake Site/Lake Bottom Subsite
Third Five-Year Review Report
Fish Tissue Data Tables and Figures

Introduction

The following includes a summary of the fish tissue data tables and figures presented in this Five-Year Review (FYR) Report and a general description of the fish tissue monitoring program since 2008. As noted in the Onondaga Lake Monitoring and Maintenance Plan (OLMMP) (Parsons, 2018), fish tissue concentrations by species, with statistical evaluation (e.g., 95 percent upper confidence limit [UCL] on the mean) are compared to the Onondaga Lake fish tissue goals and target concentrations, as presented below and in Attachment 1 Table 9 of this FYR report.

The Onondaga Lake Record of Decision (ROD) (NYSDEC and USEPA, 2005) indicated that mercury is a primary concern in the lake and is a part of all five remedial action objectives (RAOs), and therefore the ROD specified the following remedial goals for mercury in fish tissue for protection of human health and ecological exposure:

- 0.2 mg/kg (fish tissue fillet) for protection of human health based on the reasonable maximum exposure scenario assumptions from the Onondaga Lake Human Health Risk Assessment (HHRA) (TAMS, 2002a).
- 0.3 mg/kg (fish tissue fillet) based on EPA's methylmercury National Recommended Water Quality criterion for the protection of human health for the consumption of organisms.
- 0.14 mg/kg (whole fish) for protection of ecological receptors (wildlife) based on the exposure assumptions from the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (TAMS, 2002b). This ecological goal was based on the lowest-observed-adverse-effect level (LOAEL) for the river otter.

In addition to the remedial goals for mercury in fish tissue, cited above, ecological target tissue concentrations for mercury based on the no-observed-adverse-effect levels (NOAELs) as well as target tissue concentrations for bioaccumulative organic contaminants, corresponding to various risk levels (including both the 10^{-4} and 10^{-5} cancer risk levels for human health exposure and both the LOAELs and NOAELs for ecological exposure), were developed in the Onondaga Lake Feasibility Study (Parsons, 2004) based on exposure parameters from the Onondaga Lake HHRA and BERA and were included in the ROD (ROD Table 7).[21] These targets are not remedial goals, as presented in the ROD, but are points of reference for evaluations of reduction of risk for human and wildlife consumers of fish.

As indicated in the ROD, other contaminants, including PCBs, hexachlorobenzene, and PCDD/PCDFs, were not as widespread in sediments in the lake (as compared to mercury) and were found primarily in a few specific areas of the lake (e.g., sediment management units [SMUs] 1, 2, 6, and 7), which underwent aggressive active remediation (dredging and/or capping). The ecological and human health remedial goals

[21] Non-carcinogenic targets were not developed for PCDD/PCDFs prior to the issuance of the ROD. Subsequent to its issuance, a RME noncancer endpoint target of 1.3E-06 mg/kg (1.3 ng/kg) was developed using the parameters presented in Appendix G of the FS for a target concentration for the non-cancer endpoint, and using the EPA 2012 reference dose of 7E-10 mg/kg-day.

for mercury and targets for other bioaccumulative contaminants in fish tissue are summarized in Attachment 1 Table 9 in this FYR report.

As the areas of the lake with elevated concentrations of these bioaccumulative organic contaminants for which target tissue concentrations were developed were generally within the remedial areas based on exceedance of the cleanup criteria of the mean PECQ of 1 (which addresses multiple contaminants) plus the mercury PEC, the exposures to these compounds would be reduced to the same or greater extent as that of mercury. It was therefore expected that if the remedial goals for mercury in fish tissue are met in the future, that the future fish tissue concentrations for the contaminants listed in ROD Table 7 would fall within the concentration ranges shown in that table for each contaminant and receptor. If the expectation is proven not to be the case, based on ongoing fish tissue monitoring, then an evaluation will take place to determine why this expectation may no longer be valid.

The Onondaga Lake ROD envisioned a long-term monitoring program to assess the effectiveness of the remedy, since changes in the contaminant concentrations in biota typically take at least several years to fully manifest. This concept is reflected in the ten-year MNR period discussed in the ROD and is consistent with the results seen following remediation at other sediment sites (e.g., Cumberland Bay in New York State). Future FYRs will continue to assess the data trends as they are established as well as attainment of the fish tissue goals and targets.

Fish have been collected by Honeywell on an annual basis during the post-ROD baseline monitoring period (2008 to 2011) prior to commencement of remedial actions in the lake, during the remedial action period (2012 to 2016), and since 2017 after completion of dredging and capping pursuant to Honeywell's approved final design. The Second FYR Report (USEPA, 2020) included data from baseline (commencing 2008) through the first two years of post-construction monitoring (2017 and 2018). Although an additional five years of fish data were envisioned to be included in this Third FYR Report, only two years of additional Honeywell data (2021 and 2022) are available for this report at this time. Due primarily to unanticipated sample processing issues (e.g., 2019 sport fish were not descaled prior to homogenization as required in NYSDEC's standard fillet procedures, and incomplete homogenization in many samples in both 2019 and 2020) and other quality control issues at the commercial lab used by Honeywell, it was determined by NYSDEC and Honeywell that the data from the fish samples collected in 2019 and 2020 would not be reported and would not be used for comparisons to goals/targets or in any trend analyses. Additional information can be found in Honeywell's 2019 and 2020 annual reports (Parsons, 2023a; Parsons, 2024).

To address these issues, NYSDEC and Honeywell developed additional procedures and quality control requirements for both sample processing and analytical methods as well as reporting requirements and a new Quality Assurance Project Plan (QAPP) was developed by Honeywell with input by NYSDEC. In addition, Honeywell contracted with new laboratories to process and analyze the fish samples. Following NYSDEC's approval of this QAPP, the processing and analyses of the archived (frozen) fish samples collected since 2021 commenced. As of June 2025, Honeywell data from Onondaga Lake fish samples collected in 2021 and 2022 have been completed and validated and submitted to NYSDEC for review. These data are included in this report. Honeywell is in the process of completing the analyses and validation of the fish samples collected in 2023 and 2024.

To statistically assess the direction and rate of change in fish concentrations post-remedy (i.e., after 2016), additional years of data collection are needed and will be undertaken in future years as defined in the OLMMP. Therefore, the discussion in the "Data Review" section in the main portion of this FYR report focuses on a qualitative comparison of pre-remedy and post-remedy concentrations and comparisons to the fish tissue goals for mercury and the fish tissue target concentrations for the organics. A summary of the fish tissue metrics that will be utilized to evaluate attainment of fish tissue goals/targets is presented in Appendix D of the FYR report. As noted therein, those analyses and determinations will be documented in future FYR reports and/or other periodic review documents issued by EPA/DEC as additional data become available.

Fish Data Reporting

For the fish tissue data reporting, both the Honeywell data sets from 2008 to 2018, 2021, and 2022 (fillets of smallmouth bass, walleye, pumpkinseed, and carp [2014-2018, 2021 and 2022]), whole-body small prey fish, and whole-body large prey fish (2014-2018, 2021 and 2022) and NYSDEC data sets from 2008 to 2023 (largemouth bass) are used. The Honeywell fish data presented herein are as provided by Honeywell's consultants. The NYSDEC fish data from 2008 through 2016 were obtained from the August 2019 version of the NYSDEC Onondaga Lake Database (AECOM, consultant to NYSDEC) and data from 2017 through 2023 were obtained from source files provided by NYSDEC. Honeywell data from 2008 through 2011 were collected under the Baseline Monitoring Program, data from 2012 through 2016 were collected under the Monitoring and Maintenance Program during remedial action (dredging and capping)[22], and data since 2017 were collected under the Post-Construction Monitoring Program. The scope of the Post-Construction Monitoring Program is included in the OLMMP (Parsons, 2018).

For the Honeywell Baseline Monitoring Program, the selected adult sport fish species covered a range of trophic levels including top level piscivores (smallmouth bass, walleye), benthic invertivores (brown bullhead), and invertivores (pumpkinseed). In 2014, a benthic herbivore (common carp), was also collected at the request of NYSDEC. In 2015, brown bullhead was dropped from the program and replaced by common carp. Fish tissue sampling and analysis conducted by Honeywell in 2015 and 2016 were implemented consistent with NYSDEC approved submittals, including the 2015 and 2016 work scopes for tissue monitoring submitted as work plan addenda to the Onondaga Lake Tissue Monitoring Work Plan for 2012 (Parsons and Anchor QEA, 2015; Parsons and Anchor QEA, 2016). Fish tissue sampling conducted by Honeywell since 2017 was implemented consistent with draft and final versions of the Onondaga Lake Monitoring and Maintenance Plan (Parsons and Anchor QEA, 2018; Parsons, 2018).

The NYSDEC monitoring program is independent of the Honeywell program. NYSDEC instituted a long-term sampling program in 1970, initially concentrating on smallmouth bass and later largemouth bass. Other species were analyzed by NYSDEC if collected in certain years to provide information on other trophic levels such as carp, yellow and white perch (invertivores), and channel catfish (benthic omnivore). Under the NYSDEC monitoring program carp have not been collected since 2013, white perch and channel catfish have not been collected since 2012, and yellow perch have not been collected since 2018. Therefore, only the largemouth bass data are presented in this FYR report.

Based on prior discussions with Honeywell related to data usability, the Honeywell organics data from 2010 are not used and the mercury data from 2010 are qualified as estimated due to incorrect filleting procedures and potential problems with extractions resulting in very low concentrations of organic contaminants in sport fish and prey fish in 2010. In addition, four of the revised lipids results from 2011 were rejected and the lipids results for these samples are not used. As noted by NYSDEC during review

[22] Adult sport fish and alewife prey fish were collected by Honeywell in June 2012 just prior to the commencement of dredging in late July 2012. Minnow prey fish were collected in August 2012.

of the 2017 Honeywell data, due to a potential misinterpretation of the lipids analysis standard operating procedure (SOP) by the laboratory, the lipid analysis of many of the fish samples may not have confirmed that the hexane solvent used in the extraction had been properly evaporated, and it is likely that many of those samples were not properly dried. This potentially caused the laboratory to report artificially high weights of residuals, resulting in lipid results biased high in 2017. A limited set of the samples using archived material were reanalyzed although many of the samples did not have sufficient mass for reanalysis. It is believed that similar issues existed with the 2018 data. Based on this, as well as other modifications to the analytical program to incorporate improvements in the QA/QC procedures (e.g., inclusion of additional fish tissue certified reference materials analyzed and evaluated with the lake fish samples), some of the analytical SOPs were revised for the analysis of fish samples collected in the 2019 and 2020 seasons. However, as noted above, the Honeywell fish sample results from 2019 and 2020 were determined to not be usable and are not presented herein.

Following Honeywell's transition to a different commercial lab and revisions of the QAPP and SOPs (Parsons, 2023b), analyses of fish collected in 2021 and 2022 have been completed (Parsons, 2025a; Parsons, 2025b) and are presented herein. As noted in the main section of this FYR report, the fish data from 2021 and 2022 for all analytes were determined to be valid and usable during data validation. For some analytes such as PCBs, there were many samples qualified as "possibly biased low" due to low recovery in standard (certified) reference materials. In addition, NYSDEC has indicated that results for PCBs and lipids are potentially biased low based on split samples analyzed at NYSDEC labs. Therefore, NYSDEC and Honeywell are evaluating potential modifications of extraction/analytical methods for future sampling. If modifications are determined to be necessary, updates to the QAPP will be prepared. In addition, NYSDEC and Honeywell are currently exploring options for applying estimation factors to the PCB and lipid results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the revised estimated concentrations (including statistics and figures) will be documented and discussed in an addendum to this FYR.

Calculations of total PCBs, sum of DDT and metabolites, and dioxin/furan toxic equivalence (TEQs) (based on the World Health Organization human health and mammalian-based toxicity equivalence factors [TEFs] from van den Berg et al., 2006) were performed for those data sets where totals were not included in the source files.

For ecological exposure, the prey fish samples were grouped into two size classes: small (30 to 180 mm) and large (180 to 600 mm) consistent with the Onondaga Lake BERA (TAMS, 2002b). Data for small whole-body prey fish are available in the Honeywell data set since 2008. Between 2014 and 2018, Honeywell collected large (180 to 600 mm) prey fish for whole-body analysis, consisting exclusively of white suckers. In 2021 and 2022, the large prey fish also included shorthead redhorse. As large whole-body prey fish were not collected from 2008 to 2013 and to supplement the large prey fish data collected since 2014, whole-body concentrations were estimated based on the fillet samples from that size class and the site-specific fillet to whole-body conversion factors (0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) from the Onondaga Lake BERA (Section 8.2.6.4). These conversion factors will be reassessed with new data in the future, if appropriate.

In this attachment, Tables 1 and 2 provide a summary of the number of samples used in the analyses for each species and analyte for the Honeywell and NYSDEC data sets, respectively. Tables 3a, 3b, and 3c include annual fish tissue arithmetic mean and 95% UCL contaminant concentrations, as defined below, for each species for the 2015-2018 and 2021-2022 period for the Honeywell sport fish fillet data, prey fish whole-body data, and calculated whole-body concentrations based on the fillet data, respectively. Tables

4a and 4b include annual fish tissue mean and 95% UCL contaminant concentrations for the NYSDEC sport fish fillet data for largemouth bass, and calculated whole-body concentrations based on the NYSDEC fillet data, respectively. USEPA's ProUCL Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations was used by both Honeywell/Parsons and NYSDEC/AECOM for calculation of the 95% UCL and mean values for their respective fish data sets in each year, unless three or fewer results were detects (USEPA, 2015). If three or fewer results were detected in an annual data set, the mean was calculated arithmetically, substituting one-half the detection limit (mercury) or reporting limit (organic analytes) for non-detects. 95% UCLs were not calculated for the figures and tables if there were three or fewer detects. The numbers of samples collected each year, and detections are noted at the top of the figures. The sport fish fillet, small prey fish, and large prey fish data are presented in the Sets 1, 2, and 3 figures, respectively.

The data are presented in the Sets 1 through 3 figures as box-and-whisker plots with 95% UCL values as well as individual data points so the full range and distribution of the data can be seen. The normalized data are presented as means plus and minus two standard errors in the Set 4 Honeywell figures, which provides an estimate of 95 percent upper and lower confidence limits. (See Figure 1 in this attachment for notes and details.)

Honeywell Labs for Fish Analyses (2008 to 2022):

- 2008. Test America, Vermont (all analytes)
- 2009. Accutest, New Jersey (mercury in prey fish); Test America, Pittsburgh, PA (other analytes, mercury in sport fish)
- 2010. SGS, North Carolina (dioxins/furans); Accutest, NJ (other analytes)
- 2011, 2012, 2013. Test America, Pittsburgh PA and Knoxville TN
- 2014, 2015, 2016. Pace Analytical, Schenectady, NY (mercury, PCBs, lipids) and Minneapolis, MN (dioxins/furans)
- 2017, 2018. Eurofins – Lancaster, PA and Eurofins – Frontier, WA
- 2021, 2022. SGS, North Carolina (dioxins/furans, lipids); SGS, Dayton, NJ (mercury, PCBs, DDT and metabolites)

NYSDEC Lab for Fish Analyses (2008 to 2023):

- Hale Creek Field Station, Analytical Services Unit

Note, largemouth bass was the predominant species analyzed by NYSDEC during the 2015 to 2023 period. As samples of the other species (*i.e.,* yellow perch, white perch, carp, channel catfish) were not analyzed after 2018 as shown in Table 2, only the largemouth bass fillet data are included in the NYSDEC fish data figures in Set 1.

LIST OF FISH MONITORING SUMMARY TABLES

- Table 1: Honeywell Fish Data Used in the Analyses (Number of Samples)
- Table 2: NYSDEC Fish Data Used in the Analyses (Number of Samples)
- Table 3a: Summary of Honeywell Fish Tissue Chemical Concentrations: Sport Fish Fillet (2015 - 2022)
- Table 3b: Summary of Honeywell Fish Tissue Chemical Concentrations: Prey Fish Whole Body (2015 - 2022)

LIST OF FISH MONITORING SUMMARY FIGURES

Set 1: Sport Fish Fillet Concentrations for Human Health Remedial Goals and Targets

Honeywell Data (2008 to 2022)

NYSDEC Data (2008 to 2023)

Set 2: Small (30 to 180 mm) Prey Fish Whole-Body Concentrations for Ecological Remedial Goal and Targets

Honeywell Data (2008 to 2022)

- Figure 1: Mercury Concentrations in Small Prey Fish
- Figure 2: Total PCB Concentrations in Small Prey Fish
- Figure 3: DDT and Metabolites Concentrations in Small Prey Fish
- Figure 4: Hexachlorobenzene Concentrations in Small Prey Fish

Note, all species of small prey fish (whole body) collected by Honeywell are included in this data set (banded killifish, round goby, golden shiner, brook silverside, minnow, bluntnose minnow [alewife excluded]).

Set 3: Large (180 to 600 mm) Prey Fish Whole-Body Concentrations for Ecological Remedial Goal and Targets

Honeywell Data (2008 to 2022)

- Figure 1: Mercury Concentrations in Large Prey Fish
- Figure 2: Total PCB Concentrations in Large Prey Fish
- Figure 3: DDT and Metabolites Concentrations in Large Prey Fish
- Figure 4: Hexachlorobenzene Concentrations in Large Prey Fish

Set 4: Additional Reporting to Assess Potential Impacts of Remediation

For information on the potential impact of the implementation of the remediation on contaminant concentrations in fish tissue (as opposed to the risk to consumers of fish), the changes in concentration over time are reported. In these Set 4 figures, the data are presented in a way that controls factors which may influence the wet-weight concentrations but are independent of any exposure to the site-related contamination. This reduces the variability (e.g., noise) in the data.

For mercury, the variability due to fish age is corrected by using length as a surrogate for age. The wet-weight mercury concentration of each individual fish is adjusted by dividing the concentration (in mg/kg) by its length (in millimeters [mm]), providing a concentration as mg/kg per mm. For the organic contaminants, the amount of lipid in the fish has a major influence on the wet-weight concentrations (Sloan et al., 2002). For PCBs, dioxin/furans, DDTs, and hexachlorobenzene, the wet-weight concentrations for each individual fish are adjusted by dividing the concentration by its lipid content, providing a lipid-normalized concentration (e.g., mg PCBs/kg lipid).

The first subset of figures presents mercury data normalized to fish length and organic contaminants (PCBs, dioxin/furan TEQs, DDTs, hexachlorobenzene) normalized to lipids for both sport fish and prey fish. As the normalized data are not compared to the goals (which are on a wet-weight basis) and all sport fish species for each contaminant are shown on one figure, the Honeywell data are presented as means plus and minus two standard errors rather than box-and-whisker plots to provide a simpler image.

The second subset of figures presents the data by sample location for localized small prey fish species collected by Honeywell (note, whole-body prey fish were not collected by NYSDEC). These figures show concentrations for the sediment management units (SMUs) from which the prey fish samples were collected. Note, Honeywell's fish sampling program did not include stations in SMU 1 prior to 2017.

Honeywell Data (2008 to 2022)

Set 4, Subset 1
- Figure 1: Length-Normalized Mercury Concentrations in Sport Fish
- Figure 2: Length-Normalized Mercury Concentrations in Prey Fish (All SMUs)
- Figure 3: Lipid-Normalized Total PCB Concentrations in Smallmouth Bass and Walleye
- Figure 4: Lipid-Normalized Total PCB Concentrations in Common Carp and Pumpkinseed
- Figure 5: Lipid-Normalized Total PCB Concentrations in Small Prey Fish (All SMUs)
- Figure 6: Lipid-Normalized Total PCB Concentrations in Large Prey Fish (All SMUs)
- Figure 7: Lipid-Normalized Dioxin/Furan Total TEQ Concentrations in Smallmouth Bass and Walleye
- Figure 8: Lipid-Normalized Dioxin/Furan Total TEQ Concentrations in Common Carp and Pumpkinseed
- Figure 9: Lipid-Normalized DDT and Metabolites Concentrations in Small Prey Fish (All SMUs)
- Figure 10: Lipid-Normalized DDT and Metabolites Concentrations in Large Prey Fish (All SMUs)
- Figure 11: Lipid-Normalized Hexachlorobenzene Concentrations in Smallmouth Bass and Walleye
- Figure 12: Lipid-Normalized Hexachlorobenzene Concentrations in Common Carp and Pumpkinseed

Set 4, Subset 2
- Figure 1: Mercury Concentrations in Small Prey Fish by SMU
- Figure 2: Total PCB Concentrations in Small Prey Fish by SMU
- Figure 3: DDT and Metabolites Concentrations in Small Prey Fish by SMU
- Figure 4: Hexachlorobenzene Concentrations in Small Prey Fish by SMU

NYSDEC Data (2008 to 2023)

Set 4
- DEC Figure 1: Mercury – Sport Fish Species (Fillet), Length Normalized
- DEC Figure 2: Total PCBs – Sport Fish Species (Fillet), Lipid Normalized
- DEC Figure 3: DDTs – Sport Fish Species (Fillet), Lipid Normalized
- DEC Figure 4: Hexachlorobenzene – Sport Fish Species (Fillet), Lipid Normalized

Note, these Set 4 figures depicting the NYSDEC data are presented as means +/- one standard deviation for consistency with the prior FYR reports.

Set 4
- DEC Figure 5: Mercury – Largemouth Bass (Fillet), Mercury vs Length, Pre and Post Remedy
- DEC Figure 6: Mercury, Largemouth Bass (Fillet), Pre and Post Remedy

In addition, as NYSDEC's largemouth bass data from Onondaga Lake are available for each year through 2023, this represents the most extensive data set for a specific species. Plots of mercury vs fish length for the baseline period prior to dredging/capping (2008 to 2012) and post-remedy period (2017 to 2023) are presented in Set 4 DEC Figure 5 as individual data points for each of the two groupings of data. Set 4 DEC Figure 6 presents box-and-whisker graphs for mercury concentrations in each of these two groupings. Combining the data into these two multi-year groupings shows the decreases in mercury resulting from the lake remedy.

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Attachment 3 Tables and Figures

TABLE 1

HONEYWELL FISH DATA USED IN THE ANALYSES (NUMBER OF SAMPLES)

	Baseline Monitoring																			
	2008					2009					2010 (2)					2011				
Analyte	SMB	WEYE	BB	PKSD	Small Prey Fish	SMB	WEYE	BB	PKSD	Small Prey Fish	SMB	WEYE	BB	PKSD	Small Prey Fish	SMB	WEYE	BB	PKSD	Small Prey Fish
Mercury (1)	18	50	50	50	40	42	50	50	50	40	41	50	51	50	40	25	25	25	25	40
Total PCBs	12	12	12	12	10	12	12	0	0	0	12	12	12	12	10	12	12	12	12	0
PCDDs/PCDFs	5	5	5	5	0	0	0	0	0	0	5	5	5	5	0	5	5	5	5	0
Hexachlorobenzene	12	12	12	12	10	0	0	0	0	0	12	12	12	11	10	11	12	9	10	0
Total DDTs	12	12	12	12	10	12	12	0	0	0	12	12	12	12	10	12	12	12	12	0
Lipids	12	12	12	12	10	12	12	0	0	0	12	12	12	12	10	10	12	11	11	0

	Monitoring During Remedial Action																												
	2012 (3)					2013					2014							2015						2016					
Analyte	SMB	WEYE	BB	PKSD	Small Prey Fish	SMB	WEYE	BB	PKSD	Small Prey Fish	SMB	WEYE	BB	PKSD	CP	Small Prey Fish	Large Prey Fish	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish
Mercury	25	25	25	0	40	25	25	24	25	40	25	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24
Total PCBs	12	12	12	0	10	25	25	25	25	40	25	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24
PCDDs/PCDFs	5	5	5	0	0	0	0	0	0	0	12	13	6	1	9	0	0	12	12	12	12	0	0	0	0	0	0	0	0
Hexachlorobenzene	12	12	12	0	10	25	25	25	25	40	25	25	25	12	25	24	24	25	25	25	25	24	24	0	0	0	0	0	0
Total DDTs	12	12	12	0	10	25	25	25	25	40	0	0	0	0	0	24	24	0	0	0	0	24	24	0	0	0	0	0	0
Lipids	12	12	12	0	10	25	25	25	25	40	25	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24

	Post-Construction Monitoring																							
	2017						2018						2021						2022					
Analyte	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish	SMB	WEYE	PKSD	CP	Small Prey Fish	Large Prey Fish
Mercury	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24
Total PCBs	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24
PCDDs/PCDFs	12	11	12	12	0	0	13	13	12	14	0	0	12	12	12	12	0	0	12	12	12	12	0	0
Hexachlorobenzene	25	25	20	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	24	24
Total DDTs	0	0	0	0	24	24	0	0	0	0	24	24	0	0	0	0	24	24	0	0	0	0	24	24
Lipids	25	25	25	25	24	24	25	25	25	25	24	24	25	25	25	25	23	23	25	25	25	25	24	24

SMB - Smallmouth Bass
WEYE - Walleye
BB - Brown Bullhead
PKSD - Pumpkinseed
CP - Carp

Notes:

1. Sample counts do not include fish plug samples collected in 2008 and 2009.
2. Results for organics and lipids from 2010 are not used in analysis. See text for discussion.
3. Adult sport fish and alewife prey fish were collected by Honeywell in June 2012 just prior to the commencement of dredging in late July 2012. Minnow prey fish were collected in August 2012.
4. Sport fish analyzed as fillet samples. Small prey fish (various species) and large prey fish (white sucker in 2014-2018, and both white sucker and shorthead redhorse in 2021 and 2022) analyzed as whole-body samples.
5. Honeywell fish data collected in 2019 and 2020 were determined by NYSDEC to not be usable for statistical analyses or decision making. See text for discussion.
6. In 2021, one small prey fish sample and one large prey fish sample were inadvertently switched at the lipids lab and these lipids results were considered unusable.
7. Honeywell 2023 fish data were not available in time for inclusion in this Third FYR Report.

TABLE 2
NYSDEC FISH DATA USED IN THE ANALYSES (NUMBER OF SAMPLES)

Analyte	Baseline Monitoring																			
	2008					2009					2010					2011				
	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC
Mercury	45	0	0	0	0	50	0	0	0	0	50	16	15	15	10	53	0	15	14	1
Total PCBs	10	0	0	0	0	49	0	0	0	0	50	16	15	15	10	53	0	15	14	1
Total DDTs	10	0	0	0	0	49	0	0	0	0	50	16	15	15	10	53	0	15	14	1
Hexachlorobenzene	10	0	0	0	0	49	0	0	0	0	50	16	15	15	10	53	0	15	14	1
Lipids	10	0	0	0	0	50	0	0	0	0	50	16	15	15	10	53	0	15	14	1

Analyte	Monitoring During Remedial Action																								
	2012 (1)					2013					2014					2015					2016				
	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC
Mercury	50	0	15	15	5	50	10	0	0	0	41	0	0	0	0	53	0	0	0	0	55	0	19	0	0
Total PCBs	50	0	15	15	5	50	10	0	0	0	41	0	0	0	0	53	0	0	0	0	55	0	20	0	0
Total DDTs	50	0	15	15	5	50	10	0	0	0	41	0	0	0	0	53	0	0	0	0	55	0	20	0	0
Hexachlorobenzene	50	0	15	15	5	50	10	0	0	0	41	0	0	0	0	53	0	0	0	0	55	0	20	0	0
Lipids	50	0	15	15	5	50	10	0	0	0	41	0	0	0	0	53	0	0	0	0	55	0	20	0	0

Analyte	Post-Construction Monitoring																								
	2017					2018					2019					2020					2021				
	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC
Mercury	50	0	0	0	0	50	0	20	0	0	50	0	0	0	0	38	0	0	0	0	40	0	0	0	0
Total PCBs	50	0	0	0	0	50	0	20	0	0	50	0	0	0	0	38	0	0	0	0	40	0	0	0	0
Total DDTs	50	0	0	0	0	50	0	20	0	0	50	0	0	0	0	38	0	0	0	0	40	0	0	0	0
Hexachlorobenzene	50	0	0	0	0	50	0	20	0	0	50	0	0	0	0	38	0	0	0	0	40	0	0	0	0
Lipids	50	0	0	0	0	50	0	20	0	0	50	0	0	0	0	38	0	0	0	0	40	0	0	0	0

Analyte	Post-Construction Monitoring									
	2022					2023				
	LMB	CP	YP	WP	CHC	LMB	CP	YP	WP	CHC
Mercury	33	0	0	0	0	39	0	0	0	0
Total PCBs	33	0	0	0	0	39	0	0	0	0
Total DDTs	33	0	0	0	0	39	0	0	0	0
Hexachlorobenzene	33	0	0	0	0	39	0	0	0	0
Lipids	33	0	0	0	0	39	0	0	0	0

LMB - Largemouth Bass
CP - Carp
YP - Yellow Perch
WP - White Perch
CHC - Channel Catfish

Notes:
1. Fish were collected by NYSDEC in May 2012 prior to the commencement of dredging in late July 2012.
2. Fish analyzed as fillet samples.

TABLE 3a SUMMARY OF FISH TISSUE CHEMICAL CONCENTRATIONS: SPORT FISH FILLET (2015-2022)

Taxon	Chemical Name	Year	Sample Size	*(detects)*	Mean[1]	95% UCL Value[1]	95% UCL Calculation Type
Smallmouth Bass	Mercury (mg/kg)	2015	25	*(25)*	1.1	1.2	95% Student's-t UCL
		2016	25	*(25)*	0.92	1.0	95% Student's-t UCL
		2017	25	*(25)*	0.71	0.82	95% Student's-t UCL
		2018	25	*(25)*	0.79	0.91	95% Student's-t UCL
		2021	25	*(25)*	0.68	0.78	95% Student's-t UCL
		2022	25	*(25)*	0.79	0.89	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	25	*(25)*	1.9	2.2	95% Student's-t UCL
		2016	25	*(25)*	1.2	1.5	95% Adjusted Gamma UCL
		2017	25	*(25)*	0.50	0.61	95% Student's-t UCL
		2018	25	*(25)*	0.47	0.57	95% Student's-t UCL
		2021	25	*(25)*	0.23	0.30	95% Student's-t UCL
		2022	25	*(25)*	0.20	0.23	95% Student's-t UCL
	Dioxin/Furan Total TEQ (ng/kg)	2015	12	*(12)*	1.9	2.4	95% Student's-t UCL
		2017	12	*(12)*	1.5	1.9	95% Student's-t UCL
		2018	13	*(13)*	1.0	1.3	95% Student's-t UCL
		2021	12	*(12)*	0.75	0.86	95% Student's-t UCL
		2022	12	*(11)*	0.81	1.0	95% KM (t) UCL
	Hexachlorobenzene (mg/kg)	2015	25	*(23)*	0.0056	0.0072	95% KM Adjusted Gamma UCL
		2017	25	*(6)*	0.0021	0.0029	95% KM (t) UCL
		2018	25	*(0)*	--	--	--
		2021	25	*(22)*	0.000018	0.00022	95% KM (t) UCL
		2022	25	*(24)*	0.00019	0.00021	95% KM (t) UCL
Walleye	Mercury (mg/kg)	2015	25	*(25)*	1.4	1.6	95% Student's-t UCL
		2016	25	*(25)*	1.1	1.3	95% Student's-t UCL
		2017	25	*(25)*	0.77	0.91	95% Adjusted Gamma UCL
		2018	25	*(25)*	0.71	0.81	95% Student's-t UCL
		2021	25	*(24)*	0.80	0.92	95% KM (t) UCL
		2022	25	*(25)*	0.83	0.96	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	25	*(25)*	3.8	5.3	95% Adjusted Gamma UCL
		2016	25	*(25)*	2.5	3.3	95% Student's-t UCL
		2017	25	*(25)*	0.74	1.4	95% Chebyshev (Mean, Sd) UCL
		2018	25	*(25)*	0.96	1.2	95% Student's-t UCL
		2021	25	*(25)*	0.35	0.42	95% Student's-t UCL
		2022	25	*(25)*	0.30	0.41	95% H-UCL
	Dioxin/Furan Total TEQ (ng/kg)	2015	12	*(12)*	2.1	2.6	95% Student's-t UCL
		2017	12	*(12)*	1.6	2.4	95% Student's-t UCL
		2018	13	*(13)*	1.8	2.5	95% Student's-t UCL
		2021	12	*(12)*	0.73	0.83	95% Student's-t UCL
		2022	12	*(12)*	0.64	0.74	95% Student's-t UCL
	Hexachlorobenzene (mg/kg)	2015	25	*(25)*	0.027	0.032	95% Student's-t UCL
		2017	25	*(17)*	0.0044	0.0065	95% KM Adjusted Gamma UCL
		2018	25	*(3)*	--	--	--
		2021	25	*(25)*	0.00041	0.00046	95% Student's-t UCL
		2022	25	*(25)*	0.00042	0.00052	95% Standard Bootstrap UCL[2]

Notes:

1. For 2015 - 2018, mean and 95% UCL were calculated using ProUCL version 5.1. For 2021 and 2022, mean and 95% UCL were calculated using ProUCL version 5.2. UCLs were not calculated when 3 or fewer results were detects (USEPA,2015). 95% UCL is an estimate of the upper bound for the true population mean. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the detection/reporting limit).
2. For 2021-2022, ProUCL version 5.2 suggested the 95% Student's-t UCL for datasets that did not follow a discernible distribution when all samples were detected. These circumstances were reviewed, and the non-parametric 95% Standard Bootstrap UCL was determined to be a better fit for these datasets.

Abbreviations:

-- Insufficient data to calculate Mean or 95% UCL; 3 or fewer results were detects DDT: dichlorodiphenyltrichloroethane
KM: Kaplan-Meier
mg/kg: milligrams per kilogram
ng/kg: nanograms per kilogram
ND: non-detect
PCB: polychlorinated biphenyl
TEQ: toxicity equivalent quotient
UCL: upper confidence limit

References:

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USEPA, 2022. ProUCL Version 5.2 User Guide. https://nepis.epa.gov/Exe/ZyPDF.cgi/P10157JD.PDF?Dockey=P10157JD.PDF Accessed November 21, 2024.

Note: Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the mean and 95% UCL values in this table will be revised and documented in an addendum to this FYR.

TABLE 3a SUMMARY OF FISH TISSUE CHEMICAL CONCENTRATIONS: SPORT FISH FILLET (2015-2022)

Taxon	Chemical Name	Year	Sample Size	*(detects)*	Mean[1]	95% UCL Value[1]	95% UCL Calculation Type
Common Carp	Mercury (mg/kg)	2015	25	*(25)*	0.20	0.31	95% H-UCL
		2016	25	*(25)*	0.20	0.24	95% Adjusted Gamma UCL
		2017	25	*(25)*	0.19	0.24	95% Student's-t UCL
		2018	25	*(20)*	0.097	0.14	95% KM Adjusted Gamma UCL
		2021	25	*(25)*	0.14	0.18	95% Standard Bootstrap UCL[2]
		2022	25	*(19)*	0.14	0.17	95% KM (t) UCL
	Total PCBs (mg/kg)	2015	25	*(25)*	2.0	2.9	95% Adjusted Gamma UCL
		2016	25	*(25)*	1.8	2.7	95% Adjusted Gamma UCL
		2017	25	*(25)*	0.50	0.74	95% Adjusted Gamma UCL
		2018	25	*(25)*	0.27	0.44	95% Adjusted Gamma UCL
		2021	25	*(25)*	0.19	0.26	95% Student's-t UCL
		2022	25	*(25)*	0.31	0.46	95% Adjusted Gamma UCL
	Dioxin/Furan Total TEQ (ng/kg)	2015	12	*(12)*	5.9	15	95% Adjusted Gamma UCL
		2017	12	*(12)*	4.2	9.2	95% Adjusted Gamma UCL
		2018	14	*(14)*	1.1	3.2	95% H-UCL
		2021	12	*(12)*	1.0	1.4	95% Student's-t UCL
		2022	12	*(10)*	1.5	5.3	95% KM Bootstrap t UCL
	Hexachlorobenzene (mg/kg)	2015	25	*(23)*	0.038	0.081	Gamma Adjusted KM-UCL (use when k<=1 and 15 < n < 50 but k<=1)
		2017	25	*(13)*	0.0040	0.0056	95% KM (t) UCL
		2018	25	*(2)*	--	--	--
		2021	25	*(22)*	0.00043	0.00065	95% KM Adjusted Gamma UCL
		2022	25	*(24)*	0.00064	0.00082	95% KM (t) UCL
Pumpkinseed	Mercury (mg/kg)	2015	25	*(25)*	0.28	0.32	95% Student's-t UCL
		2016	25	*(25)*	0.19	0.24	95% Adjusted Gamma UCL
		2017	25	*(25)*	0.17	0.20	95% Student's-t UCL
		2018	25	*(16)*	0.088	0.11	95% KM (t) UCL
		2021	25	*(24)*	0.13	0.16	95% KM (t) UCL
		2022	25	*(24)*	0.13	0.16	95% KM (t) UCL
	Total PCBs (mg/kg)	2015	25	*(25)*	0.14	0.18	95% Adjusted Gamma UCL
		2016	25	*(17)*	0.045	0.21	KM H-UCL
		2017	25	*(25)*	0.096	0.13	95% Adjusted Gamma UCL
		2018	25	*(23)*	0.090	0.12	95% KM Adjusted Gamma UCL
		2021	25	*(22)*	0.017	0.021	95% KM (t) UCL
		2022	25	*(15)*	0.024	0.061	95% KM Adjusted Gamma UCL
	Dioxin/Furan Total TEQ (ng/kg)	2015	12	*(9)*	0.38	0.53	95% KM (t) UCL
		2017	12	*(12)*	0.27	0.33	95% Student's-t UCL
		2018	12	*(12)*	0.54	0.73	95% Student's-t UCL
		2021	12	*(1)*	--	--	--
		2022	12	*(7)*	0.36	0.60	95% KM Adjusted Gamma UCL
	Hexachlorobenzene (mg/kg)	2015	25	*(1)*	--	--	--
		2017	20	*(0)*	--	--	--
		2018	23	*(0)*	--	--	--
		2021	25	*(11)*	0.000083	0.000099	95% KM (t) UCL
		2022	25	*(14)*	0.00010	0.00012	95% KM (t) UCL

Notes:

1. For 2015 - 2018, mean and 95% UCL were calculated using ProUCL version 5.1. For 2021 and 2022, mean and 95% UCL were calculated using ProUCL version 5.2. UCLs were not calculated when 3 or fewer results were detects (USEPA,2015). 95% UCL is an estimate of the upper bound for the true population mean. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the detection/reporting limit).
2. For 2021-2022, ProUCL version 5.2 suggested the 95% Student's-t UCL for datasets that did not follow a discernible distribution when all samples were detected. These circumstances were reviewed, and the non-parametric 95% Standard Bootstrap UCL was determined to be a better fit for these datasets.

Abbreviations:

-- Insufficient data to calculate Mean or 95% UCL; 3 or fewer results were detects DDT: dichlorodiphenyltrichloroethane
KM: Kaplan-Meier
mg/kg: milligrams per kilogram
ng/kg: nanograms per kilogram
ND: non-detect
PCB: polychlorinated biphenyl
TEQ: toxicity equivalent quotient
UCL: upper confidence limit

References:

USEPA, 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041 https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf Accessed May 22, 2020.
USEPA, 2022. ProUCL Version 5.2 User Guide. https://nepis.epa.gov/Exe/ZyPDF.cgi/P10157JD.PDF?Dockey=P10157JD.PDF Accessed November 21, 2024.

Note: Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the mean and 95% UCL values in this table will be revised and documented in an addendum to this FYR.

TABLE 3b SUMMARY OF FISH TISSUE CHEMICAL CONCENTRATIONS: PREY FISH WHOLE BODY (2015-2022)

Taxon	Chemical Name	Year	Sample Size	*(detects)*	Mean[1]	95% UCL Value[1]	95% UCL Calculation Type
Large Prey Fish	Mercury (mg/kg)	2015	24	*(23)*	0.19	0.24	95% KM (t) UCL
		2016	24	*(23)*	0.13	0.16	95% KM (t) UCL
		2017	24	*(24)*	0.093	0.14	95% Adjusted Gamma UCL
		2018	24	*(14)*	0.17	0.21	95% KM (t) UCL
		2021	24	*(24)*	0.12	0.16	95% Adjusted Gamma UCL
		2022	24	*(24)*	0.14	0.17	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	24	*(24)*	1.6	2.0	95% Student's-t UCL
		2016	24	*(24)*	0.73	1.0	95% Adjusted Gamma UCL
		2017	24	*(24)*	0.36	0.50	95% Adjusted Gamma UCL
		2018	24	*(23)*	0.10	0.13	95% KM (t) UCL
		2021	24	*(24)*	0.33	0.51	95% Adjusted Gamma UCL
		2022	24	*(24)*	0.24	0.29	95% Student's-t UCL
	Sum of DDT and Metabolites (mg/kg)	2015	24	*(24)*	0.020	0.026	95% Adjusted Gamma UCL
		2017	24	*(24)*	0.016	0.021	95% Adjusted Gamma UCL
		2018	24	*(20)*	0.025	0.098	95% KM (Chebyshev) UCL
		2021	24	*(24)*	0.024	0.039	95% Adjusted Gamma UCL
		2022	24	*(24)*	0.022	0.026	95% Student's-t UCL
	Hexachlorobenzene (mg/kg)	2015	24	*(13)*	0.0095	0.018	95% KM Adjusted Gamma UCL
		2017	24	*(10)*	0.0019	0.0023	95% KM (t) UCL
		2018	24	*(1)*	--	--	--
		2021	24	*(22)*	0.00040	0.00053	95% KM (t) UCL
		2022	24	*(24)*	0.00033	0.00042	95% Student's-t UCL
Small Prey Fish	Mercury (mg/kg)	2015	24	*(24)*	0.14	0.16	95% Student's-t UCL
		2016	24	*(24)*	0.087	0.099	95% Student's-t UCL
		2017	24	*(21)*	0.057	0.074	95% KM (t) UCL
		2018	24	*(11)*	0.072	0.087	95% KM (t) UCL
		2021	24	*(24)*	0.071	0.079	95% Student's-t UCL
		2022	24	*(24)*	0.063	0.070	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	24	*(23)*	0.16	0.39	KM H-UCL
		2016	24	*(24)*	0.17	0.23	95% Adjusted Gamma UCL
		2017	24	*(24)*	0.11	0.25	95% Chebyshev (Mean, Sd) UCL
		2018	24	*(24)*	0.049	0.13	95% H-UCL
		2021	24	*(24)*	0.13	0.20	95% Standard Bootstrap UCL[2]
		2022	24	*(21)*	0.051	0.13	95% H-UCL
	Sum of DDT and Metabolites (mg/kg)	2015	24	*(13)*	0.0021	0.0029	95% KM Adjusted Gamma UCL
		2017	24	*(23)*	0.0052	0.0093	KM H-UCL
		2018	24	*(24)*	0.0061	0.0076	95% Student's-t UCL
		2021	24	*(24)*	0.0028	0.0036	95% Standard Bootstrap UCL[2]
		2022	24	*(24)*	0.0016	0.0020	95% Student's-t UCL
	Hexachlorobenzene (mg/kg)	2015	24	*(3)*	--	--	--
		2017	24	*(3)*	--	--	--
		2018	24	*(0)*	--	--	--
		2021	24	*(8)*	0.000087	0.00011	95% KM (t) UCL
		2022	24	*(8)*	0.00050	0.00093	95% KM (t) UCL

Notes:

1. For 2015 - 2018, mean and 95% UCL were calculated using ProUCL version 5.1. For 2021 and 2022, mean and 95% UCL were calculated using ProUCL version 5.2. UCLs were not calculated when 3 or fewer results were detects (USEPA,2015). 95% UCL is an estimate of the upper bound for the true population mean. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the detection/reporting limit).
2. In 2021, ProUCL version 5.2 suggested the 95% Student's-t UCL for datasets that did not follow a discernible distribution when all samples were detected. These circumstances were reviewed, and the non-parametric 95% Standard Bootstrap UCL was determined to be a better fit for these datasets.

Abbreviations:

-- Insufficient data to calculate Mean or 95% UCL; 3 or fewer results were detects
DDT: dichlorodiphenyltrichloroethane
KM: Kaplan-Meier
mg/kg: milligrams per kilogram
ND: non-detect
PCB: polychlorinated biphenyl
UCL: upper confidence limit

References:

USEPA, 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041 https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf Accessed May 22, 2020.

USEPA, 2022. ProUCL Version 5.2 User Guide. https://nepis.epa.gov/Exe/ZyPDF.cgi/P10157JD.PDF?Dockey=P10157JD.PDF Accessed November 21, 2024.

Note: Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the mean and 95% UCL values in this table will be revised and documented in an addendum to this FYR.

TABLE 3c SUMMARY OF FISH TISSUE CHEMICAL CONCENTRATIONS: SPORT FISH CALCULATED WHOLE BODY (2015-2022)

Taxon	Size[2]	Chemical Name	Year	Sample Size	*(detects)*	Mean[3]	95% UCL Value[3]	95% UCL Calculation Type
Smallmouth Bass	Large	Mercury (mg/kg)	2015	25	*(25)*	0.75	0.82	95% Student's-t UCL
			2016	25	*(25)*	0.65	0.71	95% Student's-t UCL
			2017	25	*(25)*	0.50	0.58	95% Student's-t UCL
			2018	25	*(25)*	0.55	0.64	95% Student's-t UCL
			2021	25	*(25)*	0.48	0.54	95% Student's-t UCL
			2022	25	*(25)*	0.55	0.62	95% Student's-t UCL
		Total PCBs (mg/kg)	2015	25	*(25)*	4.8	5.5	95% Student's-t UCL
			2016	25	*(25)*	3.0	3.7	95% Adjusted Gamma UCL
			2017	25	*(25)*	1.3	1.5	95% Student's-t UCL
			2018	25	*(25)*	1.2	1.4	95% Student's-t UCL
			2021	25	*(25)*	0.56	0.74	95% Student's-t UCL
			2022	25	*(25)*	0.50	0.59	95% Student's-t UCL
		Hexachlorobenzene (mg/kg)	2015	25	*(23)*	0.013	0.017	95% KM Adjusted Gamma UCL
			2017	25	*(6)*	0.0048	0.0066	95% KM (t) UCL
			2018	25	*(0)*	--	--	--
			2021	25	*(22)*	0.00042	0.00051	95% KM (t) UCL
			2022	25	*(24)*	0.00040	0.00049	95% KM (t) UCL
Walleye	Large	Mercury (mg/kg)	2015	25	*(25)*	0.96	1.1	95% Student's-t UCL
			2016	24	*(24)*	0.77	0.90	95% Student's-t UCL
			2017	25	*(25)*	0.54	0.64	95% Adjusted Gamma UCL
			2018	25	*(25)*	0.50	0.57	95% Student's-t UCL
			2021	24	*(24)*	0.56	0.65	95% KM (t) UCL
			2022	25	*(25)*	0.58	0.67	95% Student's-t UCL
		Total PCBs (mg/kg)	2015	25	*(25)*	9.6	13	95% Adjusted Gamma UCL
			2016	24	*(24)*	6.0	7.9	95% Student's-t UCL
			2017	25	*(25)*	1.8	3.5	95% Chebyshev (Mean, Sd) UCL
			2018	25	*(25)*	2.4	3.0	95% Student's-t UCL
			2021	25	*(25)*	0.88	1.0	95% Student's-t UCL
			2022	25	*(25)*	0.74	1.0	95% H-UCL
		Hexachlorobenzene (mg/kg)	2015	25	*(25)*	0.062	0.073	95% Student's-t UCL
			2017	25	*(17)*	0.010	0.015	95% KM Adjusted Gamma UCL
			2018	25	*(3)*	--	--	--
			2021	25	*(25)*	0.00094	0.0011	95% Student's-t UCL
			2022	25	*(25)*	0.00097	0.0012	95% Standard Bootstrap UCL[4]
Common Carp	Large	Mercury (mg/kg)	2015	13	*(13)*	0.11	0.14	95% Adjusted Gamma UCL
			2016	9	*(9)*	0.10	0.12	95% Student's-t UCL
			2017	10	*(10)*	0.10	0.14	95% Student's-t UCL
			2018	18	*(13)*	0.036	0.048	95% KM (t) UCL
			2021	18	*(18)*	0.059	0.068	95% Student's-t UCL
			2022	9	*(4)*	0.071	0.14	95% KM (t) UCL
		Total PCBs (mg/kg)	2015	13	*(13)*	1.5	4.6	95% H-UCL
			2016	9	*(9)*	1.6	2.2	95% Student's-t UCL
			2017	10	*(10)*	0.64	1.9	95% Chebyshev (Mean, Sd) UCL
			2018	18	*(18)*	0.26	0.41	95% Adjusted Gamma UCL
			2021	18	*(18)*	0.26	0.35	95% Student's-t UCL
			2022	9	*(9)*	0.68		Recommendation cannot be provided[5]
		Hexachlorobenzene (mg/kg)	2015	13	*(11)*	0.067	0.30	95% KM (Chebyshev) UCL
			2017	10	*(3)*	--	--	--
			2018	18	*(2)*	--	--	--
			2021	18	*(16)*	0.0008	0.0011	95% KM (t) UCL
			2022	9	*(9)*	0.00065	0.00092	95% Student's-t UCL

Notes:

1. Although not collected as prey fish, remedial goals and target concentrations may be compared to contaminant concentrations in whole body sportfish (i.e., specifically Smallmouth Bass, Walleye, Pumpkinseed, and Common Carp in the OLMMP) where fillet data are converted to whole body data using "conversion factors developed in the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (i.e., 0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) (TAMS 2002b)" (Parsons 2018). For these calculations, fish with lengths 180–600 mm and 30–180 mm are compared to goal and target concentrations for large and small prey fish, respectively.

2. Small fish defined as 30 - 180 mm. Large fish defined as 180 - 600 mm.

3. For 2015 through 2018, mean and 95% UCL were calculated using ProUCL version 5.1. For 2021 and 2022, mean and 95% UCL were calculated using ProUCL version 5.2. UCLS were not calculated when 3 or fewer results were detects (USEPA,2015). 95% UCL is an estimate of the upper bound for the true population mean. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).

4. For 2022, ProUCL version 5.2 suggested the 95% Student's-t UCL for datasets that did not follow a discernible distribution when all samples were detected. These circumstances were reviewed, and the non-parametric 95% Standard Bootstrap UCL was determined to be a better fit for these datasets.

5. ProUCL did not recommend a suggested UCL for this population, likely due to the small samples size along with the distribution of the data.

Abbreviations:

-- Insufficient data to calculate Mean or 95% UCL; 3 or fewer results were detects

DDT: dichlorodiphenyltrichloroethane

MDL: method detection limit

mg/kg: milligrams per kilogram

mm: millimeter

OLMMP: Onondaga Lake Monitoring and Maintenance Plan

PCB: polychlorinated biphenyl

RL: reporting limit

UCL: upper confidence limit

References:

Parsons, 2018. *Onondaga Lake Monitoring and Maintenance Plan* . Prepared for Honeywell. June 2018.

USEPA, 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041 https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf Accessed May 22, 2020.

USEPA, 2022. ProUCL Version 5.2 User Guide. https://nepis.epa.gov/Exe/ZyPDF.cgi/P10157JD.PDF?Dockey=P10157JD.PDF Accessed November 21, 2024.

Note: Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the mean and 95% UCL values in this table will be revised and documented in an addendum to this FYR.

TABLE 3c SUMMARY OF FISH TISSUE CHEMICAL CONCENTRATIONS: SPORT FISH CALCULATED WHOLE BODY (2015-2022)

Taxon	Size[2]	Chemical Name	Year	Sample Size	*(detects)*	Mean[3]	95% UCL Value[3]	95% UCL Calculation Type
Pumpkinseed	Large	Mercury (mg/kg)	2015	2	*(2)*	--	--	--
			2016	8	*(8)*	0.21	0.27	95% Student's-t UCL
			2017	5	*(5)*	0.17	0.23	95% Student's-t UCL
			2018	5	*(4)*	0.10	0.15	95% KM (t) UCL
			2021	3	*(3)*	--	--	--
			2022	6	*(6)*	0.12	0.20	95% Student's-t UCL
		Total PCBs (mg/kg)	2015	2	*(2)*	--	--	--
			2016	8	*(6)*	0.14	0.22	95% KM (t) UCL
			2017	5	*(5)*	0.22	0.27	95% Student's-t UCL
			2018	5	*(5)*	0.28	0.42	95% Student's-t UCL
			2021	3	*(3)*	--	--	--
			2022	6	*(0)*	--	--	--
		Hexachlorobenzene (mg/kg)	2015	2	*(0)*	--	--	--
			2017	5	*(0)*	--	--	--
			2018	5	*(0)*	--	--	--
			2021	3	*(0)*	--	--	--
			2022	6	*(0)*	--	--	--
	Small	Mercury (mg/kg)	2015	23	*(23)*	0.19	0.22	95% Student's-t UCL
			2016	17	*(17)*	0.097	0.13	95% Adjusted Gamma UCL
			2017	20	*(20)*	0.11	0.13	95% Student's-t UCL
			2018	20	*(12)*	0.052	0.063	95% KM (t) UCL
			2021	22	*(21)*	0.085	0.10	95% KM (t) UCL
			2022	19	*(18)*	0.083	0.11	95% KM Adjusted Gamma UCL
		Total PCBs (mg/kg)	2015	23	*(23)*	0.36	0.46	95% Adjusted Gamma UCL
			2016	17	*(11)*	0.31	0.91	95% KM (Chebyshev) UCL
			2017	20	*(20)*	0.25	0.35	95% Adjusted Gamma UCL
			2018	20	*(18)*	0.21	0.29	95% KM Adjusted Gamma UCL
			2021	22	*(19)*	0.045	0.057	95% KM (t) UCL
			2022	19	*(15)*	0.076	0.20	95% Adjusted Gamma UCL
		Hexachlorobenzene (mg/kg)	2015	23	*(1)*	--	--	--
			2017	15	*(0)*	--	--	--
			2018	18	*(0)*	--	--	--
			2021	22	*(11)*	0.00020	0.00024	95% KM (t) UCL
			2022	19	*(14)*	0.00025	0.00032	95% KM (t) UCL

Notes:

1. Although not collected as prey fish, remedial goals and target concentrations may be compared to contaminant concentrations in whole body sportfish (i.e., specifically Smallmouth Bass, Walleye, Pumpkinseed, and Common Carp in the OLMMP) where fillet data are converted to whole body data using "conversion factors developed in the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (i.e., 0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) (TAMS 2002b)" (Parsons 2018). For these calculations, fish with lengths 180–600 mm and 30–180 mm are compared to goal and target concentrations for large and small prey fish, respectively.
2. Small fish defined as 30 - 180 mm. Large fish defined as 180 - 600 mm.
3. For 2015 through 2018, mean and 95% UCL were calculated using ProUCL version 5.1. For 2021 and 2022, mean and 95% UCL were calculated using ProUCL version 5.2. UCLS were not calculated when 3 or fewer results were detects (USEPA,2015). 95% UCL is an estimate of the upper bound for the true population mean. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).
4. For 2022, ProUCL version 5.2 suggested the 95% Student's-t UCL for datasets that did not follow a discernible distribution when all samples were detected. These circumstances were reviewed, and the non-parametric 95% Standard Bootstrap UCL was determined to be a better fit for these datasets.
5. ProUCL did not recommend a suggested UCL for this population, likely due to the small samples size along with the distribution of the data.

Abbreviations:

-- Insufficient data to calculate Mean or 95% UCL; 3 or fewer results were detects

DDT: dichlorodiphenyltrichloroethane

MDL: method detection limit

mg/kg: milligrams per kilogram

mm: millimeter

OLMMP: Onondaga Lake Monitoring and Maintenance Plan

PCB: polychlorinated biphenyl

RL: reporting limit

UCL: upper confidence limit

References:

Parsons, 2018. *Onondaga Lake Monitoring and Maintenance Plan* . Prepared for Honeywell. June 2018.

USEPA, 2015. ProUCL Version 5.1 User Guide. EPA/600/R-07/041 https://www.epa.gov/sites/production/files/2016-05/documents/proucl_5.1_user-guide.pdf Accessed May 22, 2020.

USEPA, 2022. ProUCL Version 5.2 User Guide. https://nepis.epa.gov/Exe/ZyPDF.cgi/P10157JD.PDF?Dockey=P10157JD.PDF Accessed November 21, 2024.

Note: Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then the mean and 95% UCL values in this table will be revised and documented in an addendum to this FYR.

Table 4a.
Summary of NYSDEC Fish Tissue Chemical Concentrations: Sport Fish Fillet Data (2015 - 2023)

Taxon	Chemical Name	Year	Sample Size *(detects)*		Mean[1]	95% UCL Value[2]	95% UCL Calculation Type from ProUCL
Largemouth Bass	Mercury (mg/kg)	2015	53	*(53)*	0.898	0.963	95% H-UCL
		2016	55	*(55)*	0.809	0.868	95% Student's-t UCL
		2017	50	*(50)*	0.852	0.936	95% Student's-t UCL
		2018	50	*(50)*	0.915	0.989	95% Student's-t UCL
		2019	50	*(50)*	0.691	0.778	95% Approximate Gamma UCL
		2020	38	*(38)*	0.604	0.668	95% Student's-t UCL
		2021	40	*(40)*	0.925	0.999	95% Student's-t UCL
		2022	33	*(33)*	0.791	0.891	95% Student's-t UCL
		2023	39	*(39)*	0.633	0.708	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	53	*(53)*	0.873	1.033	95% Approximate Gamma UCL
		2016	55	*(55)*	0.481	0.579	95% Approximate Gamma UCL
		2017	50	*(50)*	0.926	1.046	95% Student's-t UCL
		2018	50	*(50)*	0.844	0.962	95% Student's-t UCL
		2019	50	*(50)*	0.873	0.997	95% Student's-t UCL
		2020	38	*(38)*	0.519	0.613	95% Student's-t UCL
		2021	40	*(40)*	0.595	0.698	95% Student's-t UCL
		2022	33	*(32)*	0.806	0.942	95% KM (t) UCL
		2023	39	*(39)*	0.698	0.851	95% Student's-t UCL
	Total DDTs (mg/kg)	2015	53	*(53)*	0.0229	0.0276	95% Approximate Gamma UCL
		2016	55	*(55)*	0.0172	0.0211	95% Approximate Gamma UCL
		2017	50	*(50)*	0.0317	0.0378	95% Student's-t UCL
		2018	50	*(50)*	0.0319	0.0369	95% Student's-t UCL
		2019	50	*(50)*	0.0347	0.0397	95% Student's-t UCL
		2020	38	*(38)*	0.0211	0.0242	95% Student's-t UCL
		2021	40	*(40)*	0.0292	0.0343	95% Student's-t UCL
		2022	33	*(33)*	0.0340	0.0405	95% Student's-t UCL
		2023	39	*(39)*	0.039	0.048	95% Adjusted Gamma UCL
	Hexachlorobenzene (mg/kg)	2015	53	*(36)*	0.009	0.010	95% GROS Approximate Gamma UCL
		2016	55	*(8)*	0.002	0.002	95% KM (t) UCL
		2017	50	*(0)*	*0.001 U*	--	--
		2018	50	*(0)*	*0.001 U*	--	--
		2019	50	*(0)*	*0.001 U*	--	--
		2020	38	*(0)*	*0.001 U*	--	--
		2021	40	*(0)*	*0.001 U*	--	--
		2022	33	*(0)*	*0.001 U*	--	--
		2023	39	*(0)*	*0.001 U*	--	--

Notes:

1. For calculation of the mean for data sets with non-detects (NDs), USEPA's ProUCL was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).
2. 95% UCL was calculated using USEPA's ProUCL version 5.1 for data through 2018; version 5.2 was used for 2019 to 2023 data. 95% UCL is an estimate of the upper bound for the true population mean; 95% UCL was not calculated when 3 or fewer results were detects. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).

Abbreviations:

-- Insufficient data to calculate 95% UCL; 3 or fewer results were detects
DDT: dichlorodiphenyltrichloroethane
mg/kg: milligrams per kilogram
PCB: polychlorinated biphenyl
UCL: upper confidence limit
U: non detect

Table 4b.

Summary of NYSDEC Fish Tissue Chemical Concentrations: Sport Fish Calculated Whole Body[1] (2015 - 2023)

Taxon	Chemical Name	Year	Sample Size *(detects)*		Mean[2]	95% UCL Value[3]	95% UCL Calculation Type from ProUCL
Whole Body (calculated) Largemouth Bass	Mercury (mg/kg)	2015	53	*(53)*	0.629	0.674	95% H-UCL
		2016	55	*(55)*	0.566	0.607	95% Student's-t UCL
		2017	50	*(50)*	0.596	0.655	95% Student's-t UCL
		2018	50	*(50)*	0.641	0.692	95% Student's-t UCL
		2019	50	*(50)*	0.484	0.544	95% Approximate Gamma UCL
		2020	38	*(38)*	0.422	0.467	95% Student's-t UCL
		2021	40	*(40)*	0.648	0.699	95% Student's-t UCL
		2022	33	*(33)*	0.554	0.624	95% Student's-t UCL
		2023	39	*(39)*	0.443	0.496	95% Student's-t UCL
	Total PCBs (mg/kg)	2015	53	*(53)*	2.181	2.583	95% Approximate Gamma UCL
		2016	55	*(55)*	1.204	1.448	95% Approximate Gamma UCL
		2017	50	*(50)*	2.315	2.616	95% Student's-t UCL
		2018	50	*(50)*	2.111	2.403	95% Student's-t UCL
		2019	50	*(50)*	2.183	2.491	95% Student's-t UCL
		2020	38	*(38)*	1.299	1.534	95% Student's-t UCL
		2021	40	*(40)*	1.487	1.745	95% Student's-t UCL
		2022	33	*(32)*	2.014	2.354	95% KM (t) UCL
		2023	39	*(39)*	1.745	2.127	95% Student's-t UCL
	Total DDTs (mg/kg)	2015	53	*(53)*	0.053	0.064	95% Approximate Gamma UCL
		2016	55	*(55)*	0.039	0.049	95% Approximate Gamma UCL
		2017	50	*(50)*	0.073	0.085	95% Student's-t UCL
		2018	50	*(50)*	0.073	0.082	95% Student's-t UCL
		2019	50	*(50)*	0.080	0.091	95% Student's-t UCL
		2020	38	*(38)*	0.049	0.056	95% Student's-t UCL
		2021	40	*(40)*	0.067	0.079	95% Student's-t UCL
		2022	33	*(33)*	0.078	0.093	95% Student's-t UCL
		2023	39	*(39)*	0.090	0.110	95% Adjusted Gamma UCL
	Hexachlorobenzene (mg/kg)	2015	53	*(36)*	0.016	0.018	95% GROS Approximate Gamma UCL
		2016	55	*(8)*	0.005	0.005	95% KM (t) UCL
		2017	50	*(0)*	*0.002 U*	--	--
		2018	50	*(0)*	*0.002 U*	--	--
		2019	50	*(0)*	*0.002 U*	--	--
		2020	38	*(0)*	*0.002 U*	--	--
		2021	40	*(0)*	*0.002 U*	--	--
		2022	33	*(0)*	*0.002 U*	--	--
		2023	39	*(0)*	*0.002 U*	--	--

Notes:

1. Although not collected as prey fish, remedial goals and target concentrations may be compared to contaminant concentrations in whole body sportfish (i.e., specifically Largemouth Bass and Yellow Perch) where fillet data are converted to whole body concentrations using "conversion factors developed in the Onondaga Lake Baseline Ecological Risk Assessment (BERA) (i.e., 0.7 for mercury, 2.5 for PCBs, and 2.3 for DDTs and hexachlorobenzene) (TAMS 2002b)" (Parsons 2018). For these calculations, fish with lengths 180–600 mm are compared to the goal and target concentrations for large prey fish.

2. For calculation of the mean for data sets with non-detects (NDs), USEPA's ProUCL was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).

3. 95% UCL was calculated using USEPA's ProUCL version 5.1 for data through 2018; version 5.2 was used for 2019 to 2023 data. 95% UCL is an estimate of the upper bound for the true population mean; 95% UCL was not calculated when 3 or fewer results were detects. For data sets with NDs, the stated statistical method was used for handling NDs rather than the substitution method (i.e., one-half of the reported concentration).

Abbreviations:

-- Insufficient data to calculate 95% UCL; 3 or fewer results were detects

DDT: dichlorodiphenyltrichloroethane

mg/kg: milligrams per kilogram

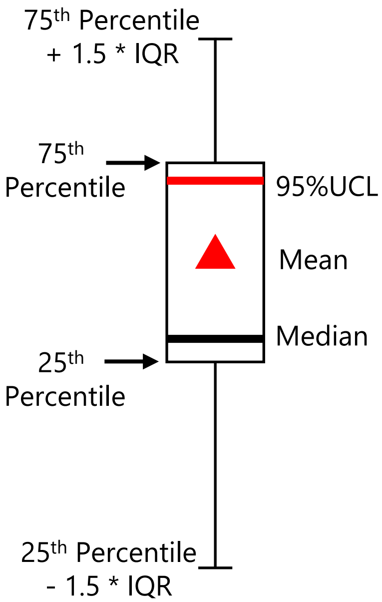
PCB: polychlorinated biphenyl

UCL: upper confidence limit

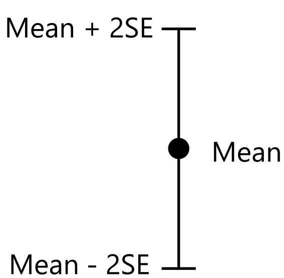
U: non detect

Attachment 3 Figures

Box and Whisker Plot



Mean and Standard Error (SE) Plot



Plot Notes

- 95%UCL: estimate of the upper bound for the true population mean; calculated using ProUCL Version 5.1 for years prior to 2021 and using ProUCL Version 5.2 for 2021 and 2022; not calculated when 3 or fewer results were detects. For data sets with NDs, ProUCL selected the statistical method. The substitution method (i.e., one-half of the MDL or RL) was not used.
- Mean: mean or average concentration; calculated by ProUCL using the same statistical method used for 95%UCL unless 3 or fewer results were detects. In that case, for plots showing the 95%UCL, the arithmetic mean was calculated with non-detects substituted at 1/2 MDL for mercury and 1/2 RL for most organic analytes (substitution method). The arithmetic mean was also calculated using the substitution method for all standard error plots.
- Median: median or midpoint concentration.
- 25th and 75th Percentiles: concentrations below which 25% and 75% of concentrations are found. The lower whisker extends to the minimum or smallest value within Q1 minus 1.5 times the IQR, whichever is higher. The upper whisker extends to the maximum or largest value within Q3 plus 1.5 times the IQR, whichever is lower.
- IQR: Interquartile Range – the range between the 25th and 75th percentiles.
- **Δ** Open symbol indicates 3 or fewer results were detects in box and whisker plots, and ND in standard error plots.
- 2SE: two times the standard error of the mean.
- "^" indicates mean value is above axis range in standard error plots; 2SE values above the axis range are not annotated.
- "ND" indicates all results were non-detects and no statistics are shown.

Analyte-Specific Details

- Total PCB is the sum of detected Aroclors. If all Aroclors are non-detects, 1/2 the maximum RL is used.
- For Dioxin/Furan Total TEQ, non-detects summed at 1/2 MDL, except for 2014 and 2015, which used 1/2 RDL; plots for 2021 and 2022 data show non-detects at 0 and 1/2 MDL. TEQs calculated using the World Health Organization 2005 human and mammalian toxic equivalency factors (TEFs) from Van den Berg et al. 2006).
- 2010 organic analyte data are excluded from temporal plots due to analytical issues.
- 2019 and 2020 data are excluded due to incomplete homogenization.
- Dioxin/furans, DDT and metabolites, and hexachlorobenzene were not analyzed on an annual basis.
- Nitrate addition began in 2011.

Fish Details

- Sport fish for comparison to human health criteria and targets
  - Smallmouth Bass, Walleye, Pumpkinseed, and Common Carp (collection of Common Carp began in 2014)
  - NYSDEC standard fillets
- Small prey fish for comparison to ecological criteria and targets
  - Primarily Banded Killifish but Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, and Round Goby were collected if Banded Killifish are unavailable (Alewife excluded).
  - Whole body composite samples
- Large prey fish for comparison to ecological criteria and targets
  - White Sucker and Shorthead Redhorse
  - Collection began in 2014
  - Individual whole-body samples
- All ages and both sexes were combined.
- In 2012, in-lake remediation began in late July; small prey fish were sampled in early August, and remaining species were sampled in mid-June to early-July.

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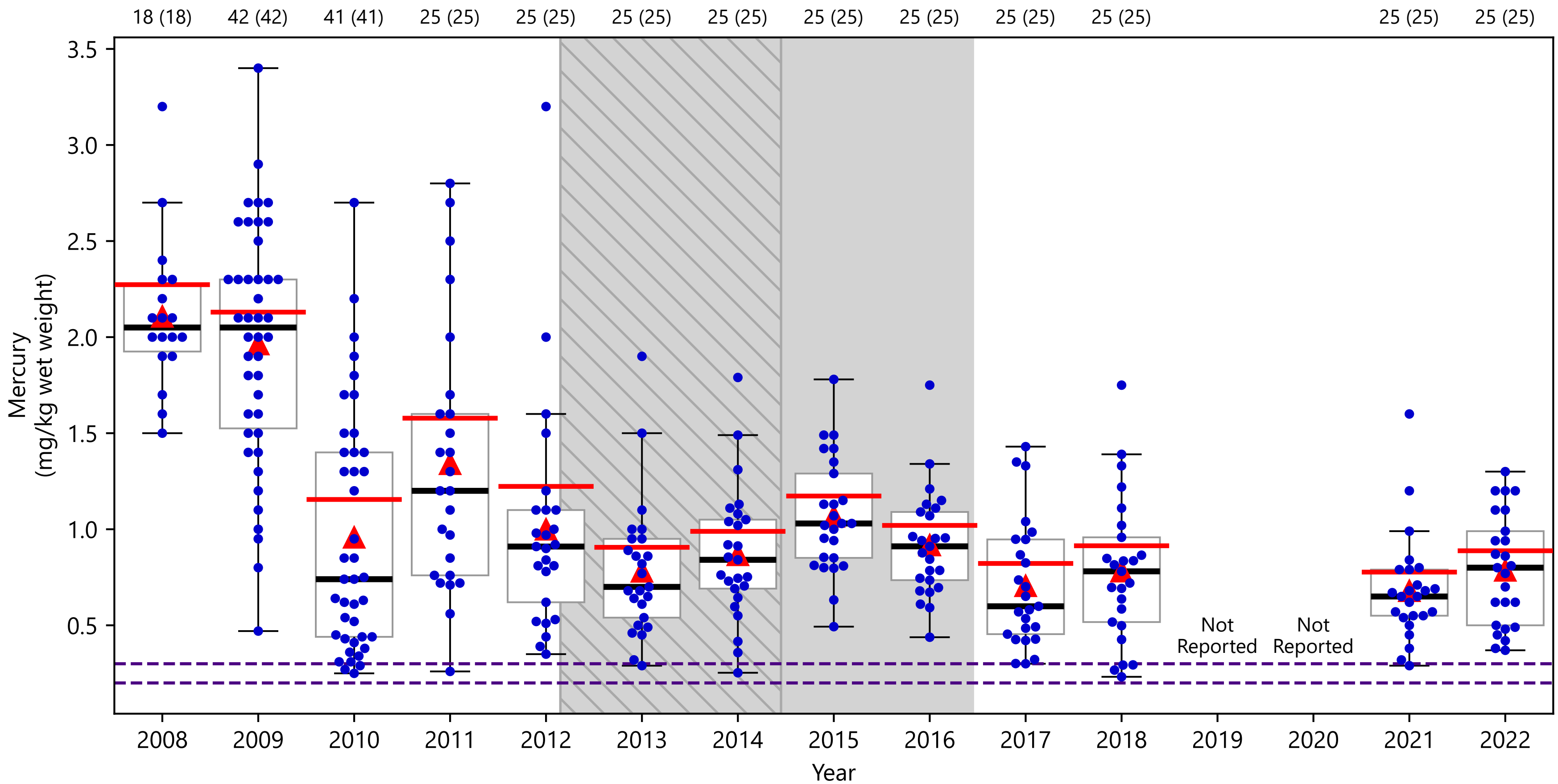
ANCHOR QEA

Figure 1
Nomenclature, Data Treatment, and Analyte-Specific Details

Set 1:
Sport Fish Fillet Concentrations
for Human Health RGs and Targets

Honeywell Set 1 Data (2008-2022)

September 2025



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL.

Human Health Performance Criteria (0.2 to 0.3 mg/kg)
Dredging
Capping
Non-detect
Detect

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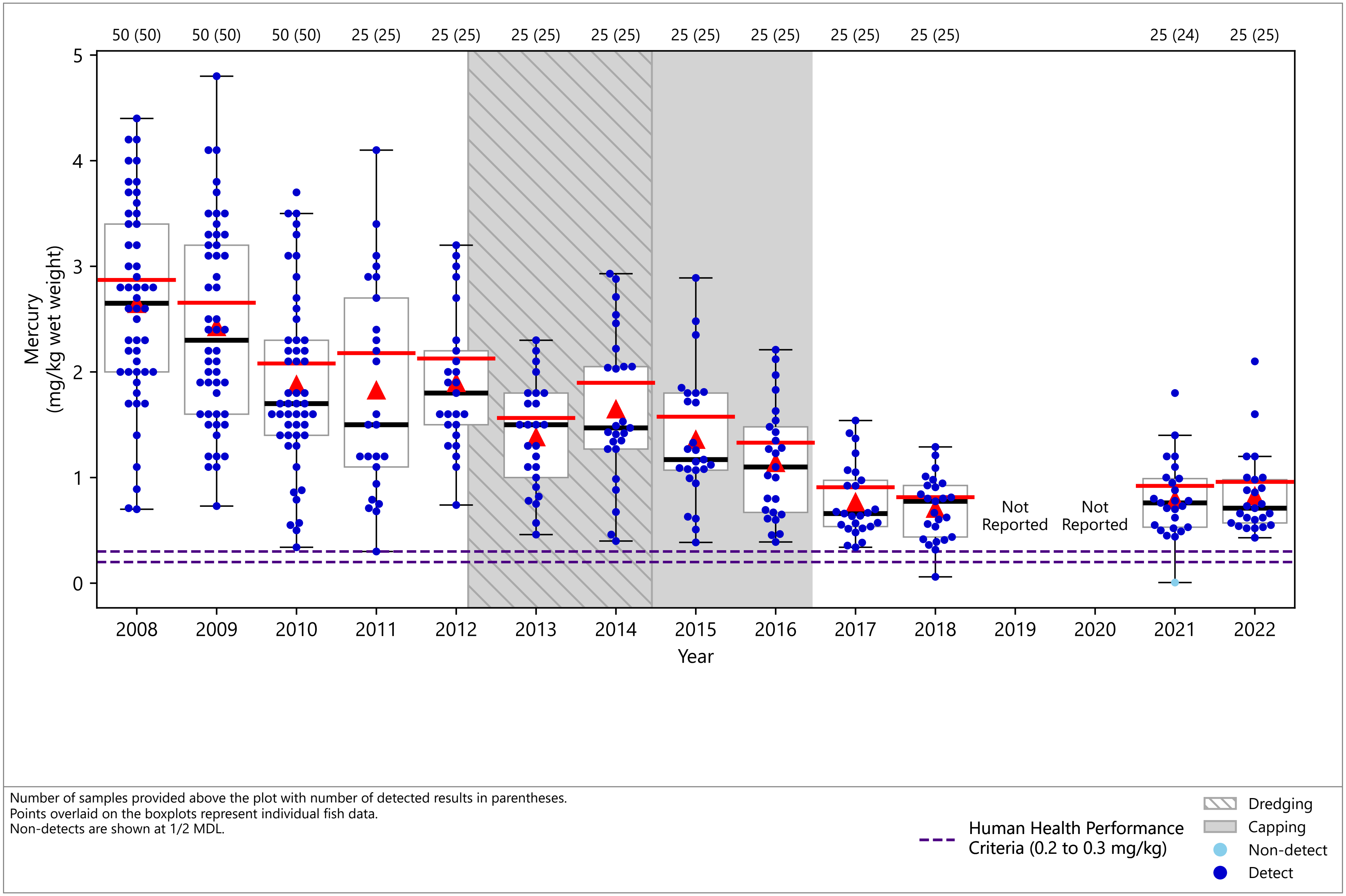
Set 1, Figure 1
Mercury Concentrations in Smallmouth Bass (2008 - 2022)



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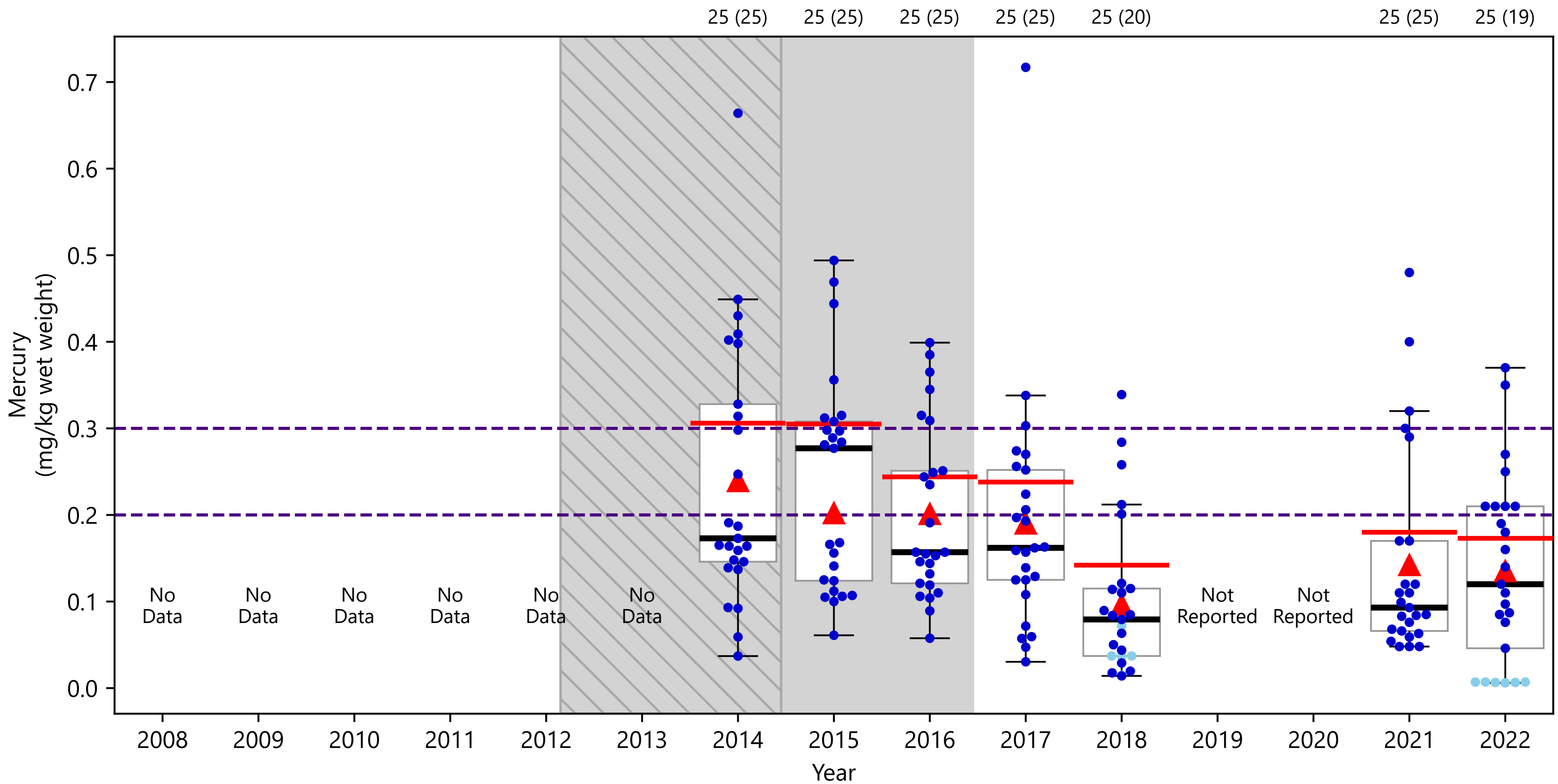
Set 1, Figure 2
Mercury Concentrations in Walleye (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL.

Human Health Performance Criteria (0.2 to 0.3 mg/kg)

Dredging
Capping
Non-detect
Detect

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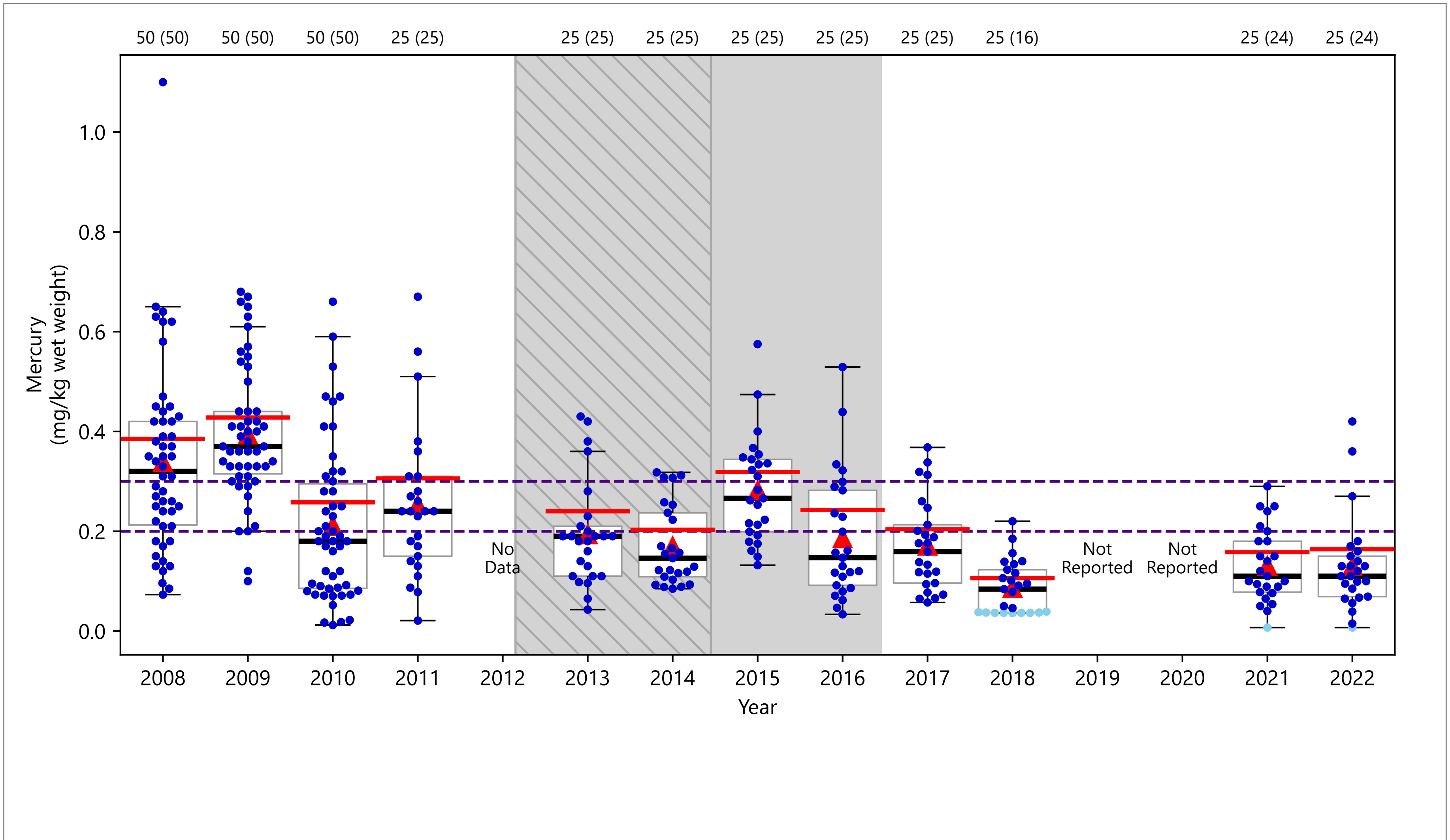
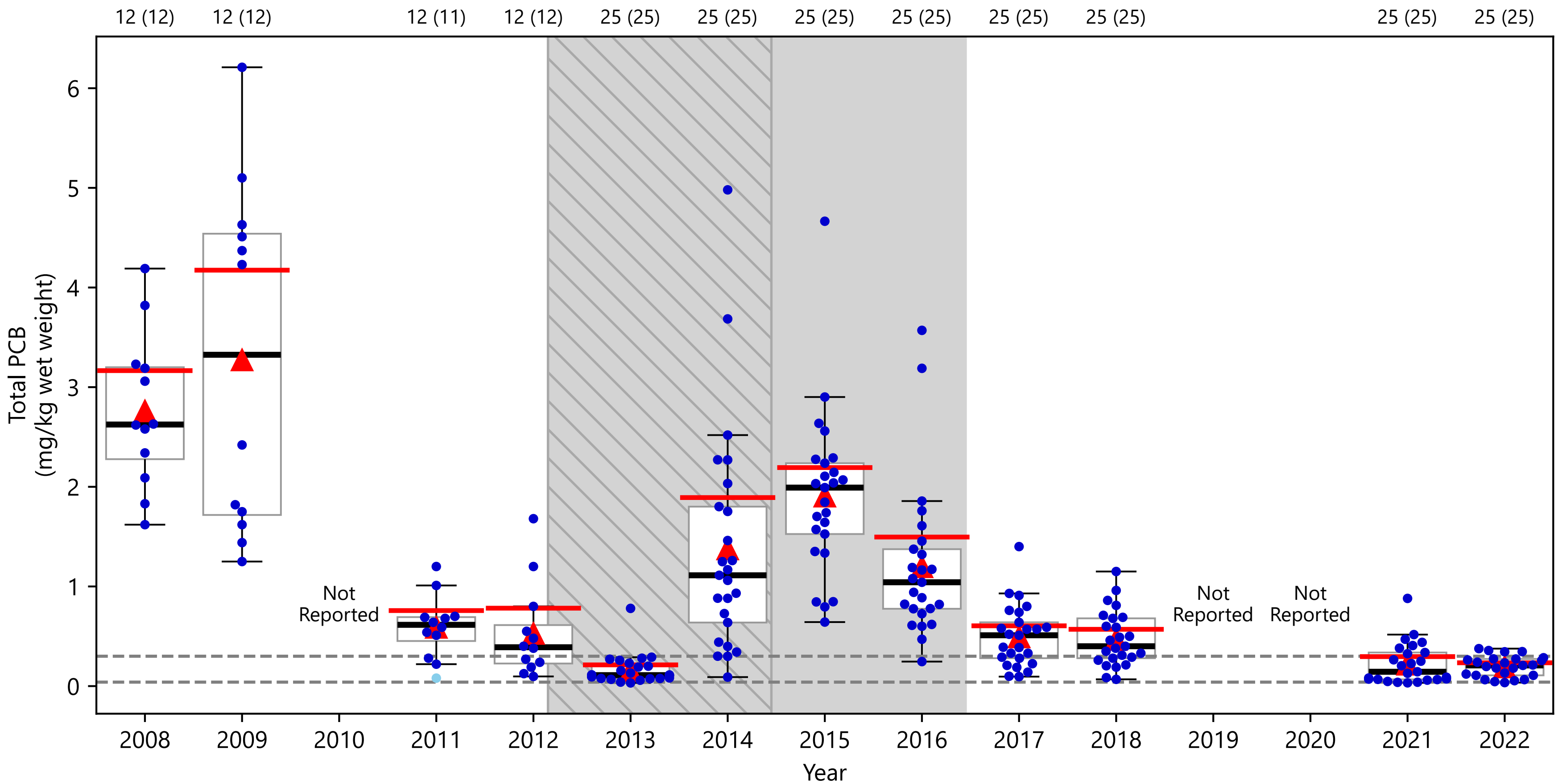
Set 1, Figure 3
Mercury Concentrations in Common Carp (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL.

Set 1, Figure 4
Mercury Concentrations in Pumpkinseed (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Human Health Target (0.04 to 0.3 mg/kg)

Dredging
Capping
Non-detect
Detect

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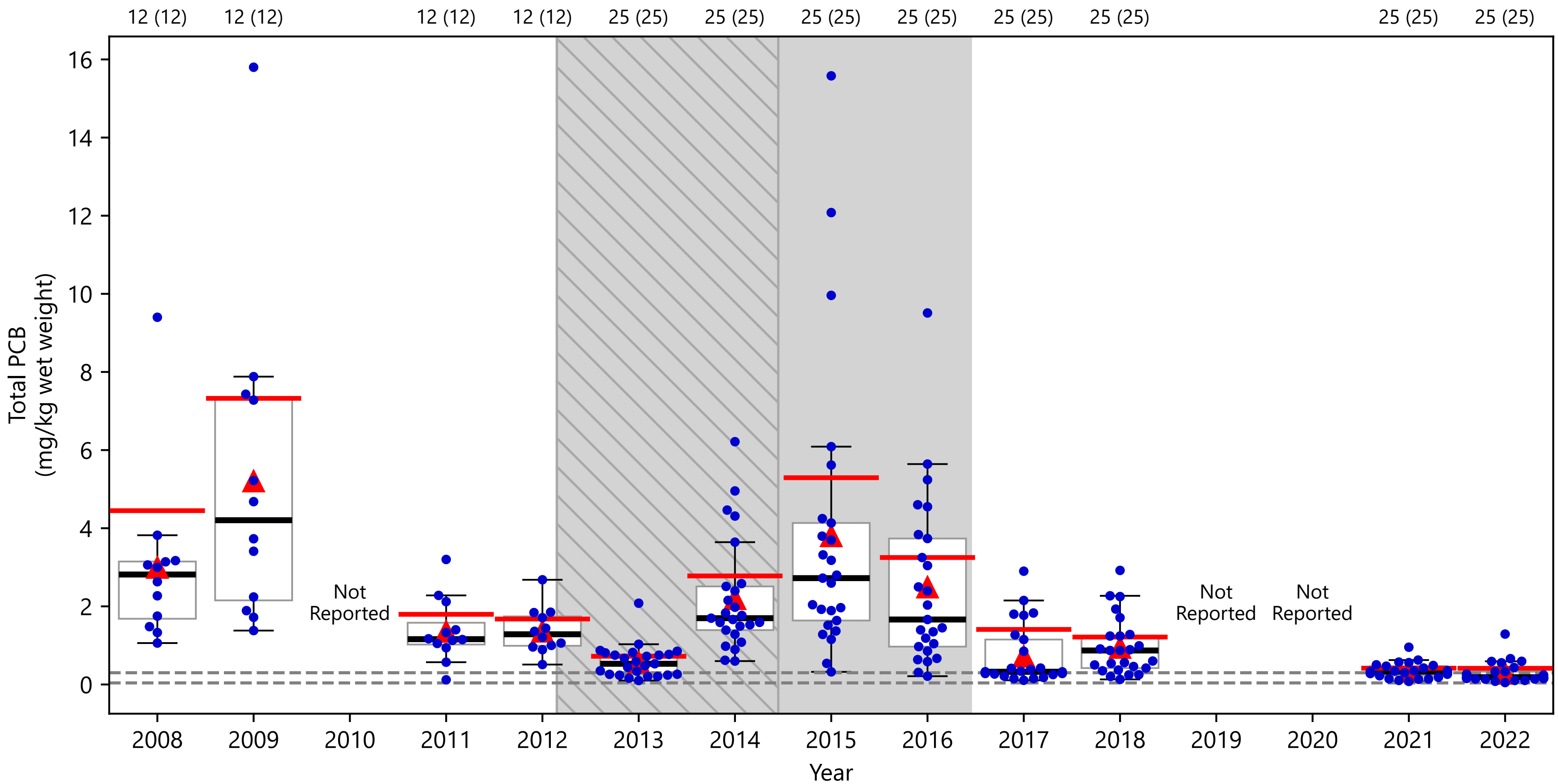
Set 1, Figure 5
Total PCB Concentrations in Smallmouth Bass (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Human Health Target (0.04 to 0.3 mg/kg)

Dredging
Capping
Non-detect
Detect

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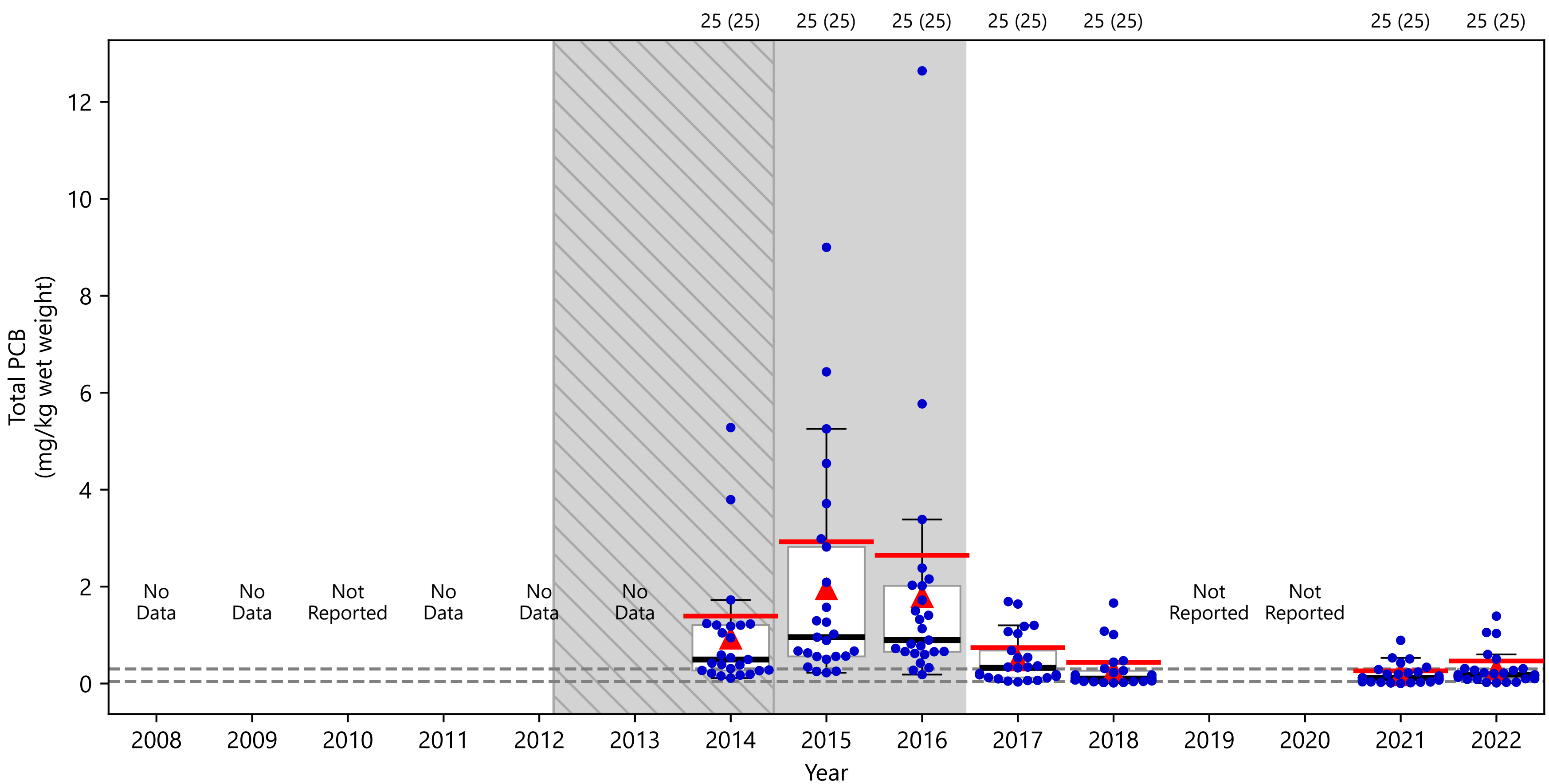
Set 1, Figure 6
Total PCB Concentrations in Walleye (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Human Health Target (0.04 to 0.3 mg/kg)

Dredging
Capping
Non-detect
Detect

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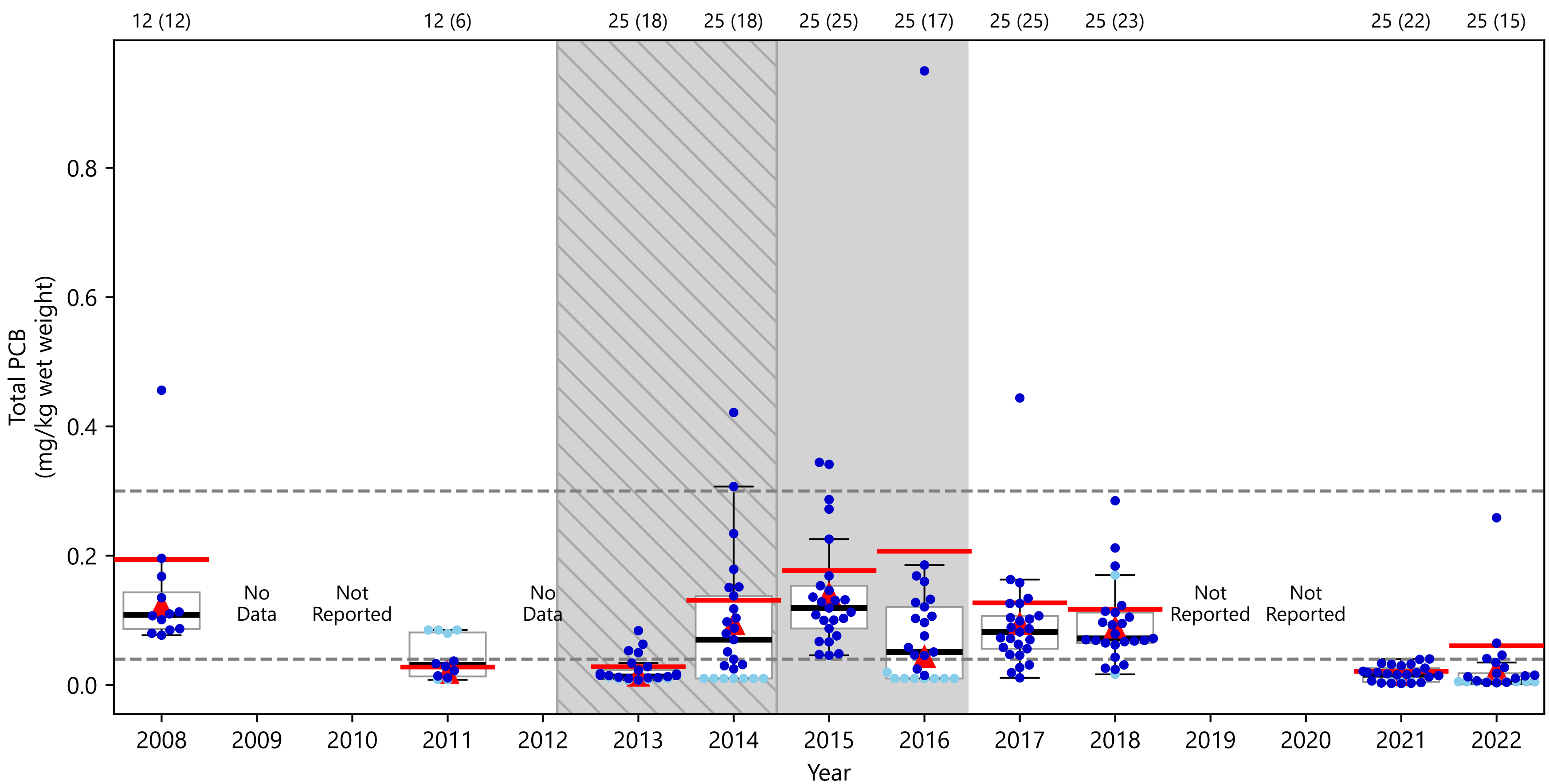
ANCHOR QEA

Set 1, Figure 7
Total PCB Concentrations in Common Carp (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Human Health Target (0.04 to 0.3 mg/kg)

Dredging
Capping
Non-detect
Detect

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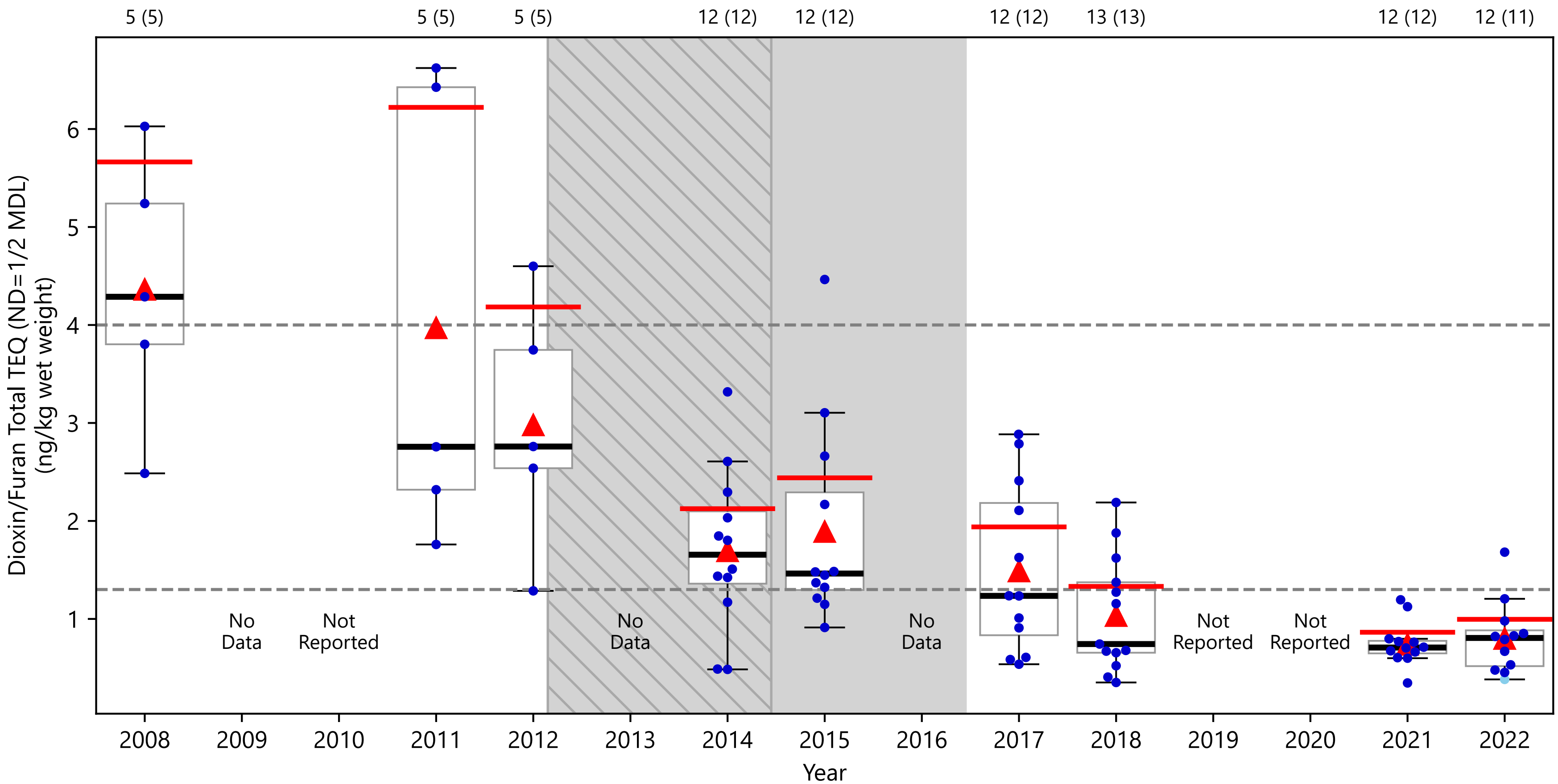
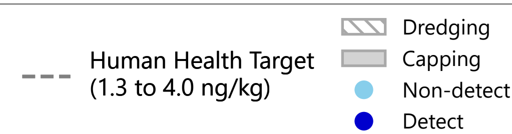
Set 1, Figure 8
Total PCB Concentrations in Pumpkinseed (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are set to 1/2 MDL in TEQ calculation.



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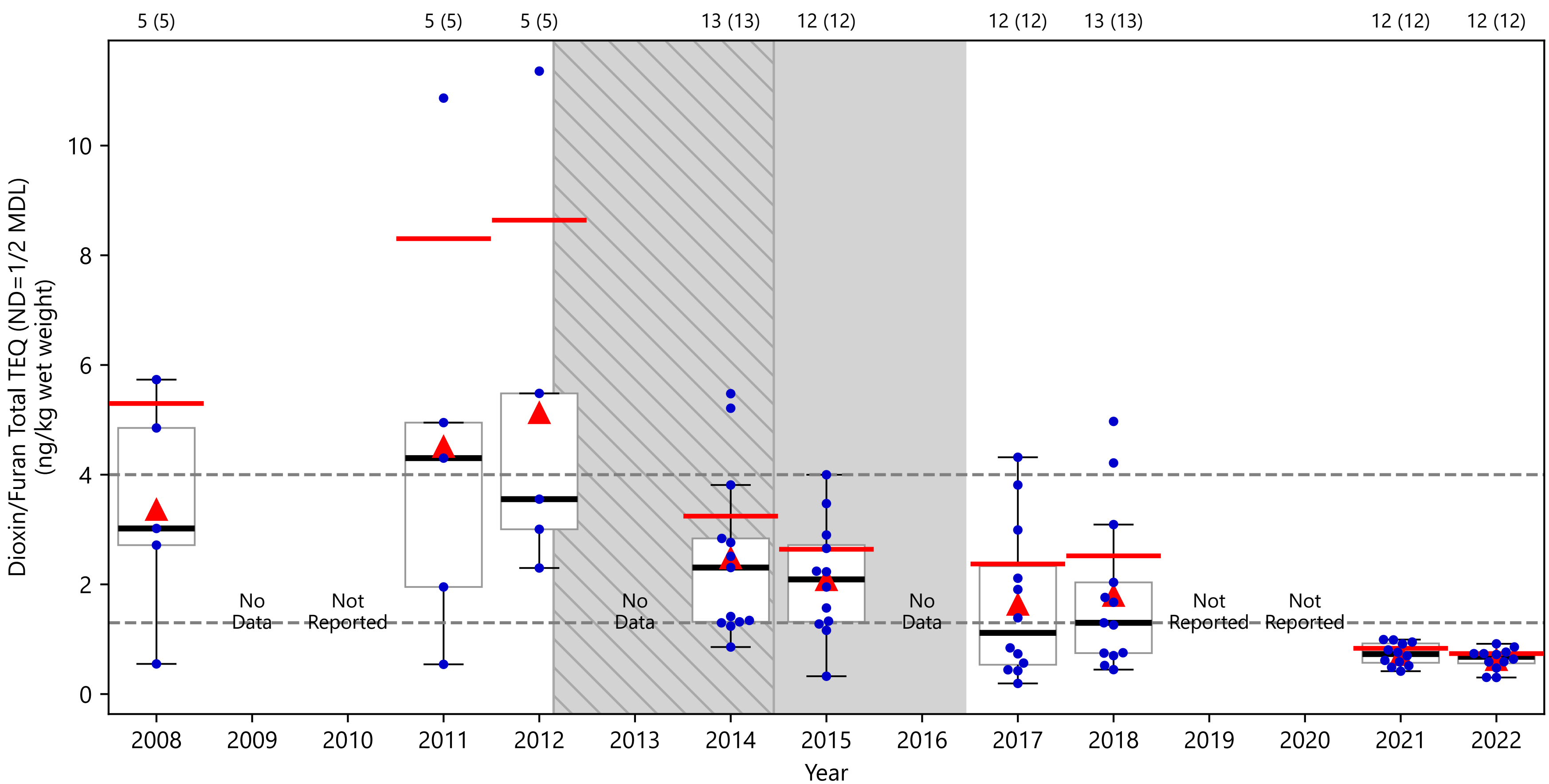
Set 1, Figure 9
Dioxin/Furan Total TEQ (ND = 0.5 MDL) Concentrations in Smallmouth Bass (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are set to 1/2 MDL in TEQ calculation.

Human Health Target (1.3 to 4.0 ng/kg)
Dredging
Capping
Non-detect
Detect

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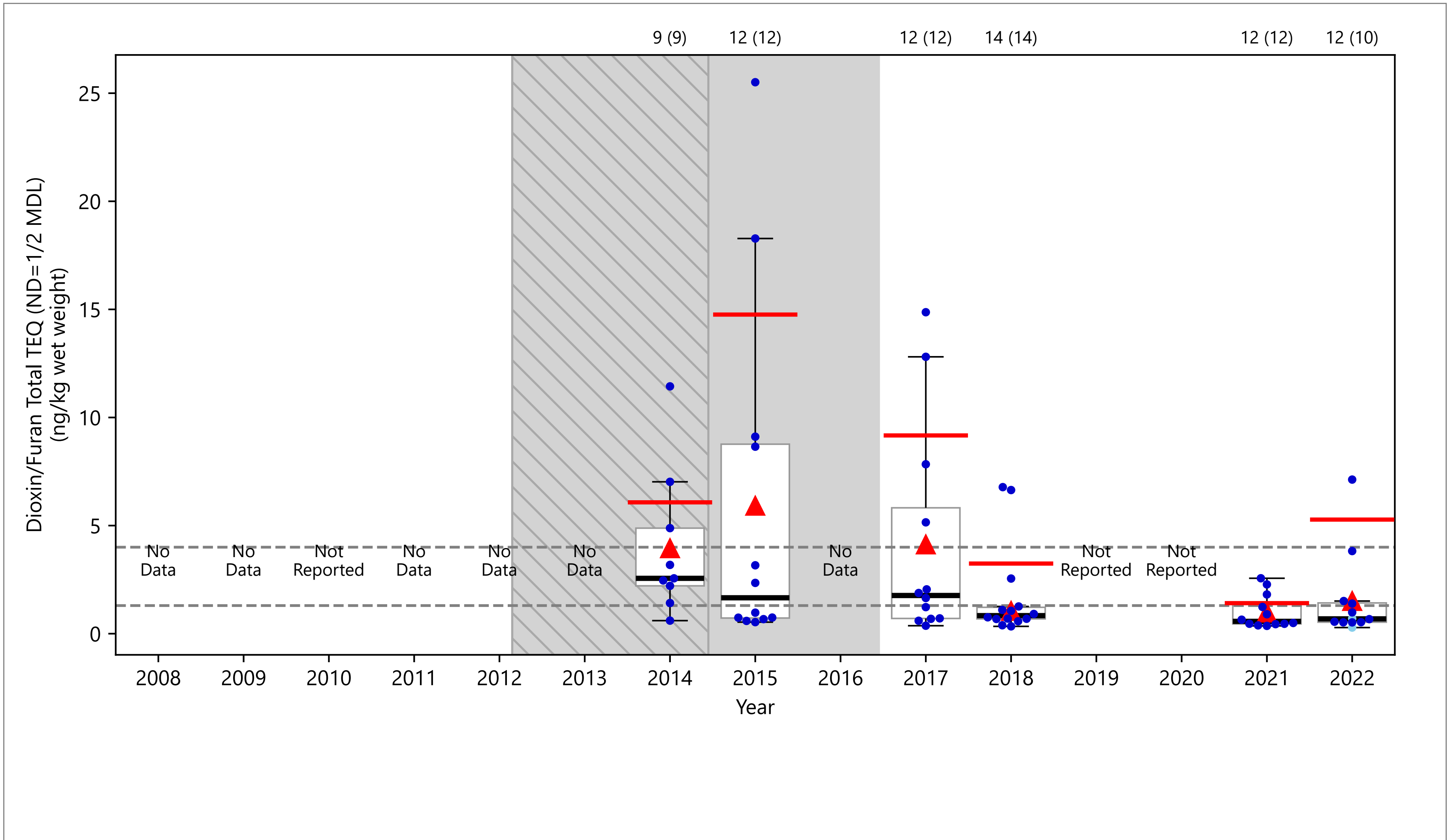
Set 1, Figure 10
Dioxin/Furan Total TEQ (ND = 0.5 MDL) Concentrations in Walleye (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are set to 1/2 MDL in TEQ calculation.

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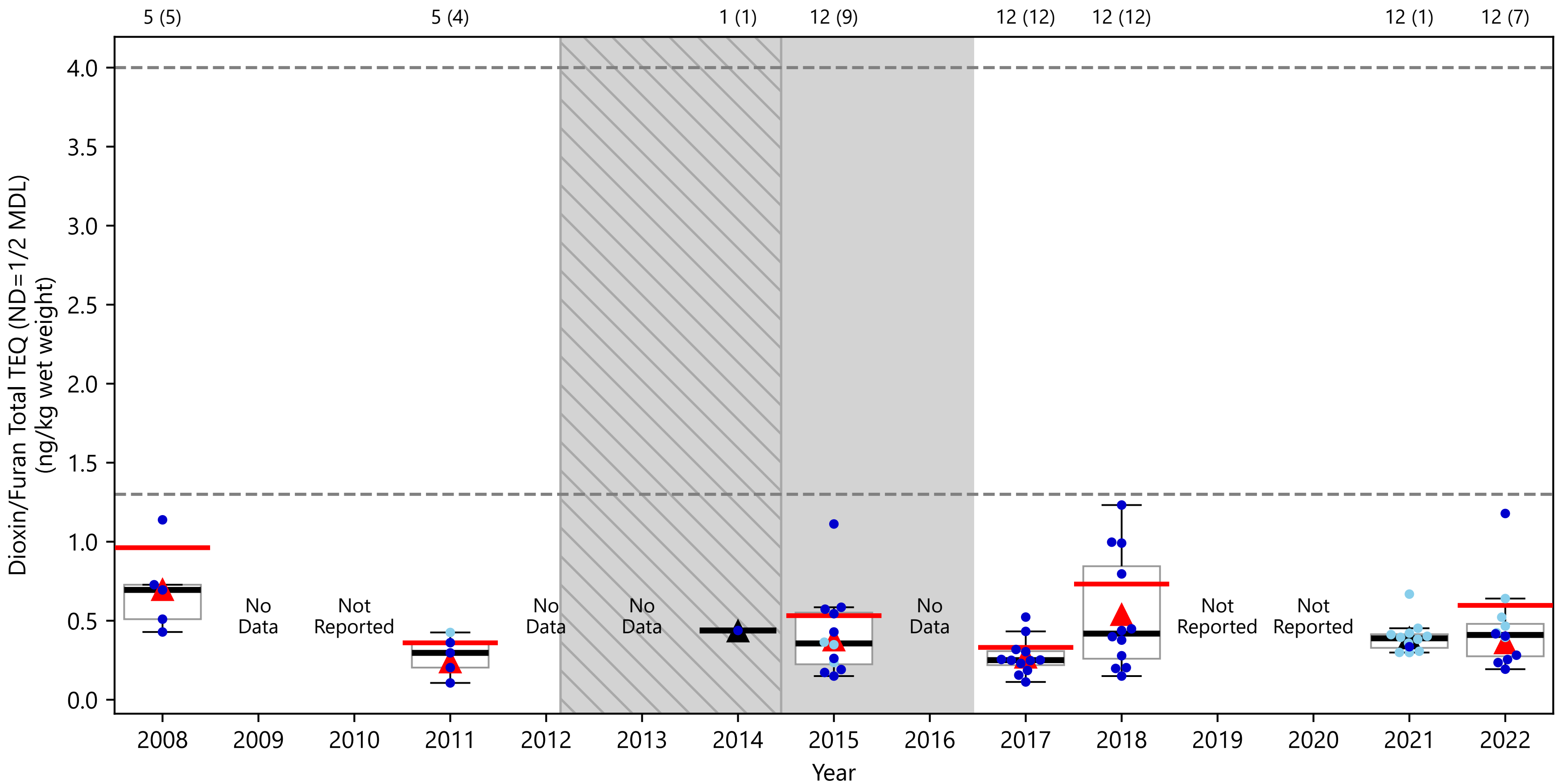
ANCHOR QEA

Set 1, Figure 11
Dioxin/Furan Total TEQ (ND = 0.5 MDL) Concentrations in Common Carp (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are set to 1/2 MDL in TEQ calculation.

Human Health Target (1.3 to 4.0 ng/kg)
Dredging
Capping
Non-detect
Detect

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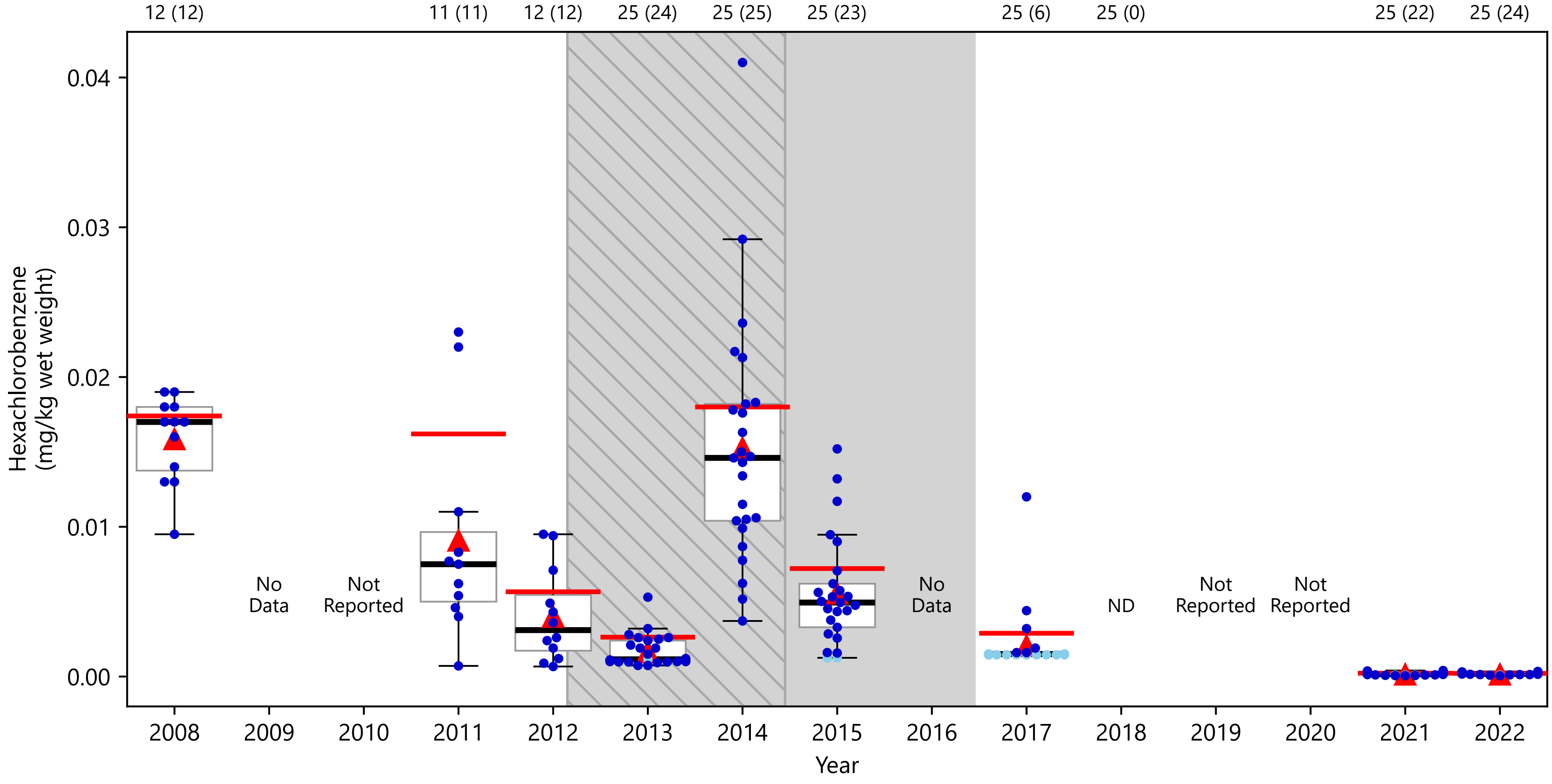
ANCHOR QEA

Set 1, Figure 12
Dioxin/Furan Total TEQ (ND = 0.5 MDL) Concentrations in Pumpkinseed (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

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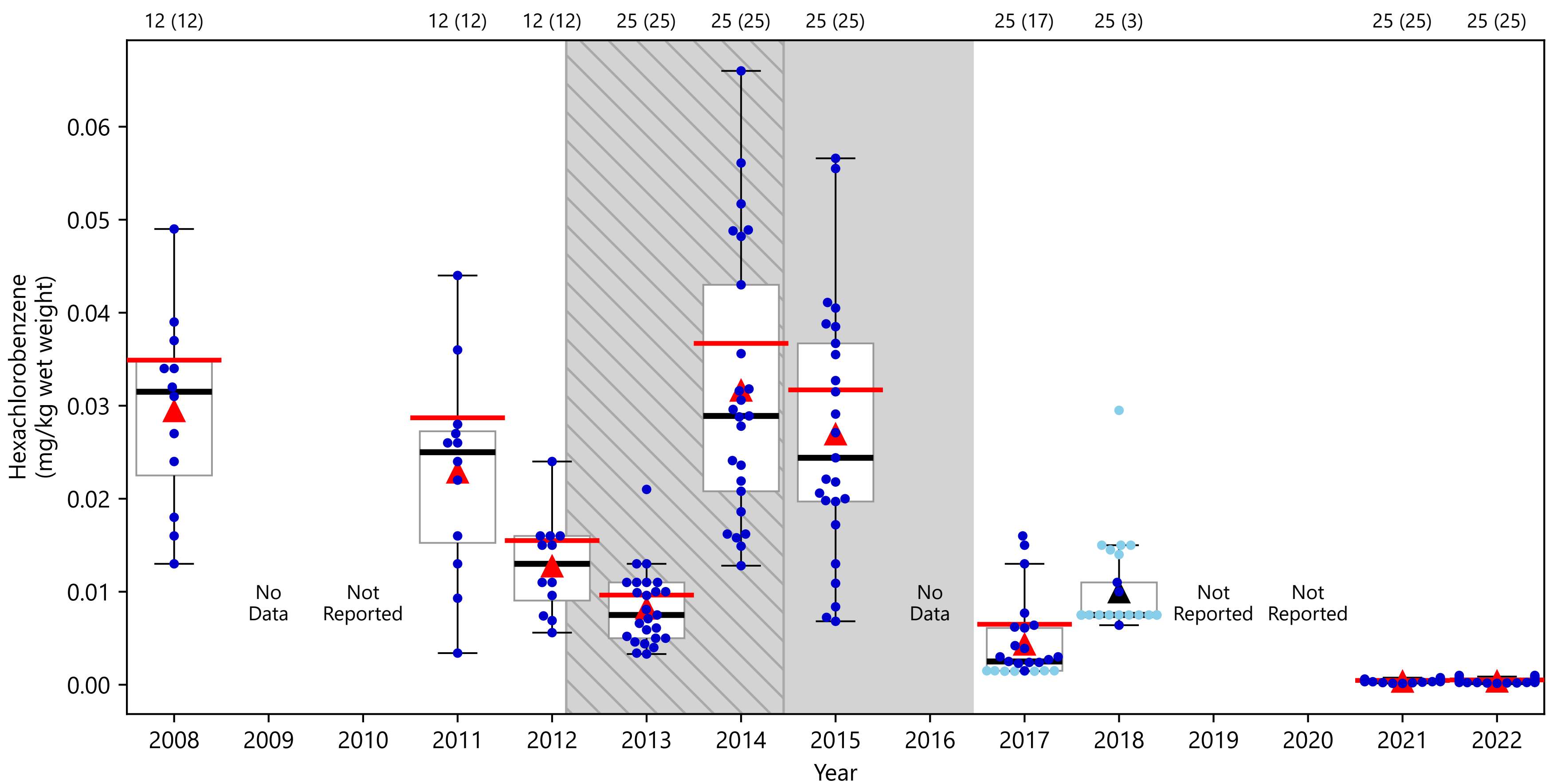
ANCHOR QEA

Set 1, Figure 13
Hexachlorobenzene Concentrations in Smallmouth Bass (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

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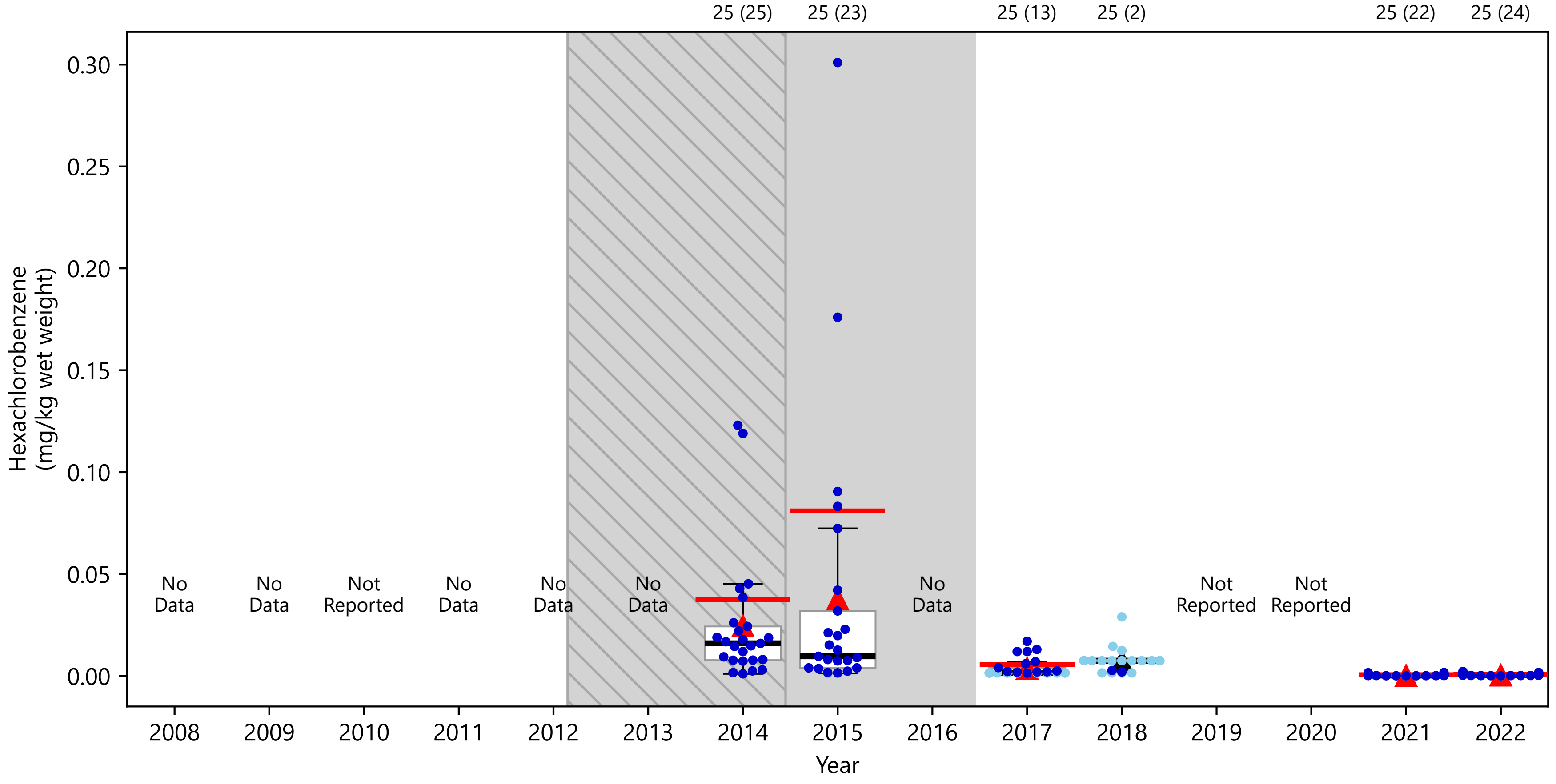
ANCHOR QEA

Set 1, Figure 14
Hexachlorobenzene Concentrations in Walleye (2008 - 2022)



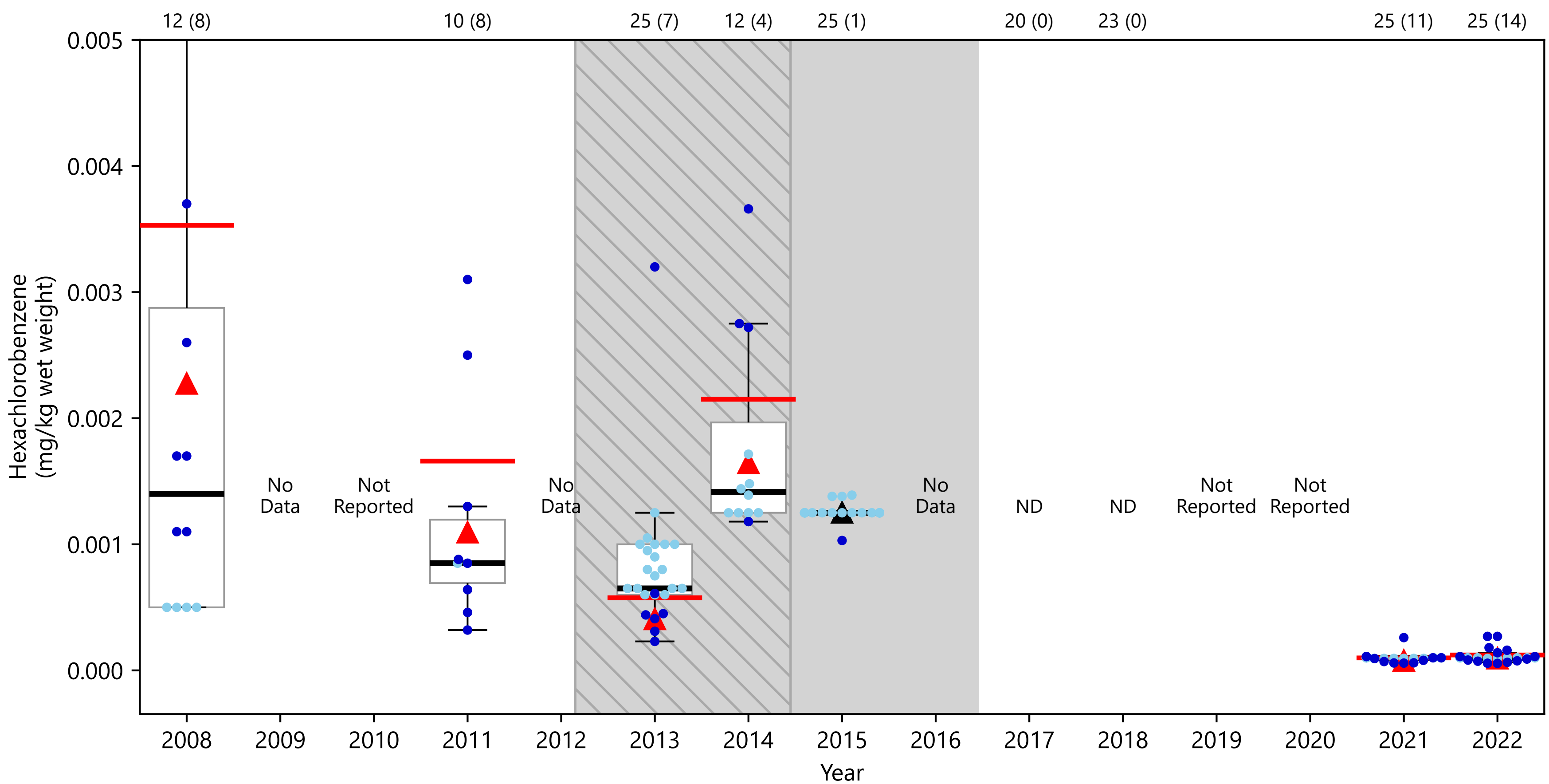
Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

ANCHOR QEA

Set 1, Figure 15
Hexachlorobenzene Concentrations in Common Carp (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

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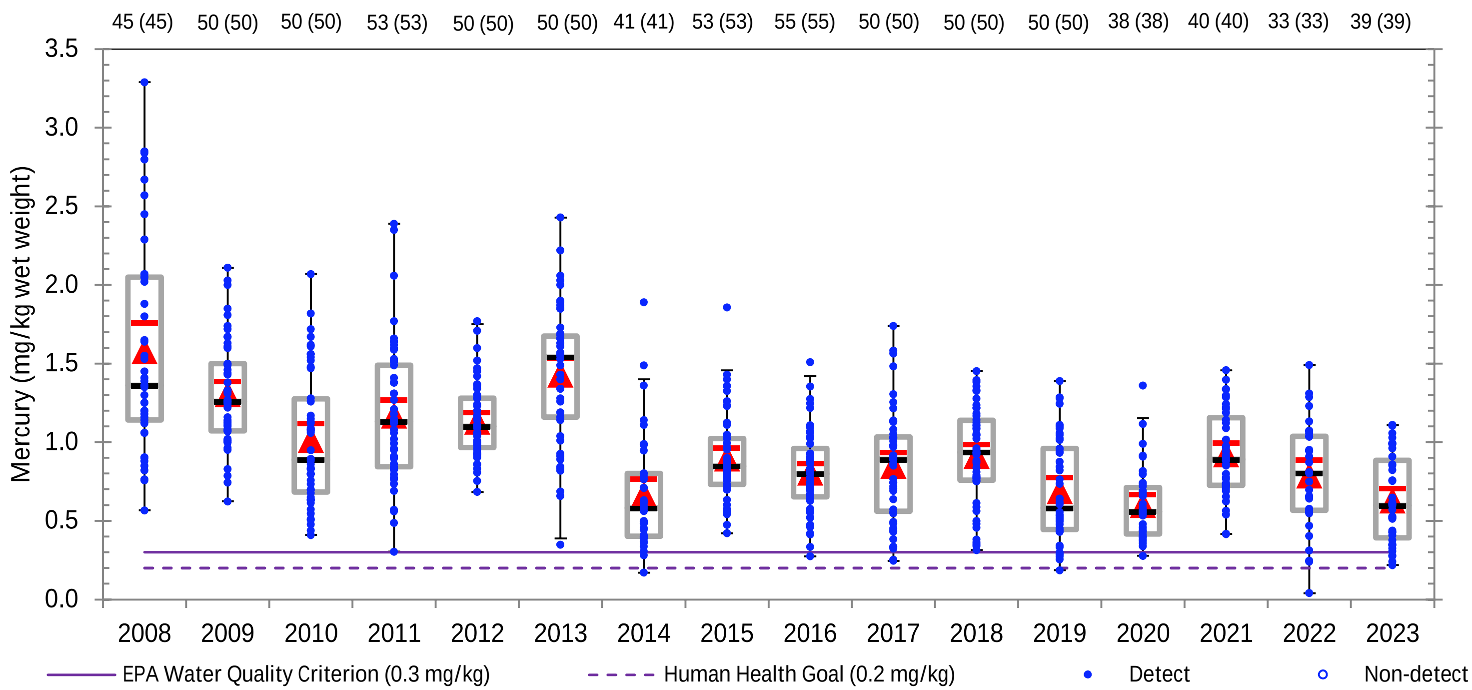
Set 1, Figure 16
Hexachlorobenzene Concentrations in Pumpkinseed (2008 - 2022)

NYSDEC Set 1 Data (2008-2023)

September 2025

Set 1, DEC Figure 1

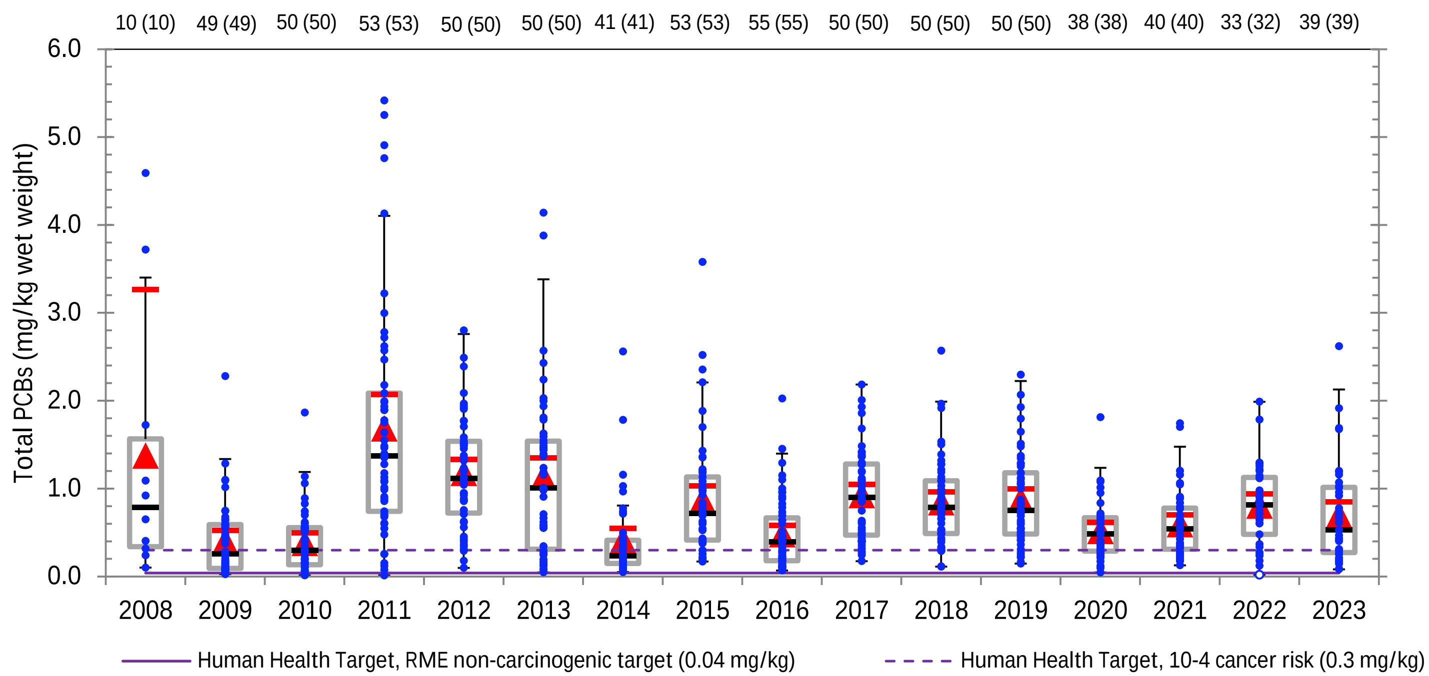
NYSDEC Mercury Data - Largemouth Bass



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL when present.

Set 1, DEC Figure 2

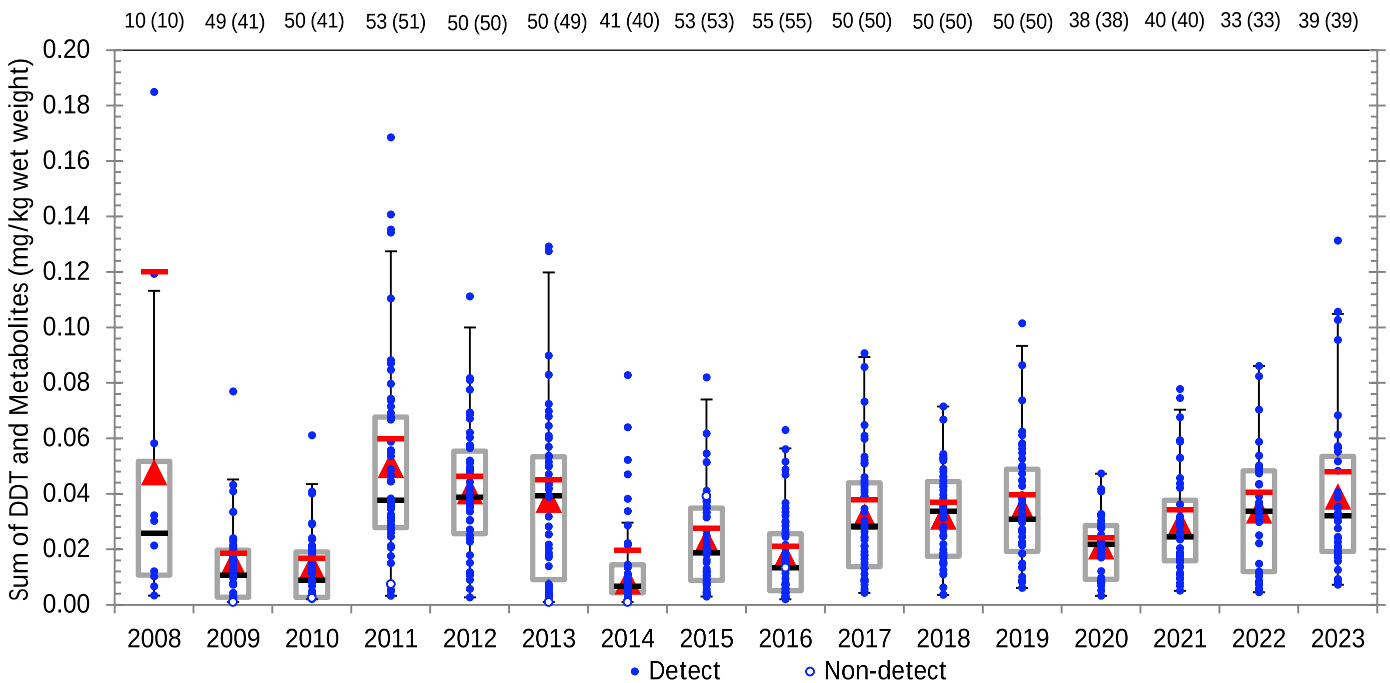
NYSDEC Total PCBs Data - Largemouth Bass



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL when present.

Set 1, DEC Figure 3

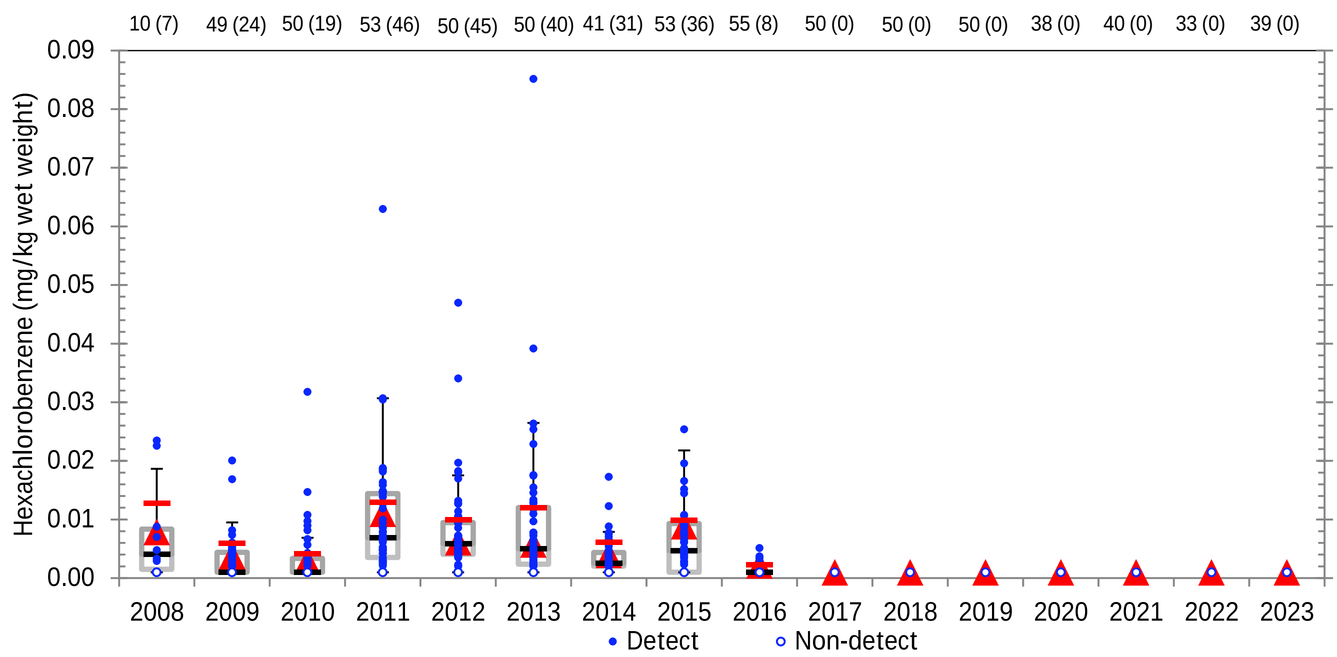
NYSDEC DDTs Data - Largemouth Bass



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL when present.

Set 1, DEC Figure 4

NYSDEC Hexachlorobenzene Data - Largemouth Bass

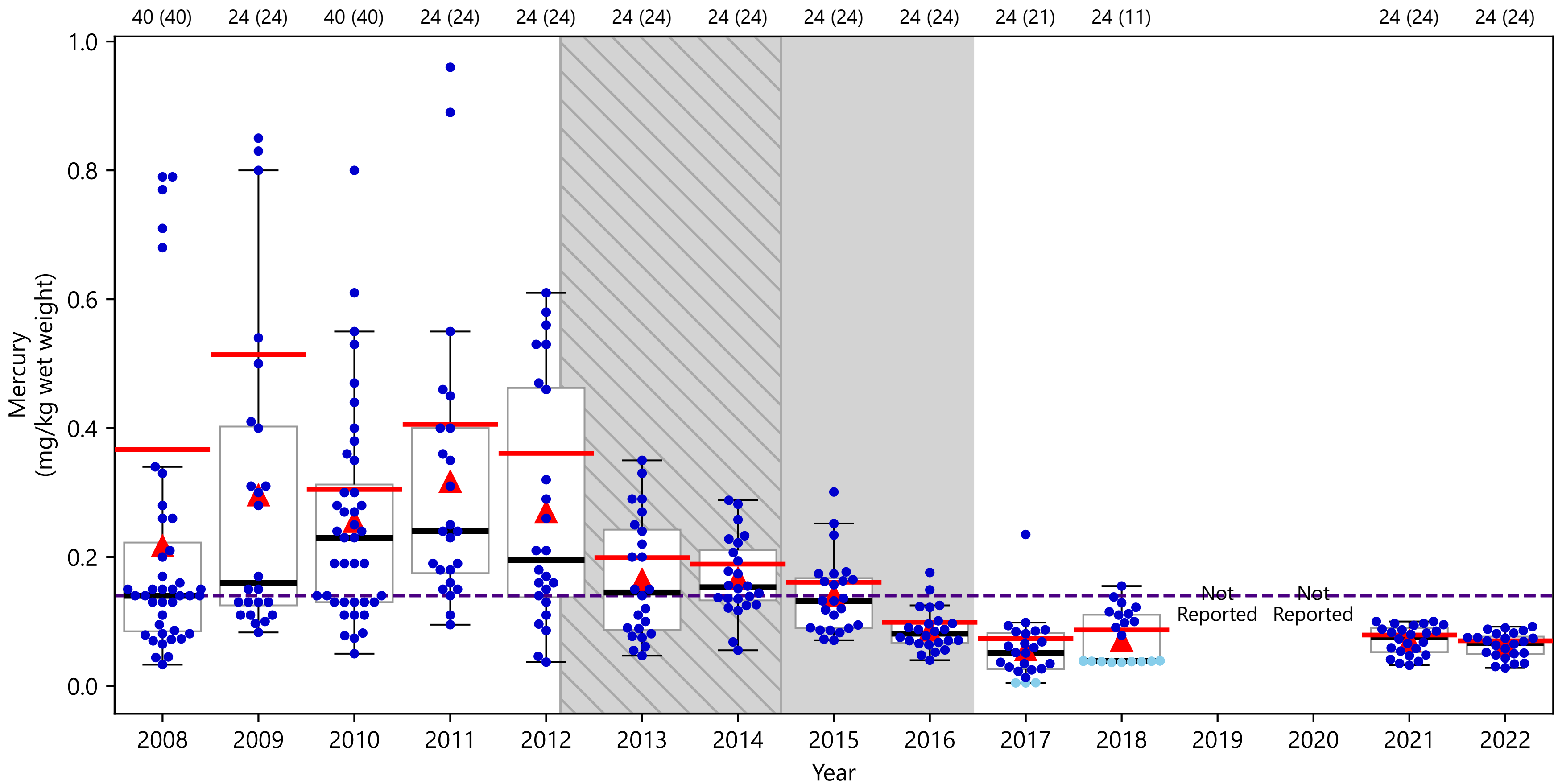


Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL when present.

Set 2:
Small (30 to 180 mm) Prey Fish Whole-Body Concentrations for Ecological Remedial Goal and Targets

Honeywell Set 2 Data (2008-2022)

September 2025



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL.

Ecological Performance Criterion (0.14 mg/kg)
Dredging
Capping
Non-detect
Detect

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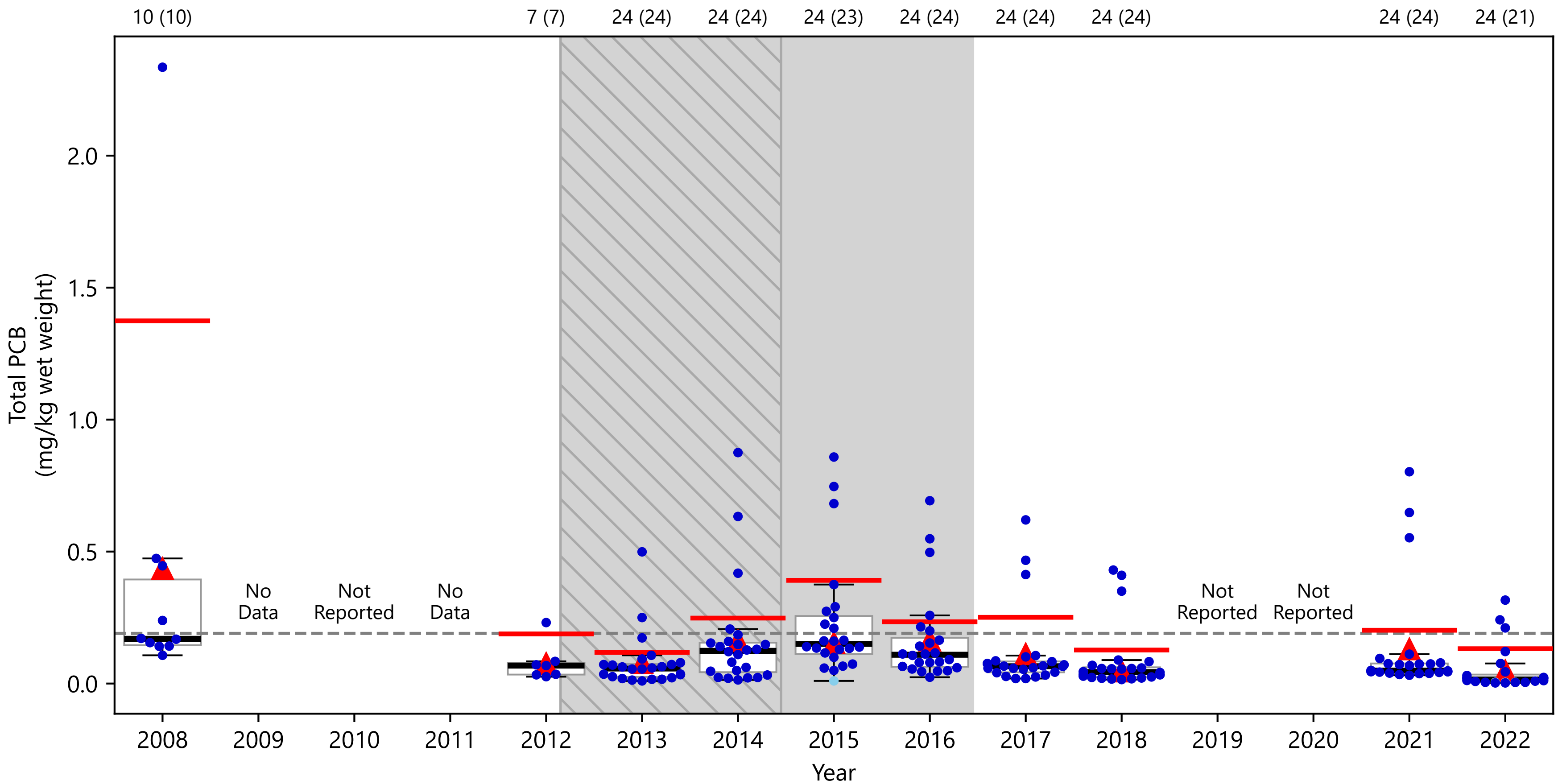
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 2, Figure 1
Mercury Concentrations in Small Prey Fish (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

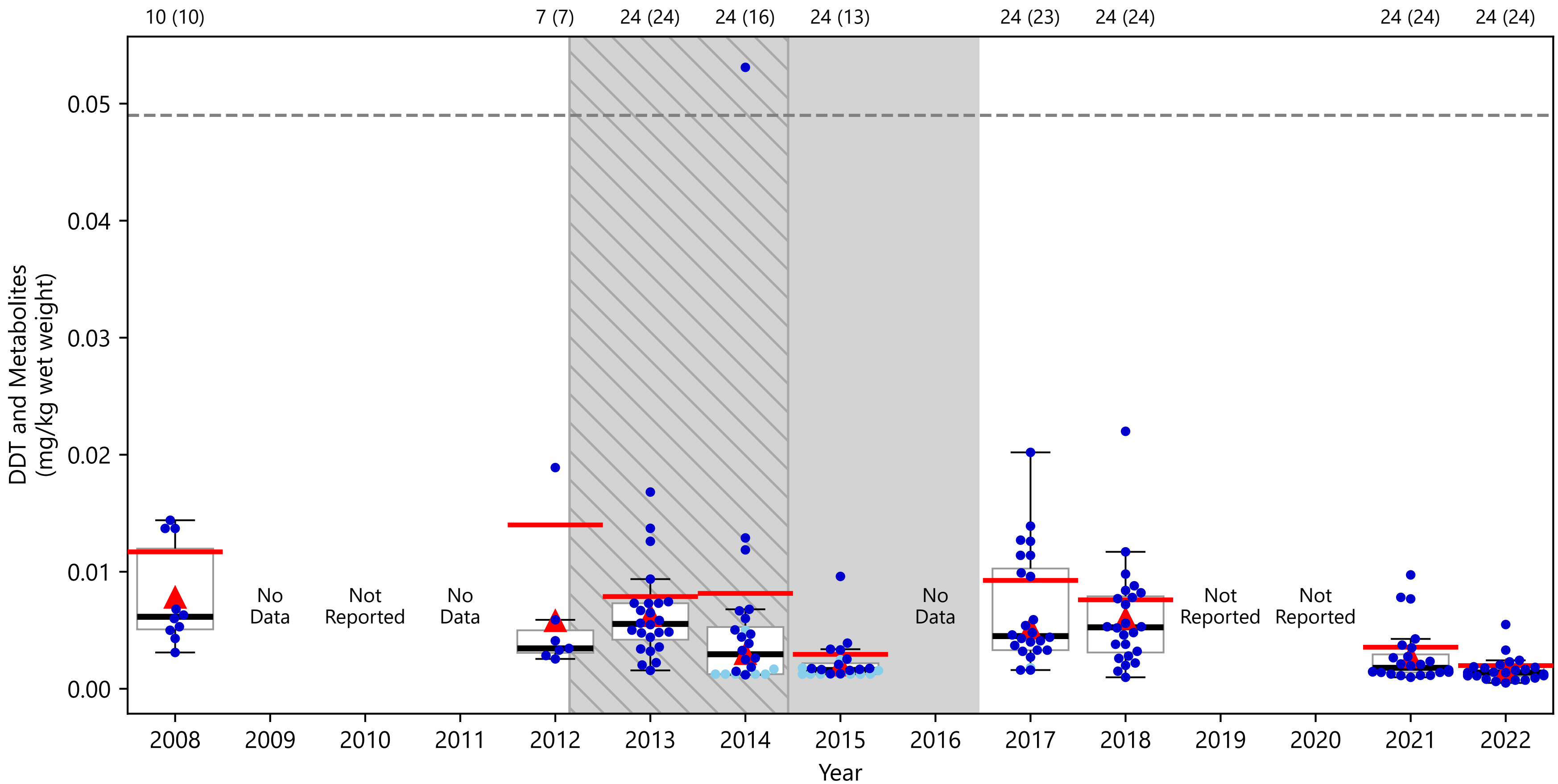
Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Ecological Target (0.19 mg/kg)
Dredging
Capping
Non-detect
Detect

Publish Date: 06/12/2025 11:49 AM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 2, Figure 2
Total PCB Concentrations in Small Prey Fish (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

Ecological Target (0.049 mg/kg)
Dredging
Capping
Non-detect
Detect

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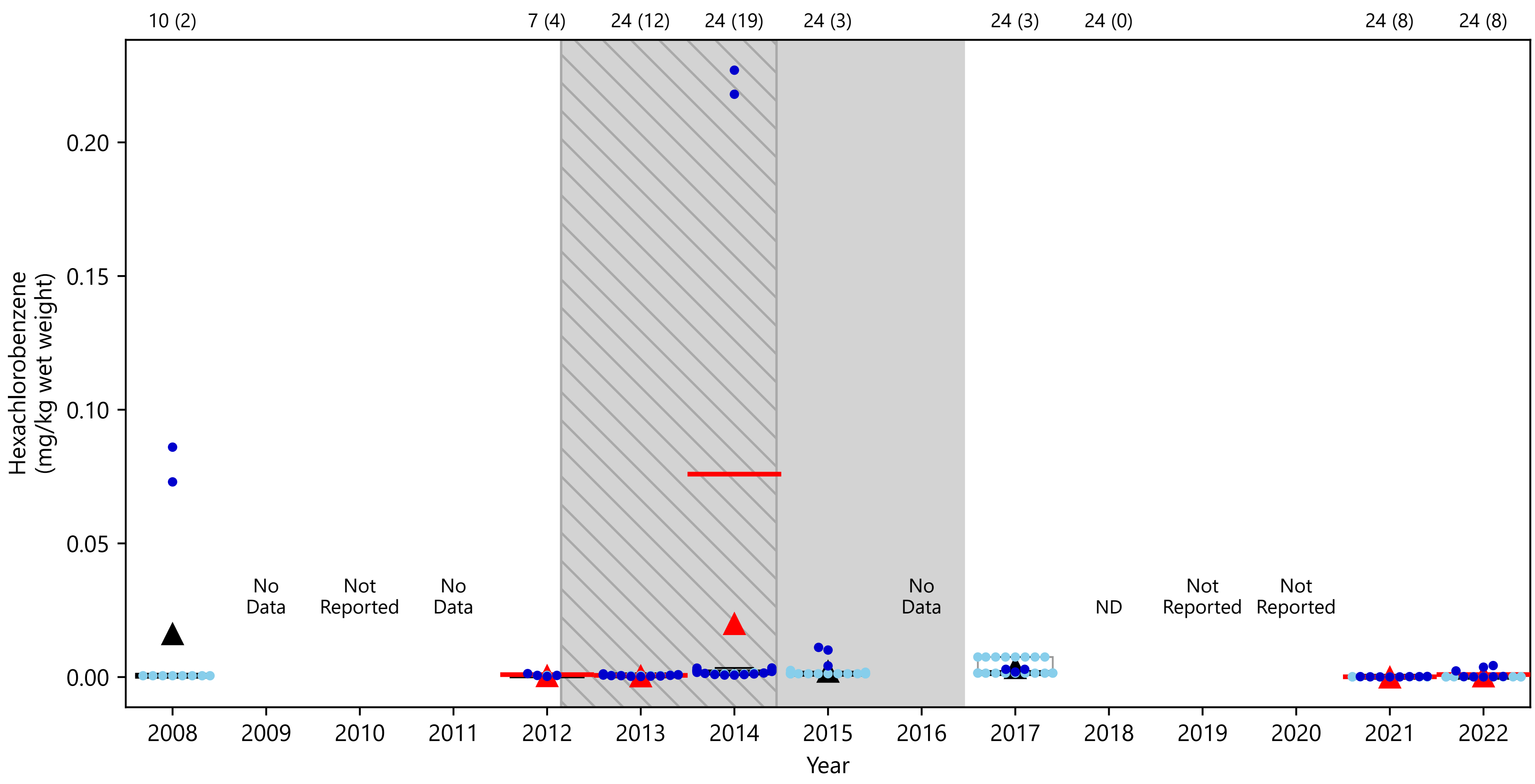
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 2, Figure 3
DDT and Metabolites Concentrations in Small Prey Fish (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

Publish Date: 05/05/2025 12:18 PM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

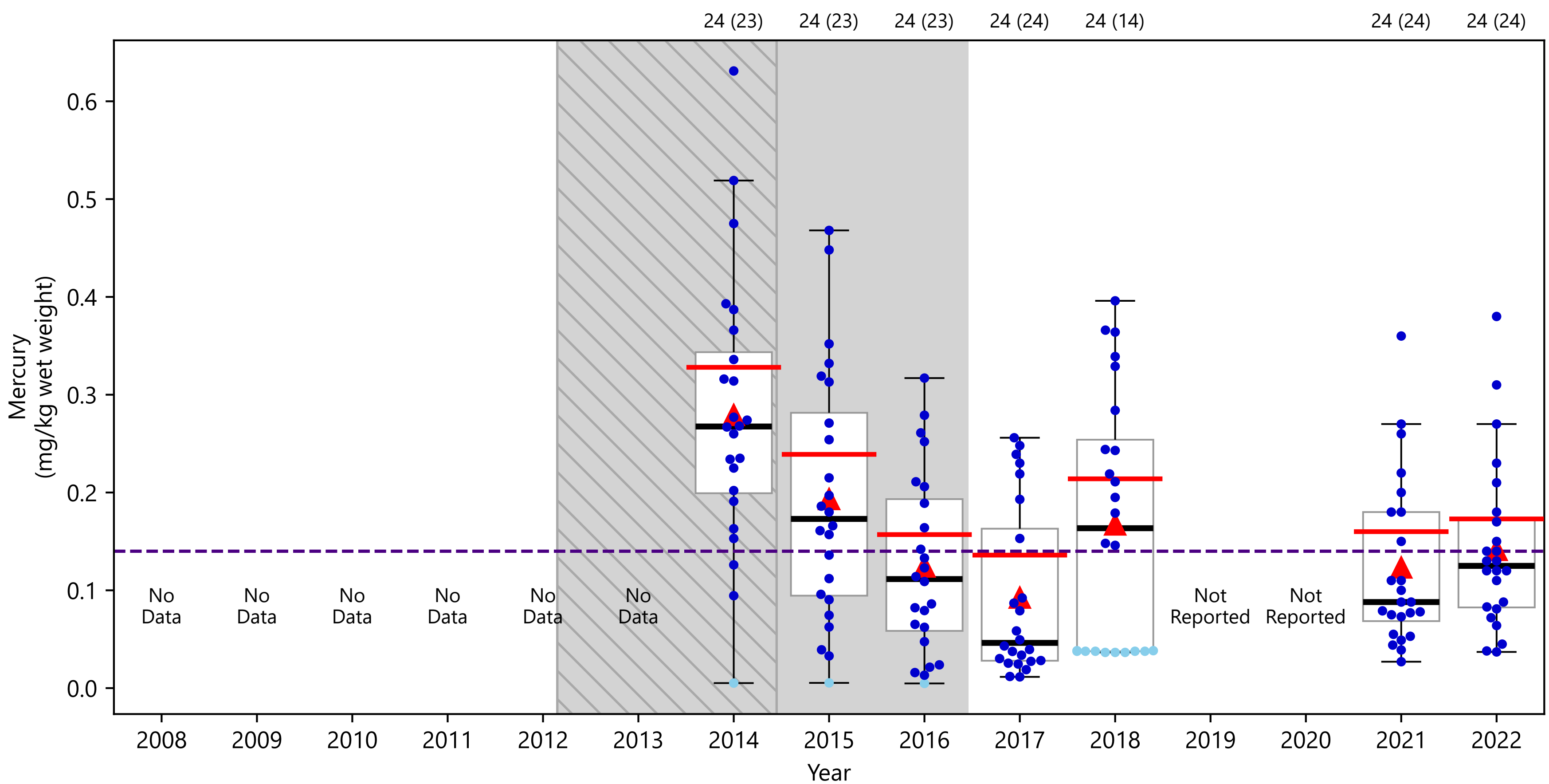
ANCHOR QEA

Set 2, Figure 4
Hexachlorobenzene Concentrations in Small Prey Fish (2008 - 2022)

Set 3: Large (180 to 600 mm) Prey Fish Whole-Body Concentrations for Ecological Remedial Goal and Targets

Honeywell Set 3 Data (2008-2022)

September 2025



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 MDL.

Ecological Performance Criterion (0.14 mg/kg)
Dredging
Capping
Non-detect
Detect

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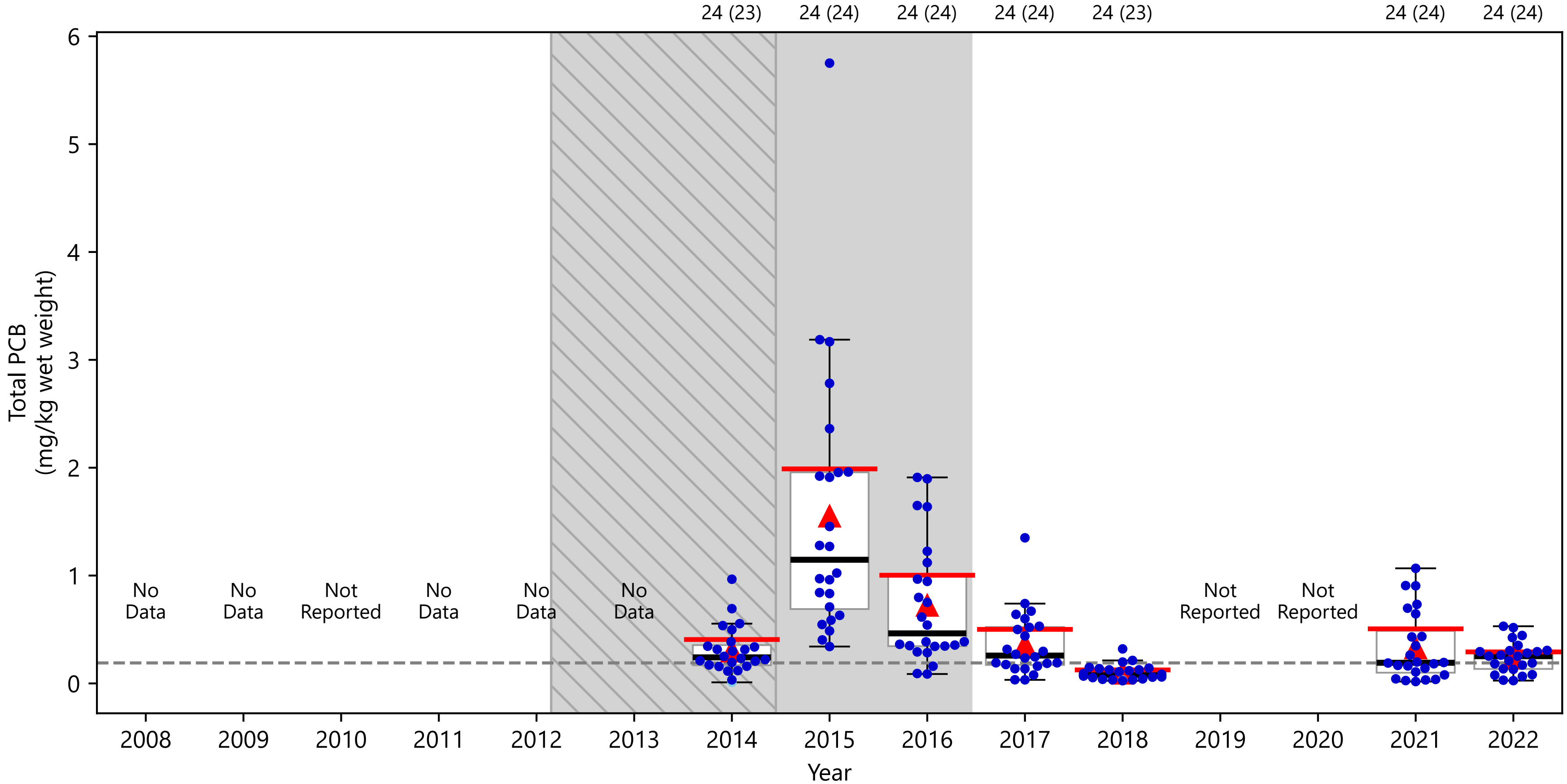
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 3, Figure 1
Mercury Concentrations in Large Prey Fish (2008 - 2022)



Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.

Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
TPCB is the sum of detected Aroclors. If all Aroclors are non-detect, the result value is set to 1/2 the maximum RL for all Aroclors.

Ecological Target (0.19 mg/kg)
Dredging
Capping
Non-detect
Detect

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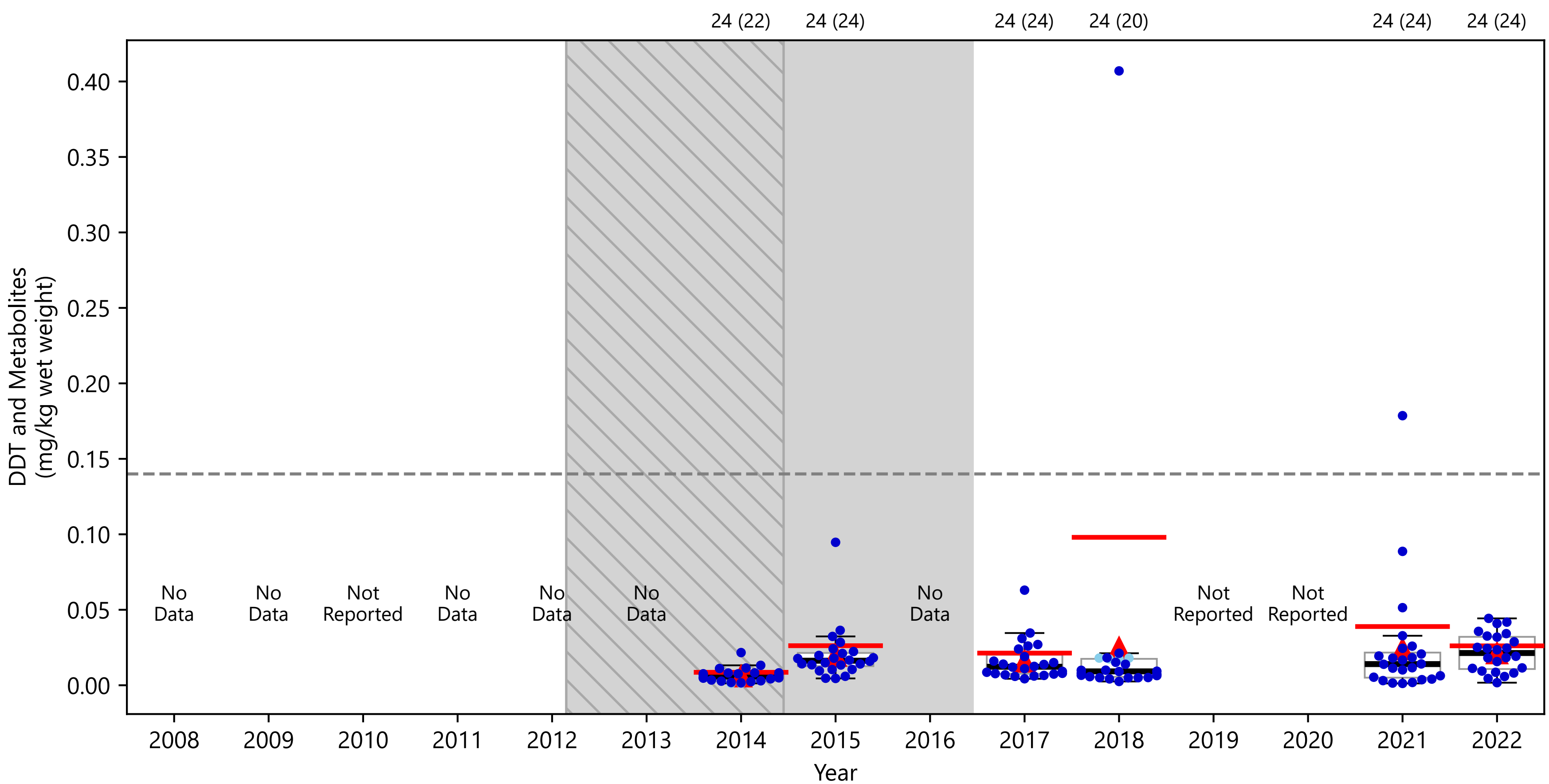
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 3, Figure 2
Total PCB Concentrations in Large Prey Fish (2008 - 2022)



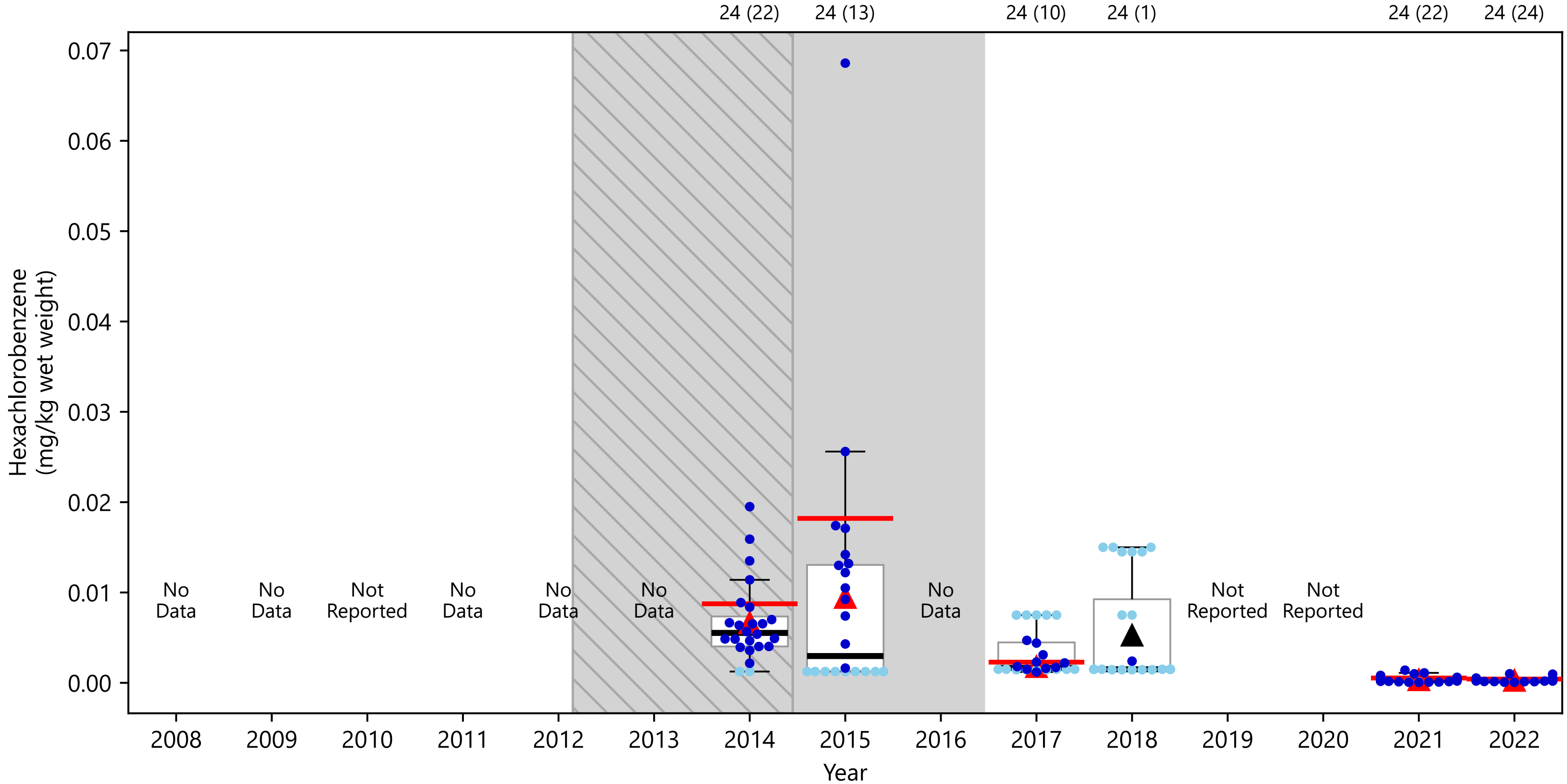
Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

Ecological Target (0.14 mg/kg)
Dredging
Capping
Non-detect
Detect

Publish Date: 05/05/2025 12:18 PM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

Set 3, Figure 3
DDT and Metabolites Concentrations in Large Prey Fish (2008 - 2022)



Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.
Non-detects are shown at 1/2 RL.

No Target

Dredging
Capping
Non-detect
Detect

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\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_box_and_scatter_whole_fillet_preyfish.py

ANCHOR QEA

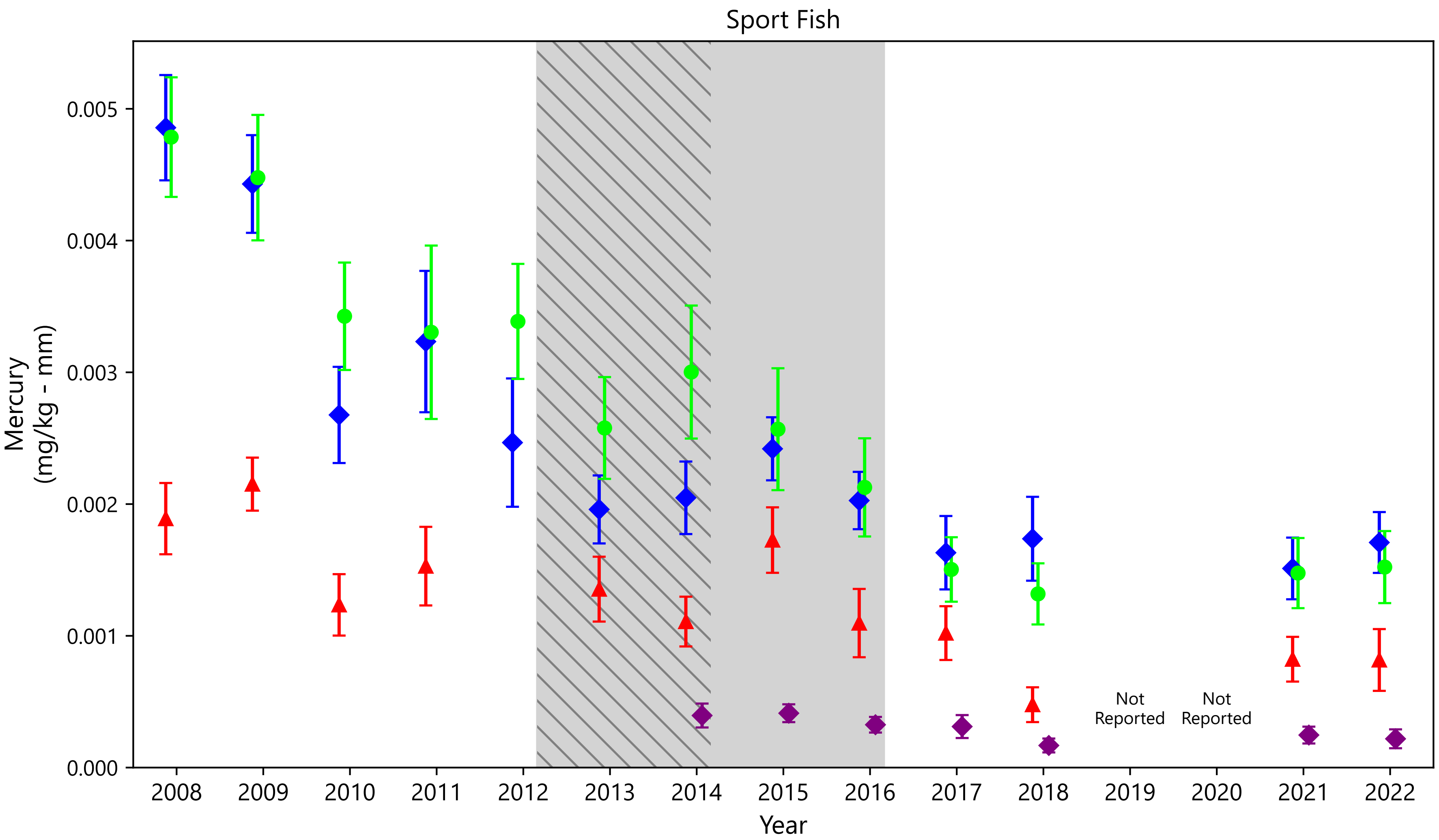
Set 3, Figure 4
Hexachlorobenzene Concentrations in Large Prey Fish (2008 - 2022)

Set 4:
Additional Reporting to Assess Potential Impacts of Remediation

September 2025

Honeywell Set 4 Data (2008-2022)

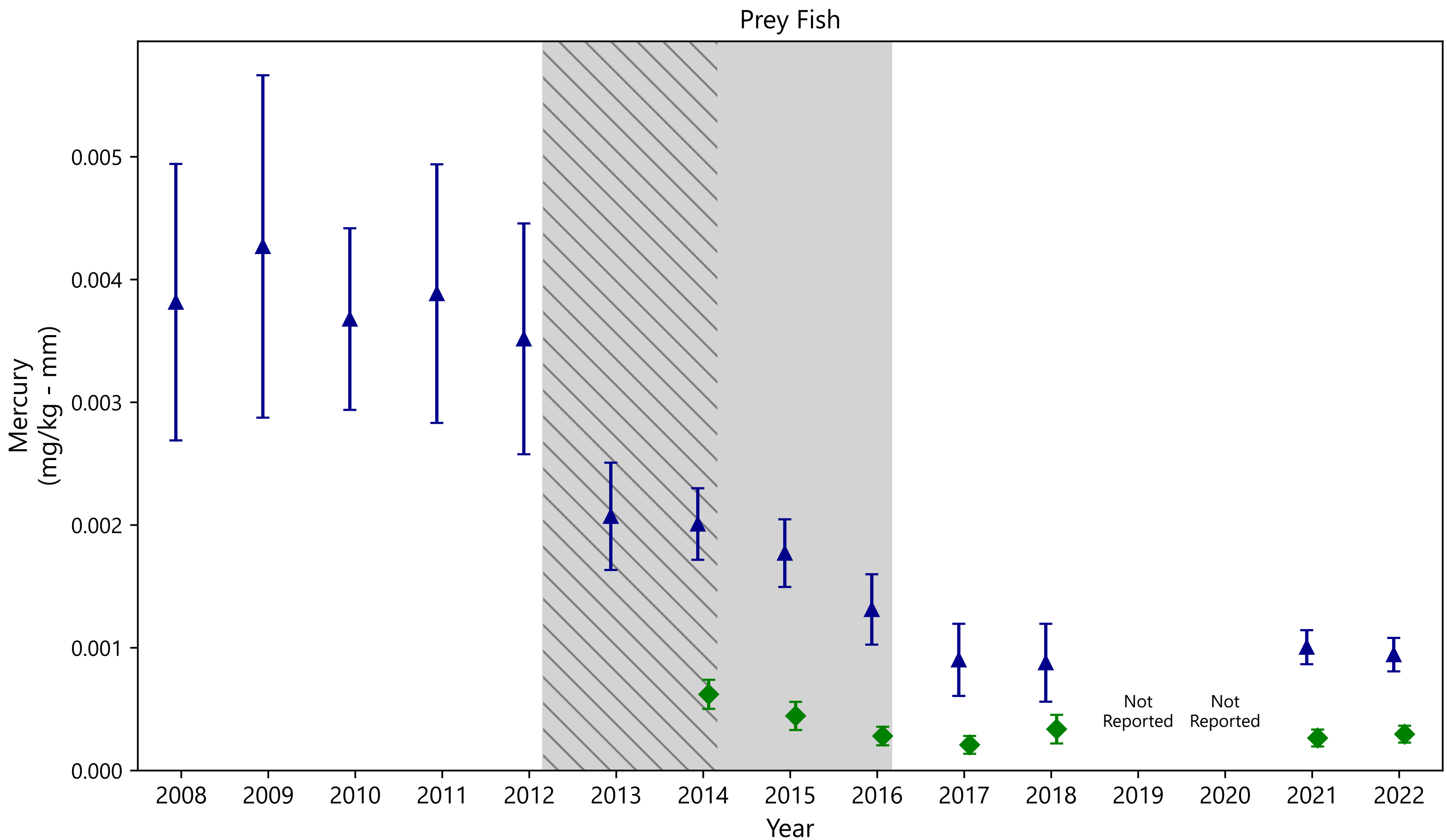
September 2025



Nitrate addition began in 2011. Fish are NYSDEC standard fillets.
Non-detects included at 1/2 MDL.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012.

Publish Date: 04/28/2025 09:08 AM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_length_normalized_Hg.py

Set 4, Subset 1 , Figure 1
Length-Normalized Mercury Concentrations in Sport Fish



Nitrate addition began in 2011. Fish are NYSDEC standard fillets.
Non-detects included at 1/2 MDL.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012.

Large Prey Fish | Small Prey Fish | Dredging | Capping

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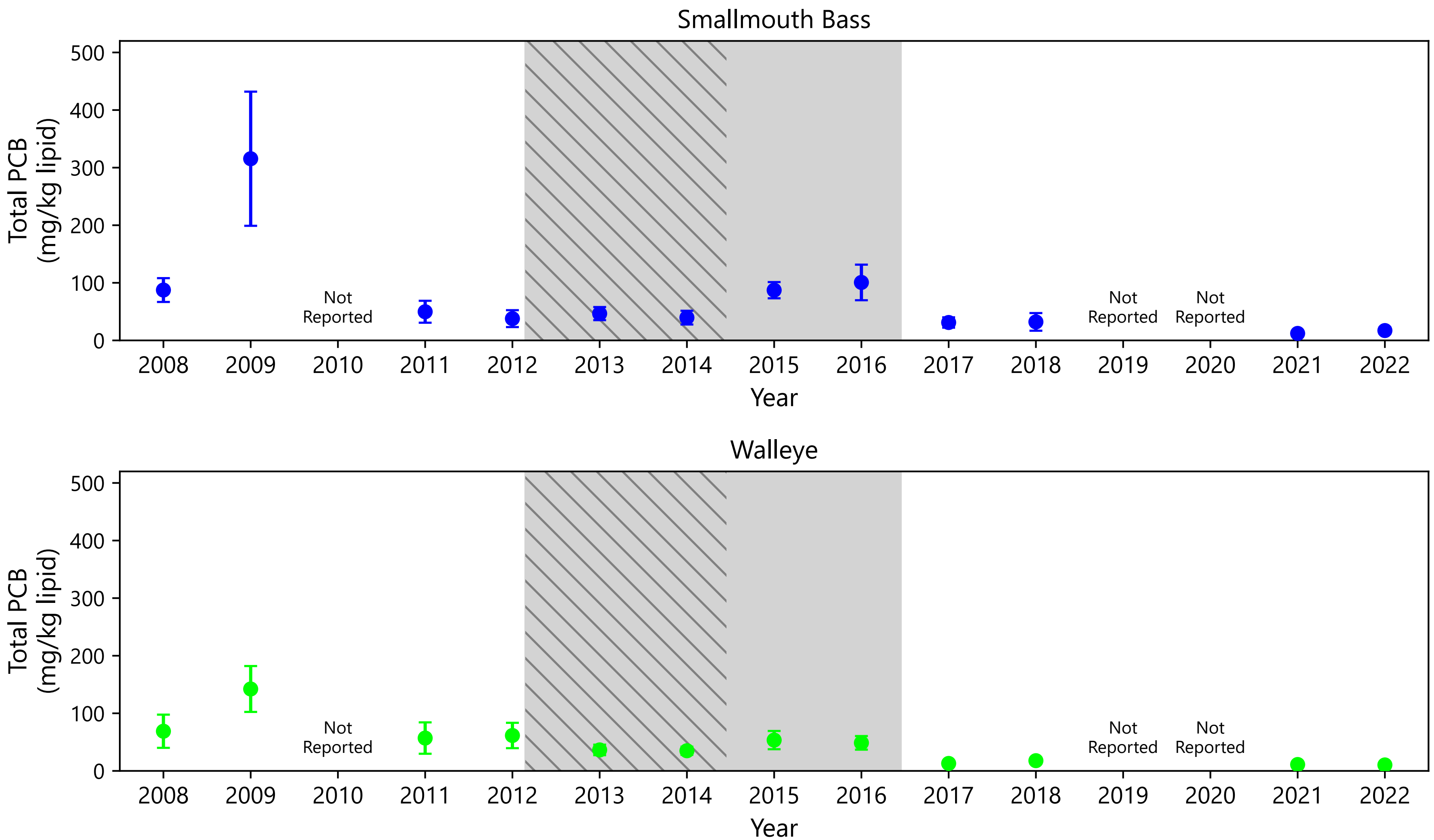
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_length_normalized_Hg.py

ANCHOR QEA

Set 4, Subset 1, Figure 2
Length-Normalized Mercury Concentrations in Prey Fish (All SMUs)



Notes: All fish are NYSDEC standard fillets. TPCB is the sum of detected Aroclors. 2010 organics data are excluded from long-term trends.
Non-detects included at 1/2 RL. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012.

Dredging
Capping

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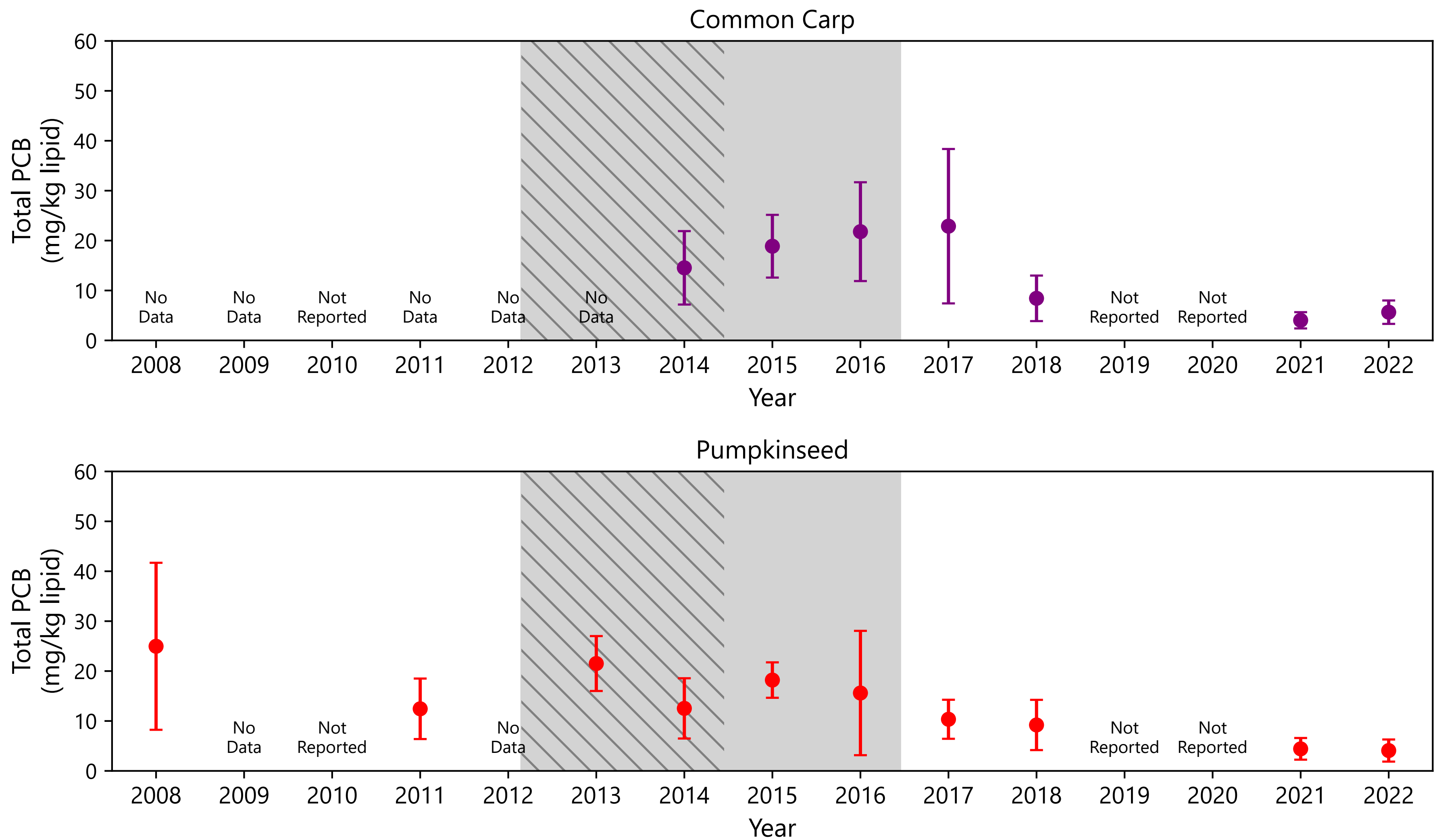
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_sportfish_organics_LipidNorm.py

ANCHOR QEA

Set 4, Subset 1, Figure 3
Lipid-Normalized Total PCB Concentrations in Smallmouth Bass and Walleye

Following review of the PCB and lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Notes: All fish are NYSDEC standard fillets. TPCB is the sum of detected Aroclors. 2010 organics data are excluded from long-term trends.
Non-detects included at 1/2 RL. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012. Collection of Common Carp began in 2014.

Dredging
Capping

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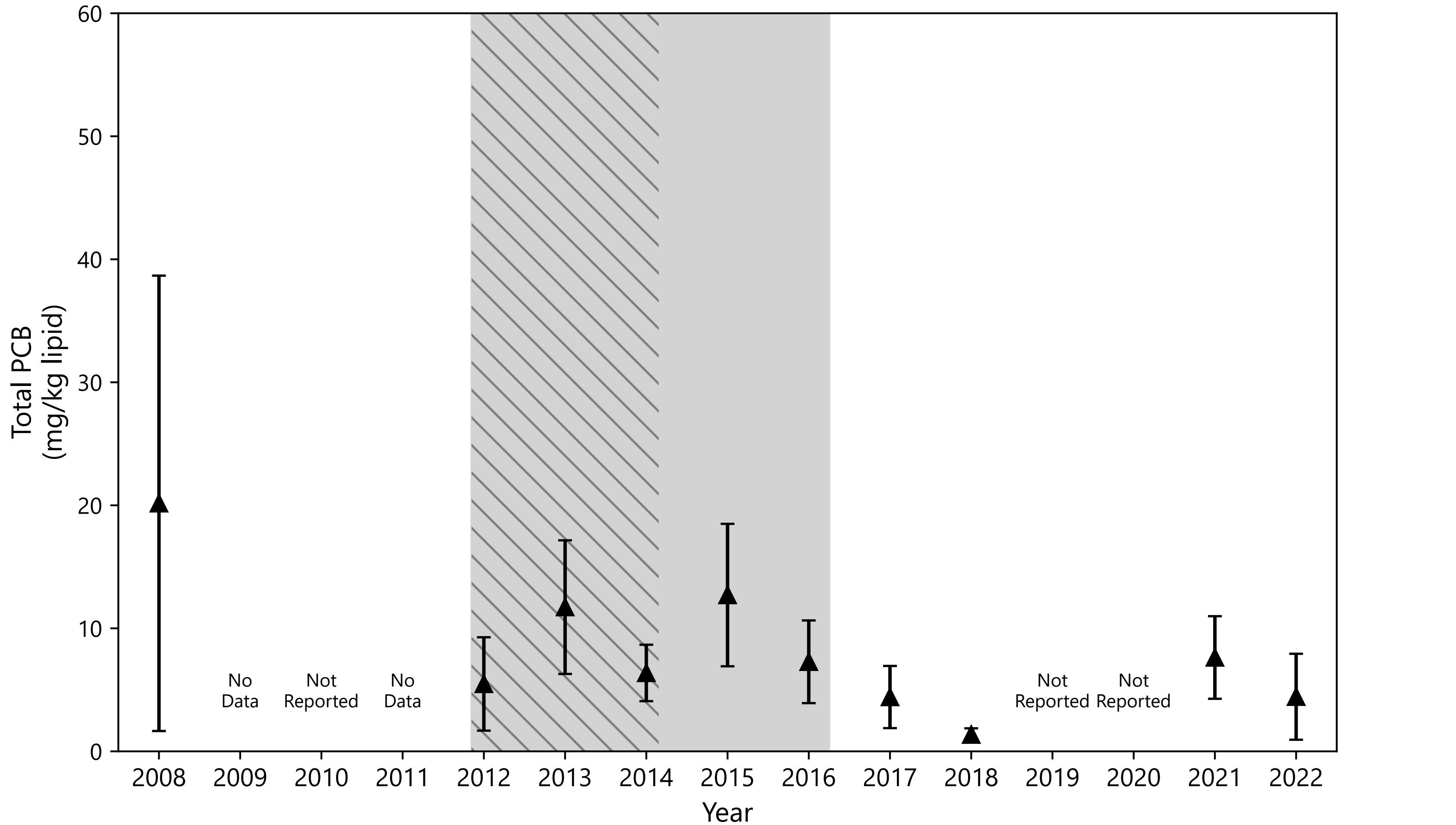
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_sportfish_organics_LipidNorm.py

ANCHOR QEA

Set 4, Subset 1, Figure 4
Lipid-Normalized Total PCB Concentrations in Common Carp and Pumpkinseed

Following review of the PCB and lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
TPCB is the sum of detected Aroclors. Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.

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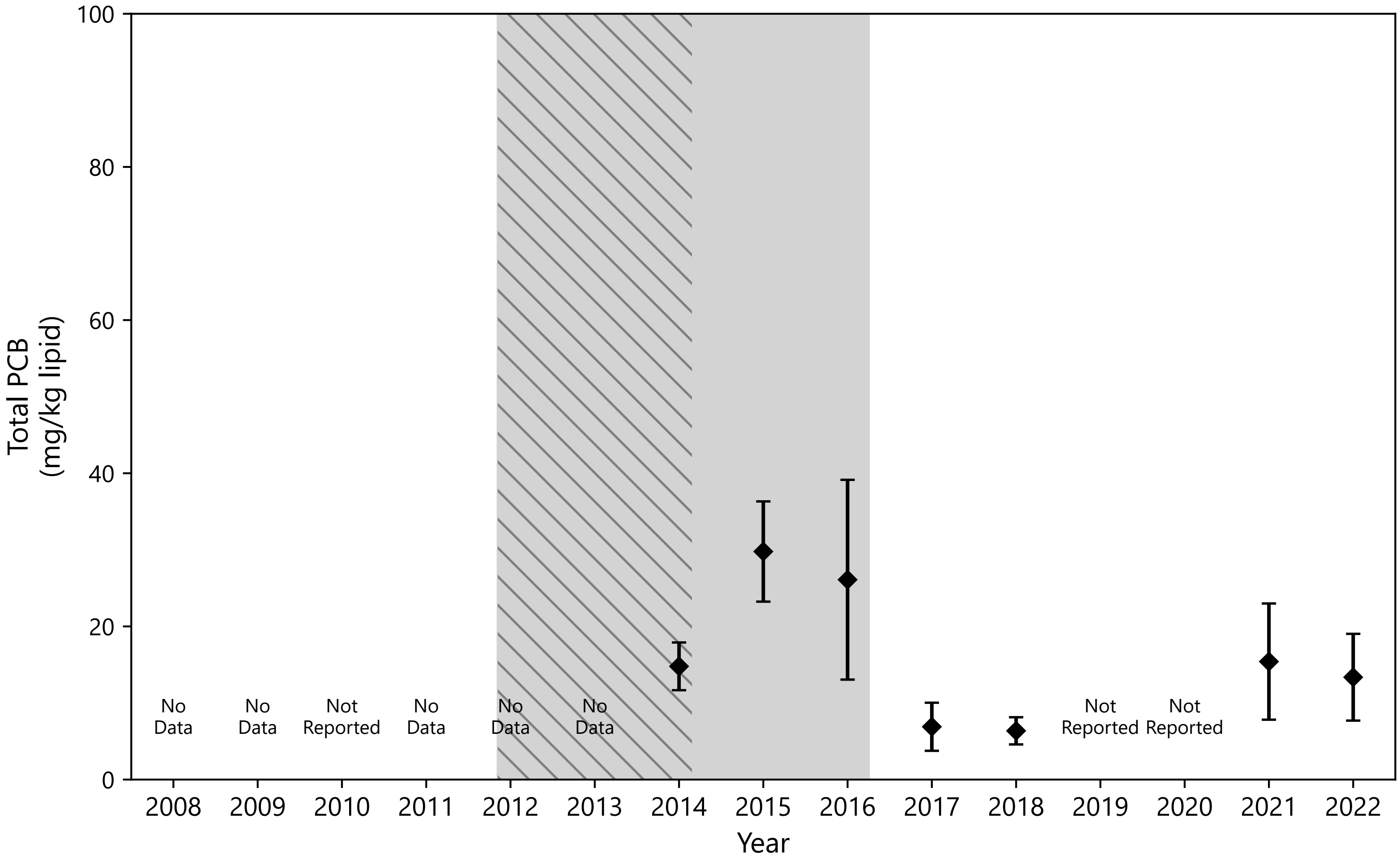
ANCHOR QEA

Set 4, Subset 1, Figure 5
Lipid-Normalized Total PCB Concentrations in Small Prey Fish (All SMUs)

Following review of the PCB and lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Large prey fish = White Sucker and Shorthead Redhorse.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
TPCB is the sum of detected Aroclors. Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In-lake remediation began in late July 2012. Large prey fish sampling began in 2014.

Dredging
Capping

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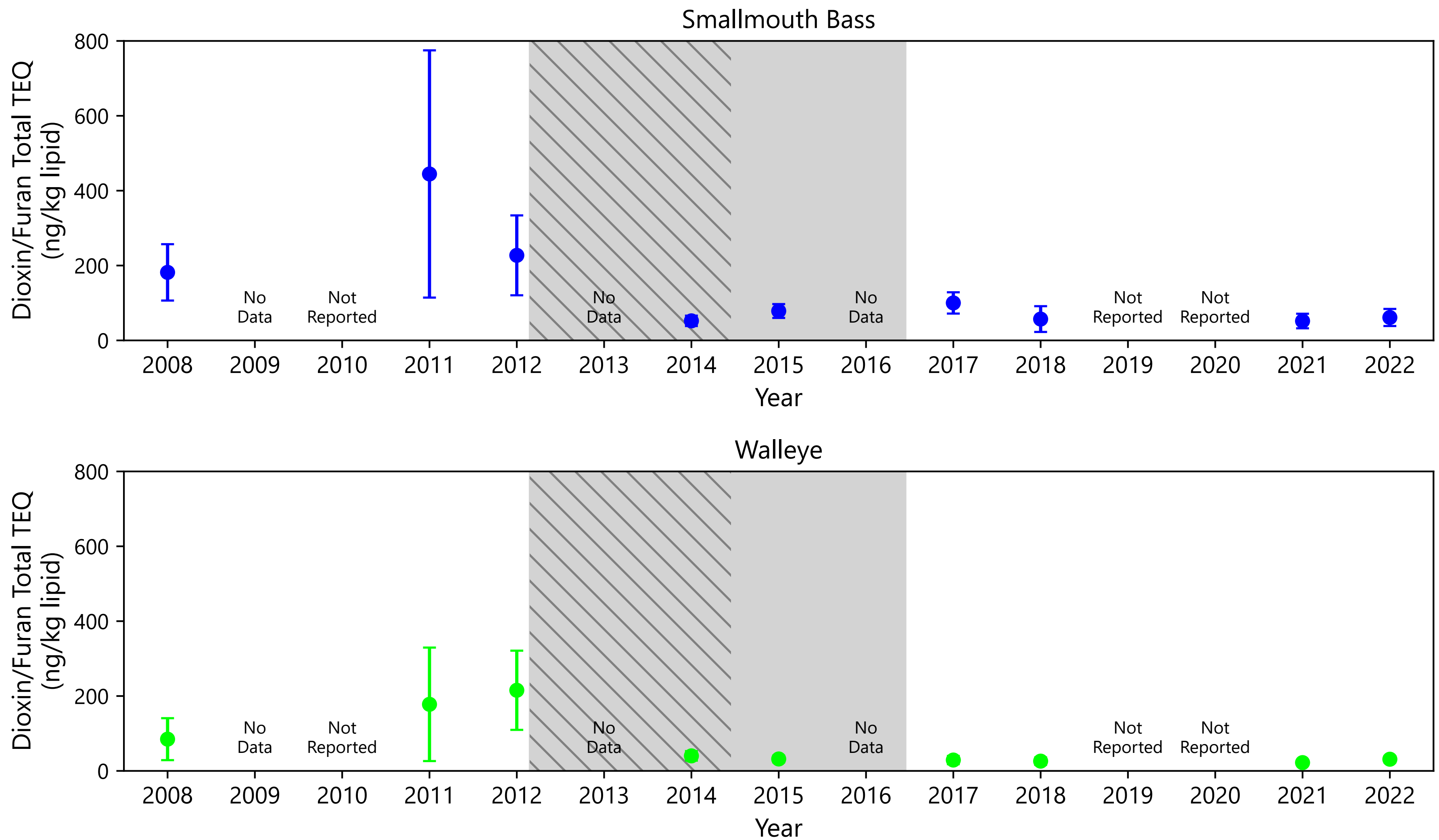
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

Set 4, Subset 1, Figure 6
Lipid-Normalized Total PCB Concentrations in Large Prey Fish (All SMUs)

Following review of the PCB and lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Notes: All fish are NYSDEC standard fillets. 2010 organics data are excluded from long-term trends.
Non-detects summed at 1/2 MDL, except 2014 and 2015, which used 1/2 RL. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012.

Dredging
Capping

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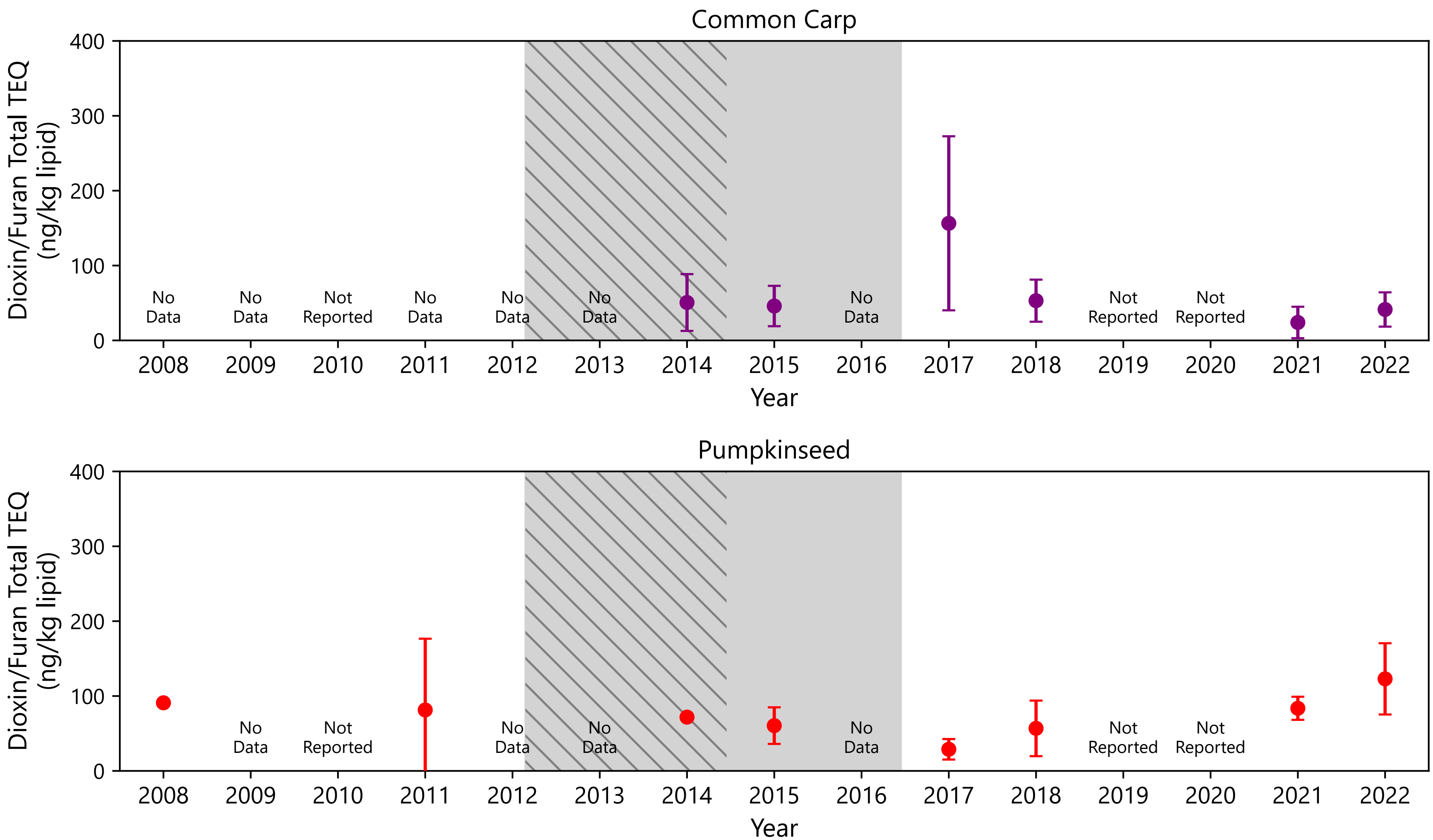
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_sportfish_organics_LipidNorm.py

ANCHOR QEA

Set 4, Subset 1, Figure 7
Lipid-Normalized Dioxin/Furan Total TEQ Concentrations in Smallmouth Bass and Walleye

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Notes: All fish are NYSDEC standard fillets. 2010 organics data are excluded from long-term trends.
Non-detects summed at 1/2 MDL, except 2014 and 2015, which used 1/2 RL. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012. Collection of Common Carp began in 2014.

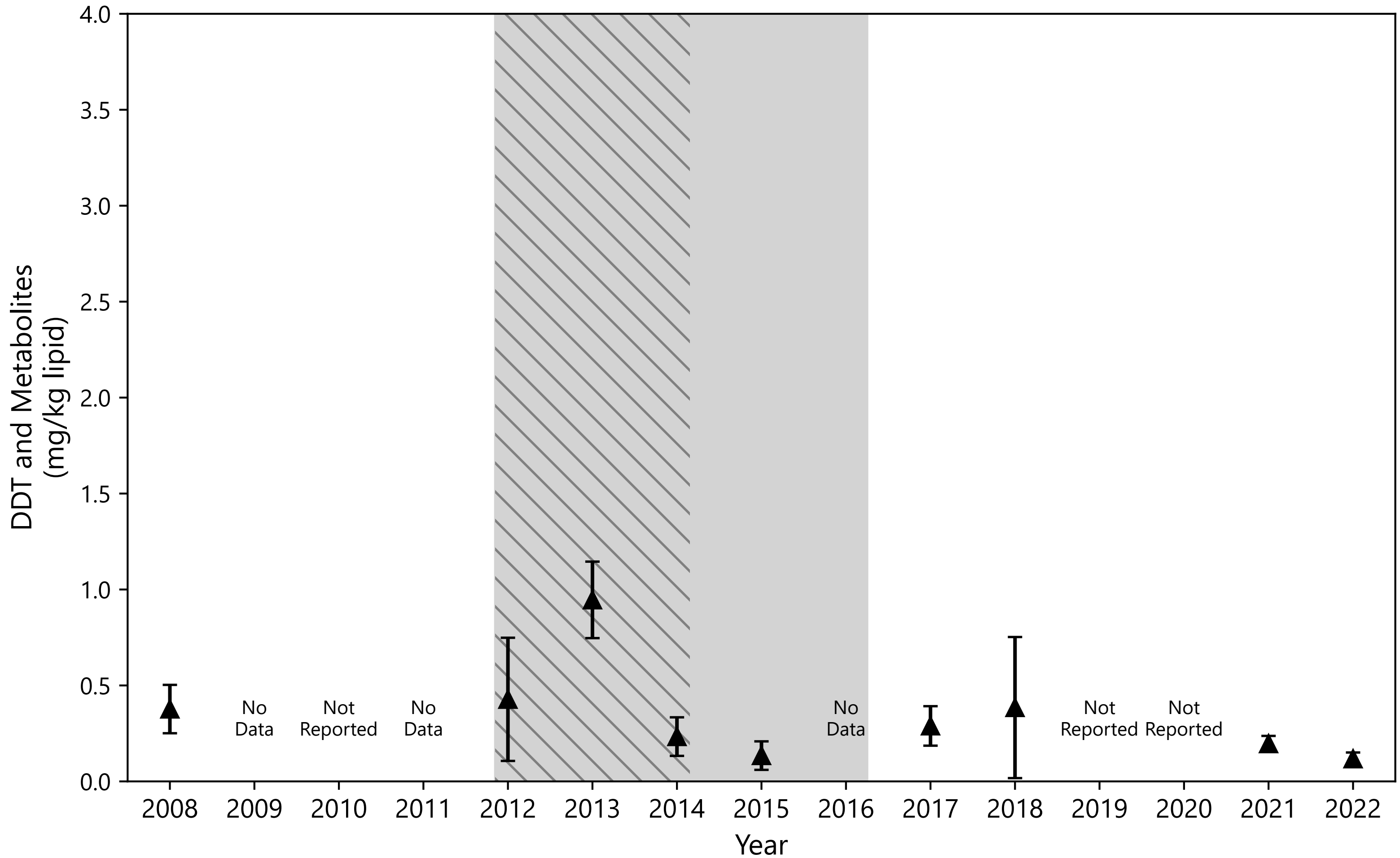
Dredging
Capping

Publish Date: 04/11/2025 15:42 PM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\temporal_sportfish_organics_LipidNorm.py

ANCHOR QEA

Set 4, Subset 1, Figure 8
Lipid-Normalized Dioxin/Furan Total TEQ Concentrations in Common Carp and Pumpkinseed

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.
DDT and Metabolites are not analyzed in fish tissue on an annual basis, and was not analyzed in 2016.

Dredging
Capping

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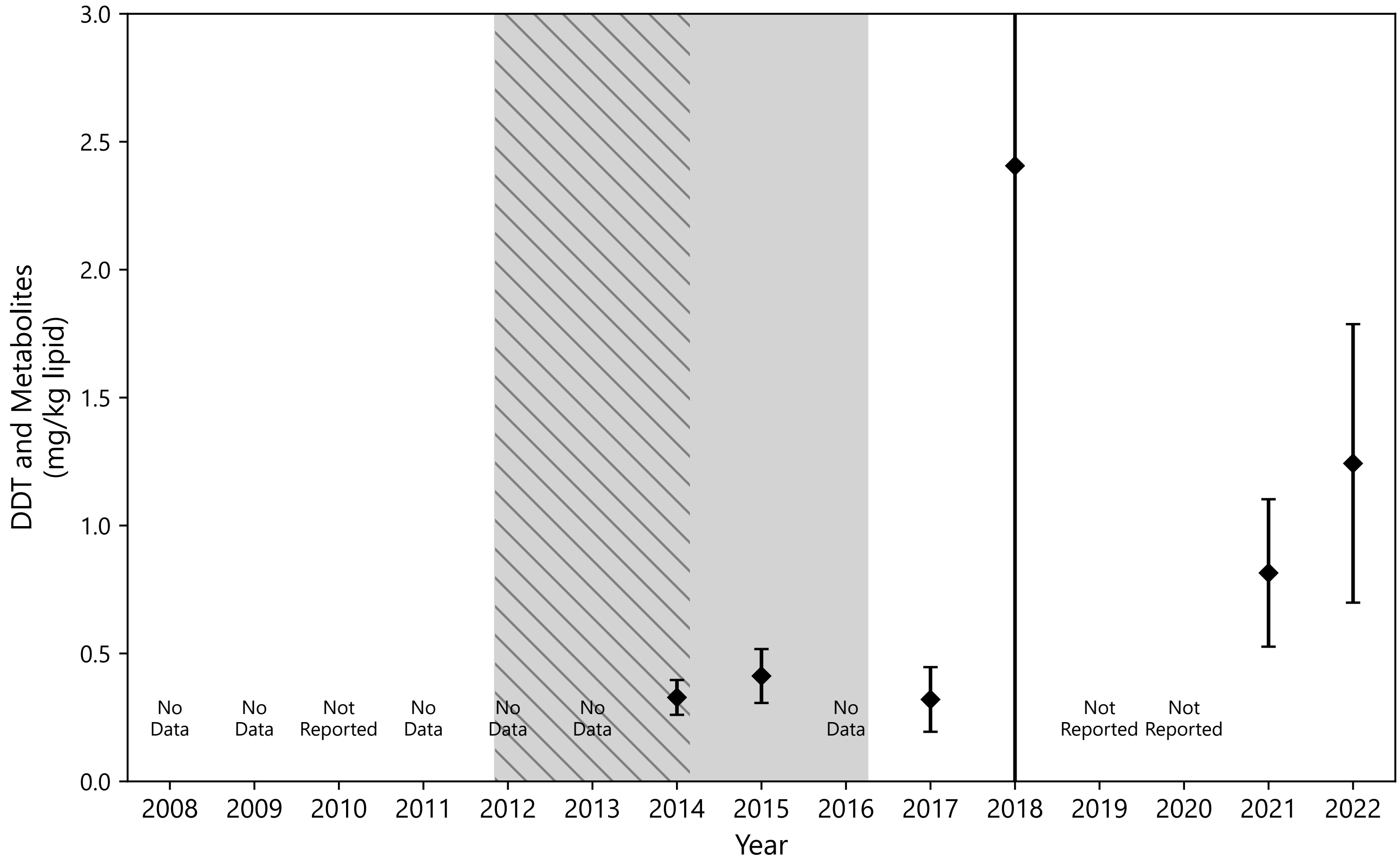
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

Set 4, Subset 1, Figure 9
Lipid-Normalized DDT and Metabolites Concentrations in Small Prey Fish (All SMUs)

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Large prey fish = White Sucker and Shorthead Redhorse.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In-lake remediation began in late July 2012. Large prey fish sampling began in 2014.
DDT and Metabolites are not analyzed in fish tissue on an annual basis, and was not analyzed in 2016.

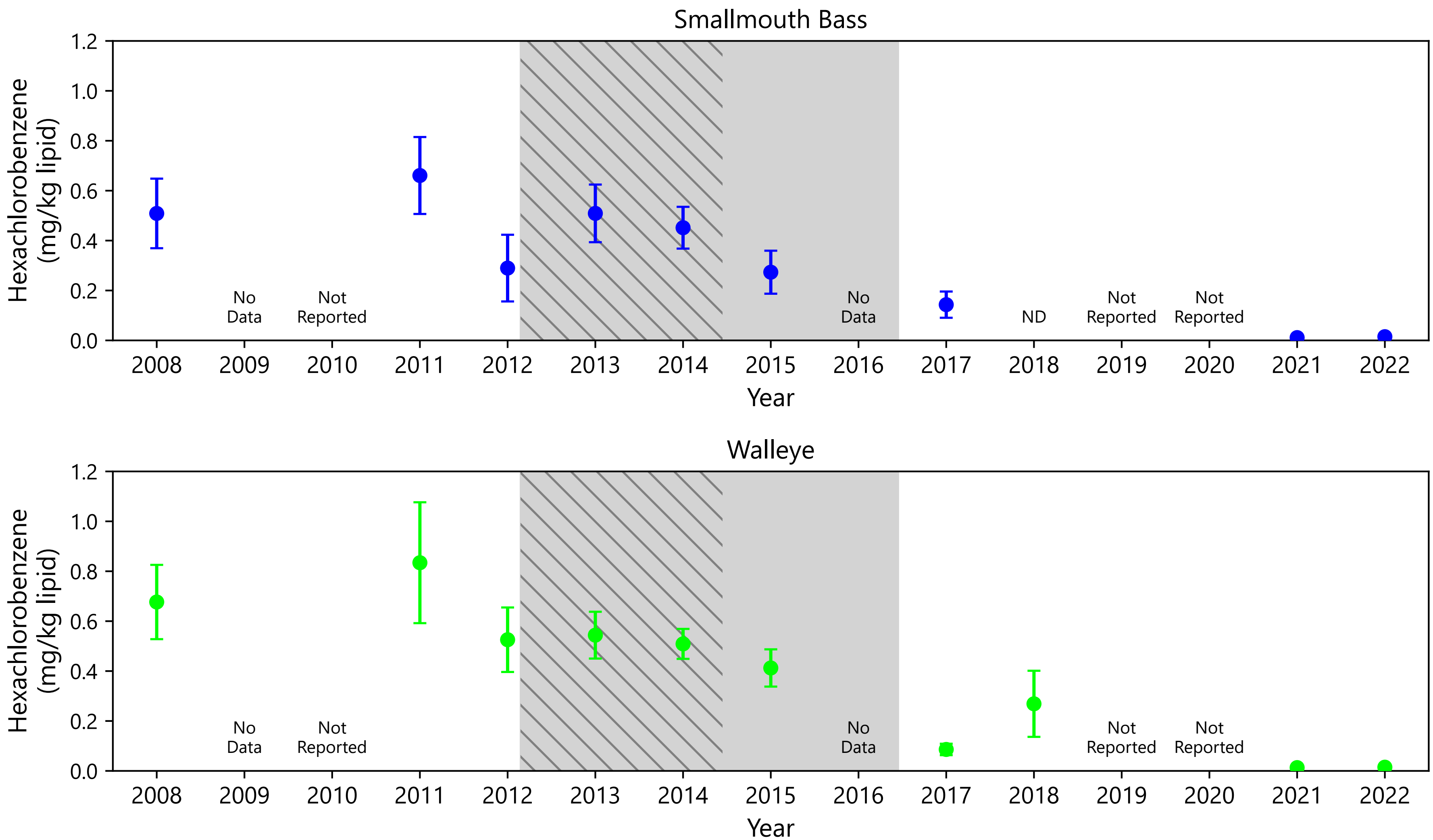
Dredging
Capping

Publish Date: 05/05/2025 16:05 PM | User: BAL-CWRI2
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

Set 4, Subset 1, Figure 10
Lipid-Normalized DDT and Metabolites Concentrations in Large Prey Fish (All SMUs)

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Notes: All fish are NYSDEC standard fillets. 2010 organics data are excluded from long-term trends.
Non-detects included at 1/2 RL. Open symbols indicate all results were non-detect. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012.

Dredging
Capping

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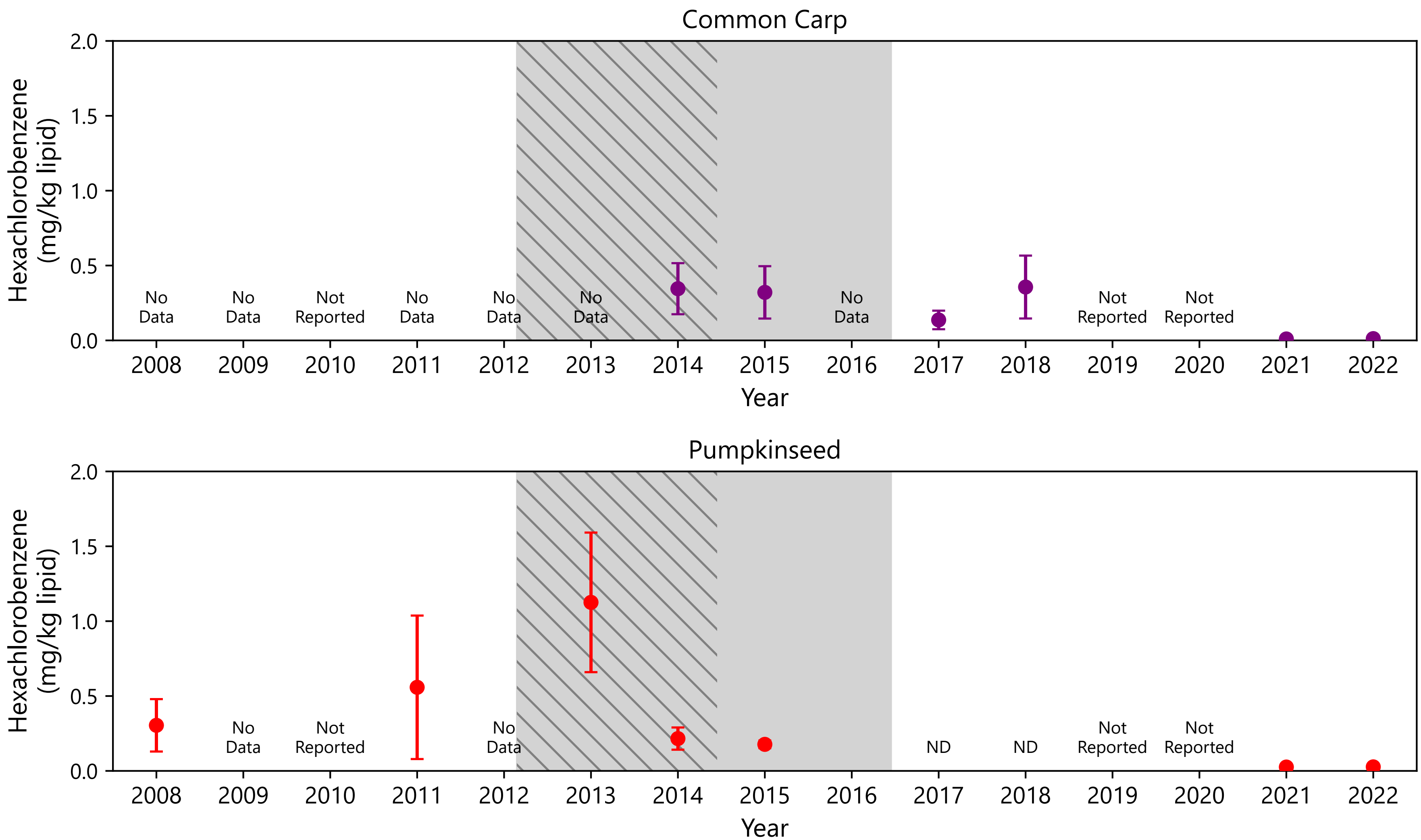
ANCHOR QEA

Set 4, Subset 1, Figure 11
Lipid-Normalized Hexachlorobenzene Concentrations in Smallmouth Bass and Walleye

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Notes: All fish are NYSDEC standard fillets. 2010 organics data are excluded from long-term trends.
Non-detects included at 1/2 RL. Open symbols indicate all results were non-detect. Data presented are means +/- 2 SE; all ages and both sexes combined.
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
In 2012, in-lake remediation began in late July and fish were sampled mid-June through early-July 2012. Collection of Common Carp began in 2014.

Dredging
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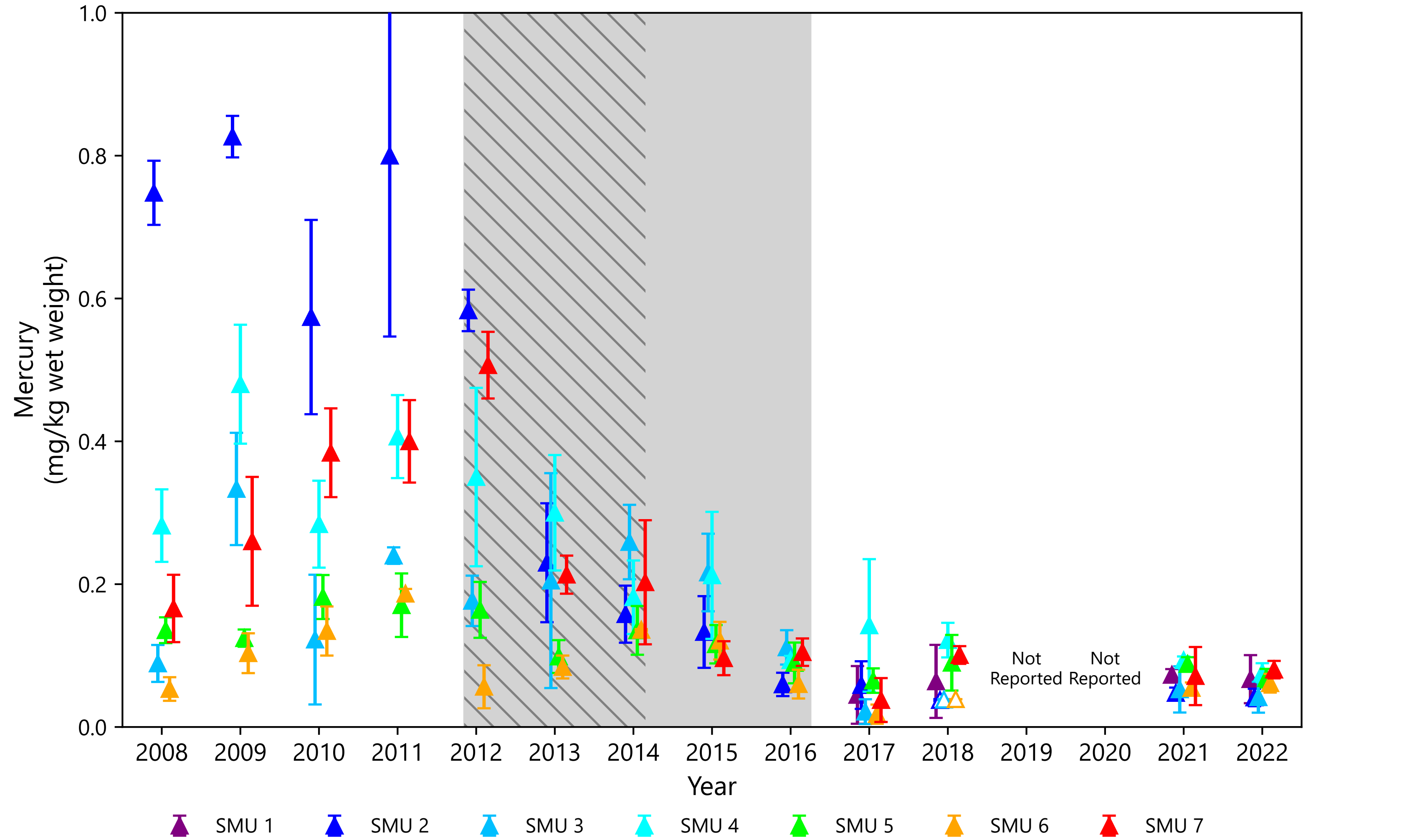
ANCHOR QEA

Set 4, Subset 1, Figure 12
Lipid-Normalized Hexachlorobenzene Concentrations in Common Carp and Pumpkinseed

Following review of the lipids results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.
Nitrate addition began in 2011.

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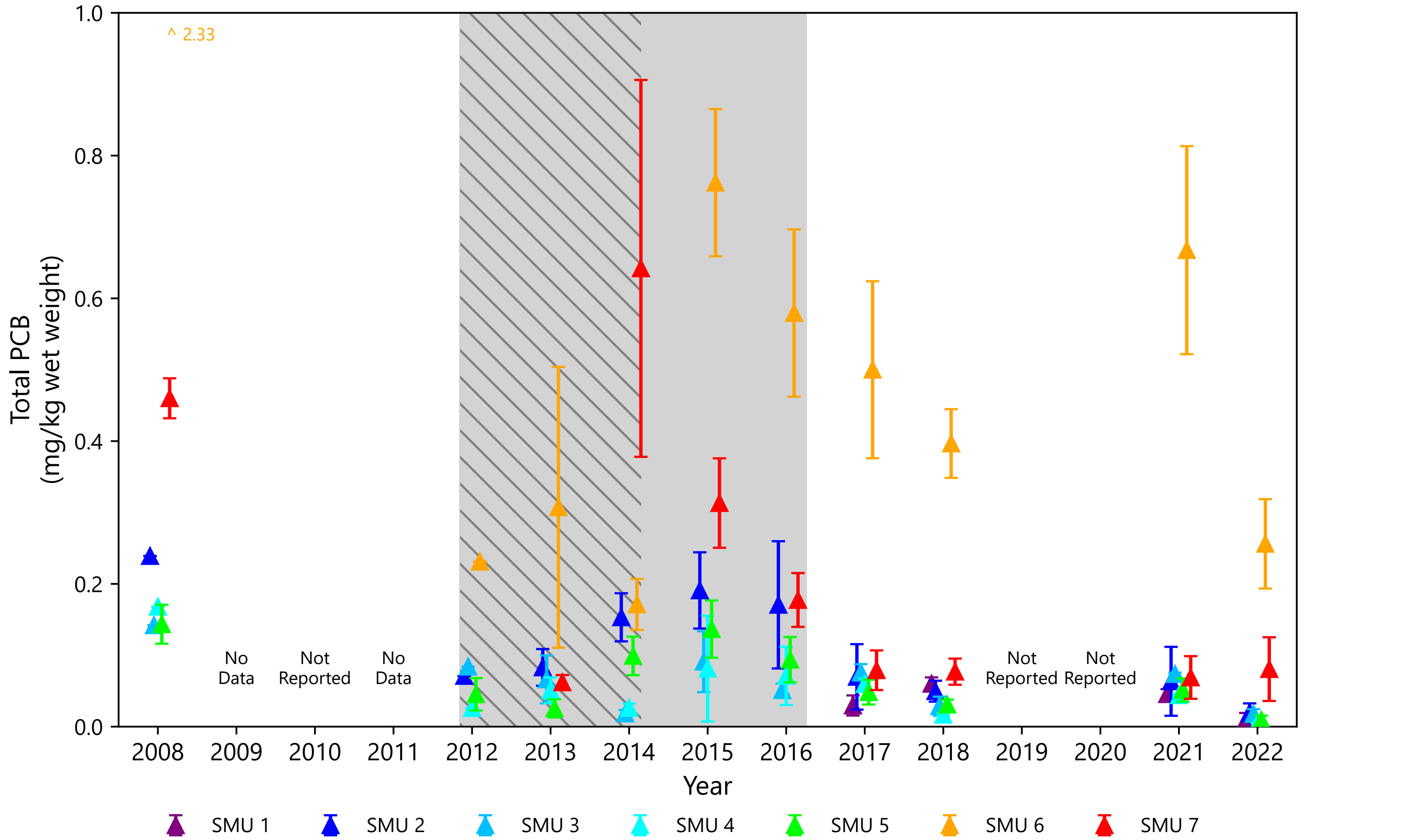
ANCHOR QEA

Set 4, Subset 2, Figure 1
Mercury Concentrations in Small Prey Fish By SMU



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
TPCB is the sum of detected Aroclors. Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.

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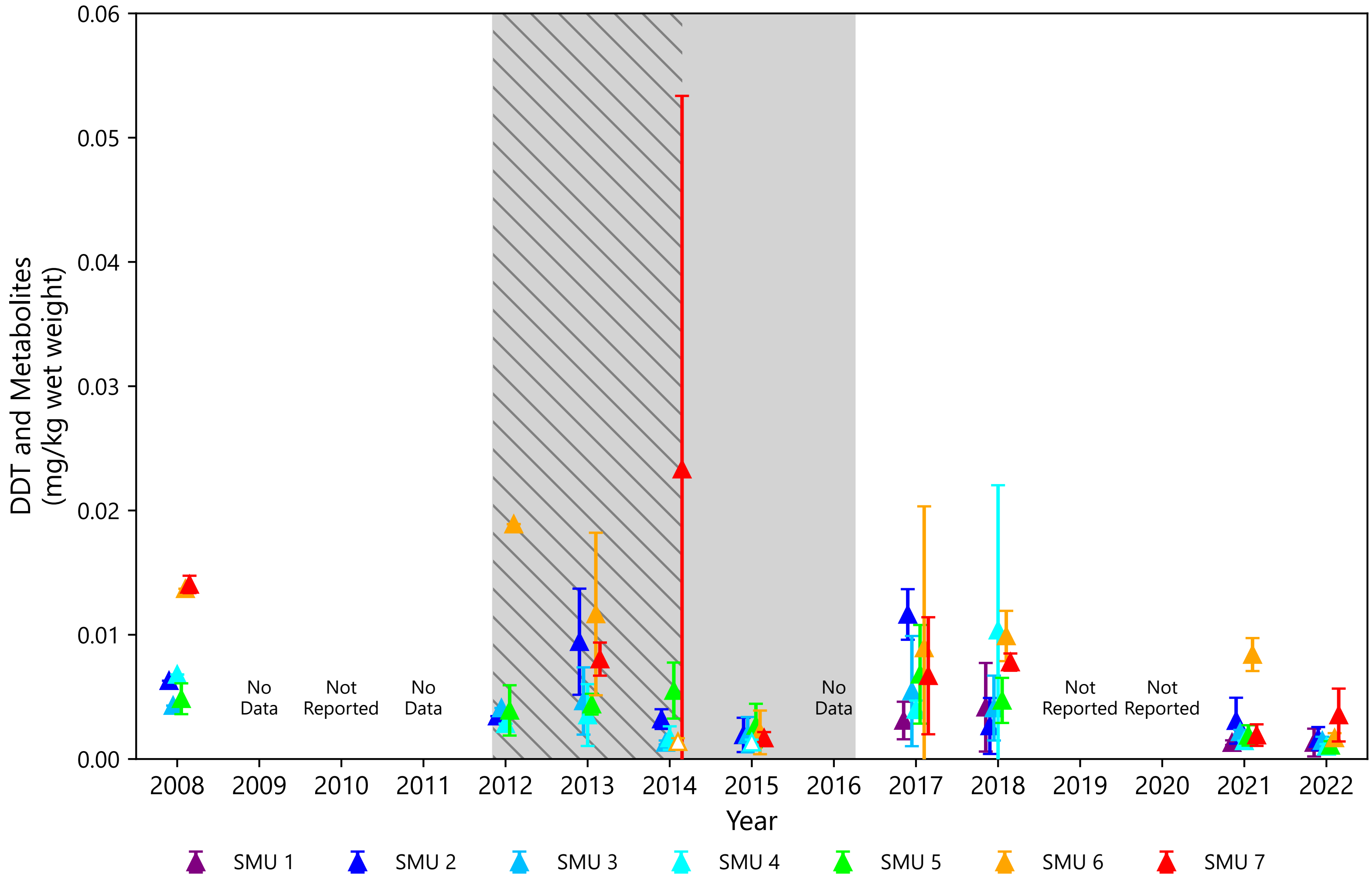
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

Set 4, Subset 2, FIgure 2
Total PCB Concentrations in Small Prey Fish By SMU

Following review of the PCB results that were analyzed by the Honeywell-contracted lab (SGS) from fish samples collected in 2021 and 2022 compared to split sample results analyzed by a NYSDEC-contracted lab, it was determined that many of the results from SGS were likely biased low. NYSDEC and Honeywell are currently exploring options for applying estimation factors to the results. If it is determined that estimation factors should be applied to each sample result from 2021 and 2022, then this figure will be revised and documented in an addendum to this FYR.



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring.
Non-detects included at 1/2 RL.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.
DDT and Metabolites are not analyzed in fish tissue on an annual basis, and was not analyzed in 2016.

Dredging
Capping

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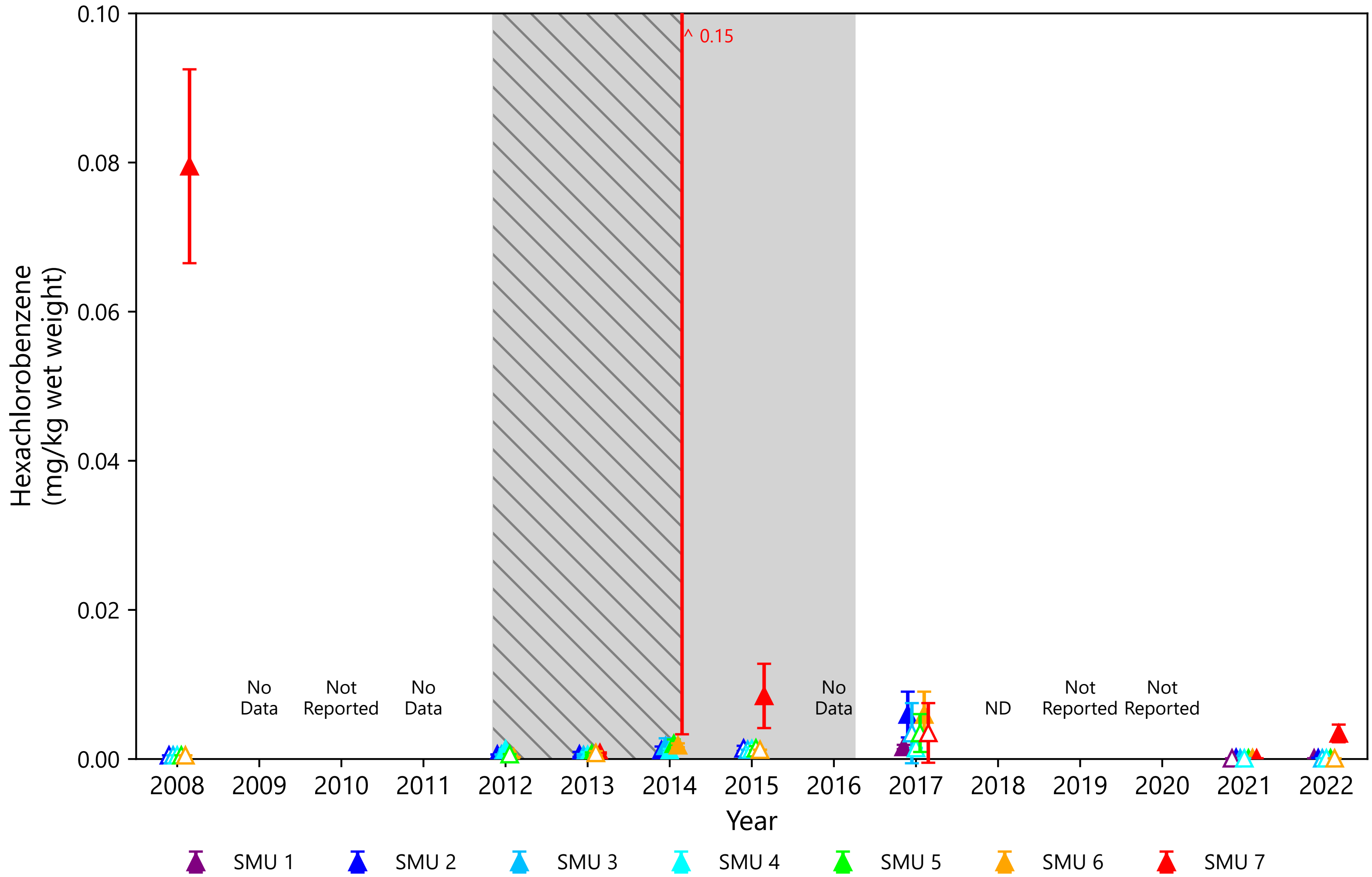
\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

Set 4, Subset 2, Figure 3
DDT and Metabolites Concentrations in Small Prey Fish By SMU



Small prey fish = Golden Shiner, Brook Silverside, Minnow, Bluntnose Minnow, Banded Killifish, and Round Goby (Alewife excluded).
Data source: 2008 through 2011 Baseline Monitoring Program and 2012 through 2022 Remedial Goal Monitoring. Non-detects included at 1/2 RL.
Open symbols indicate all results were non-detect.Prey fish had whole body preparation; all ages and sexes combined; mean +/- 2 SE.
In 2012, in-lake remediation began in late July and fish were sampled in early August 2012. 2010 organics data are excluded from long-term trends.
Hexachlorobenzene is not analyzed in fish tissue on an annual basis, and was not analyzed in 2016.

Dredging
Capping

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\\wcl-fs1\syracuse\Projects\Honeywell\Onondaga_Lake_OLMMS_(E60287)\ANALYSIS\FISH\2022_OMM\Python\errbar_preyfish_lipid_ww_bySMU_allSMU.py

ANCHOR QEA

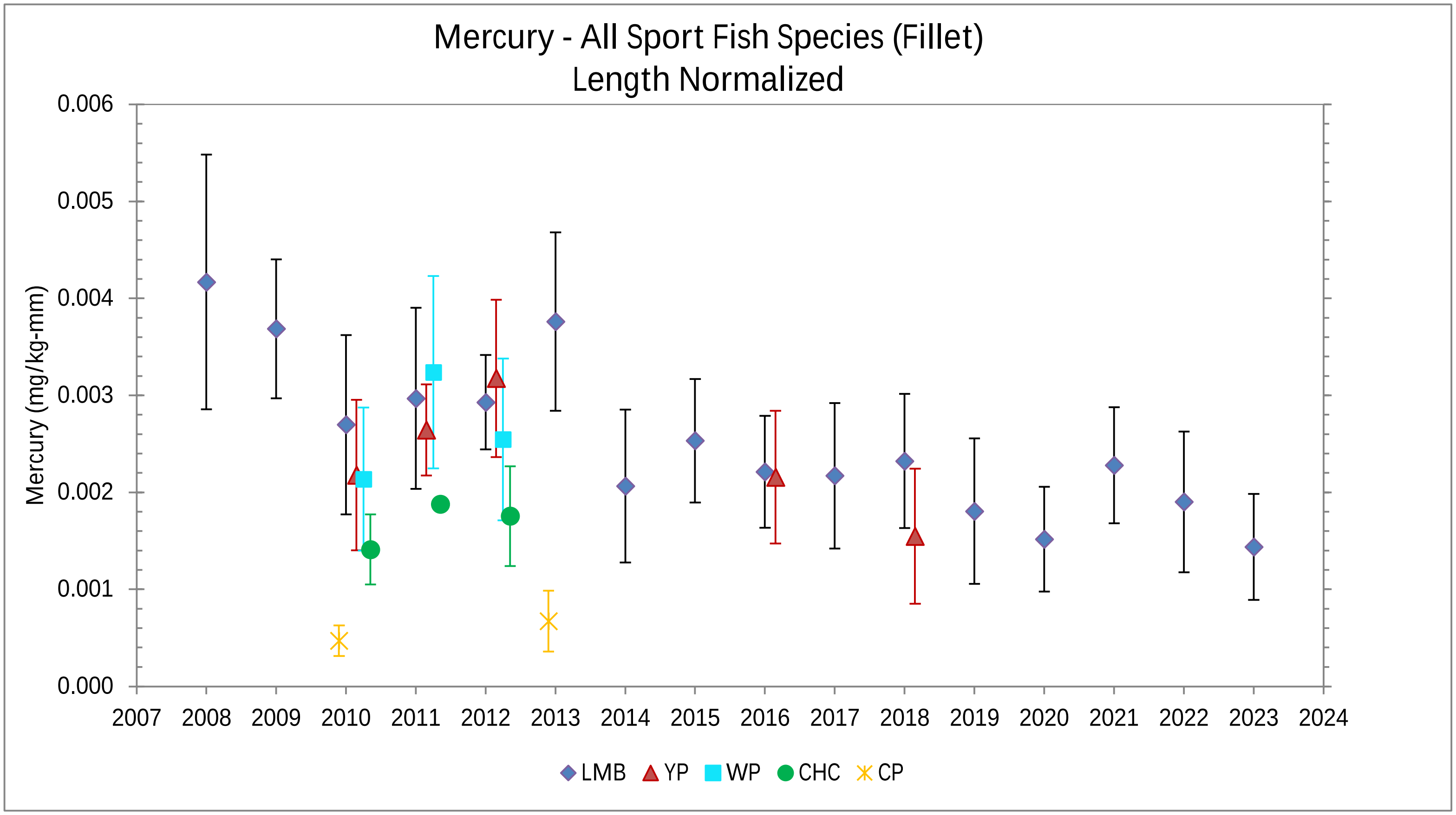
Set 4, Subest 2, Figure 4
Hexachlorobenzene Concentrations in Small Prey Fish By SMU

NYSDEC Set 4 Data (2008-2023)

September 2025

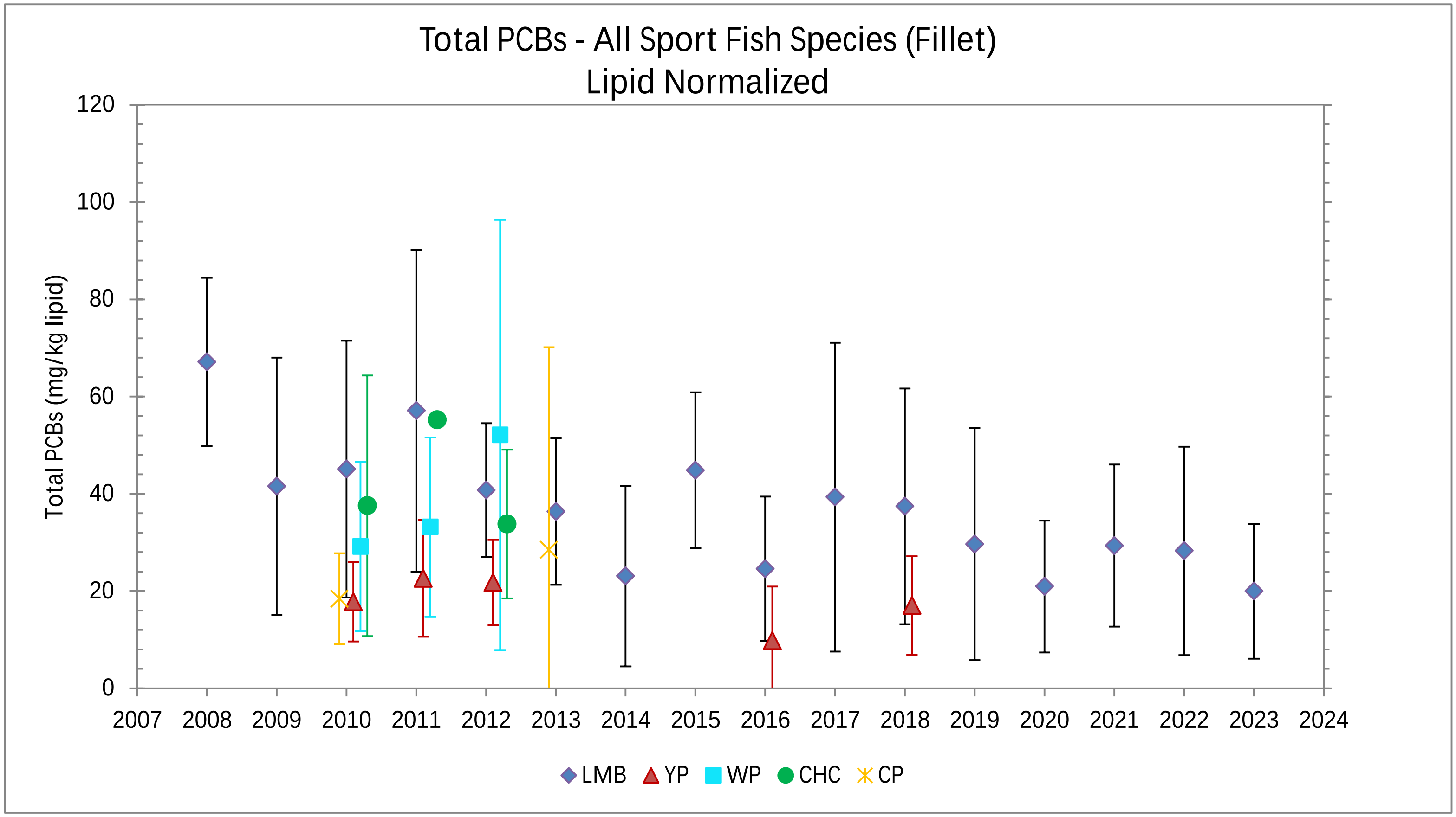
Set 4 DEC Figure 1

NYSDEC Length-Normalized Mercury Data



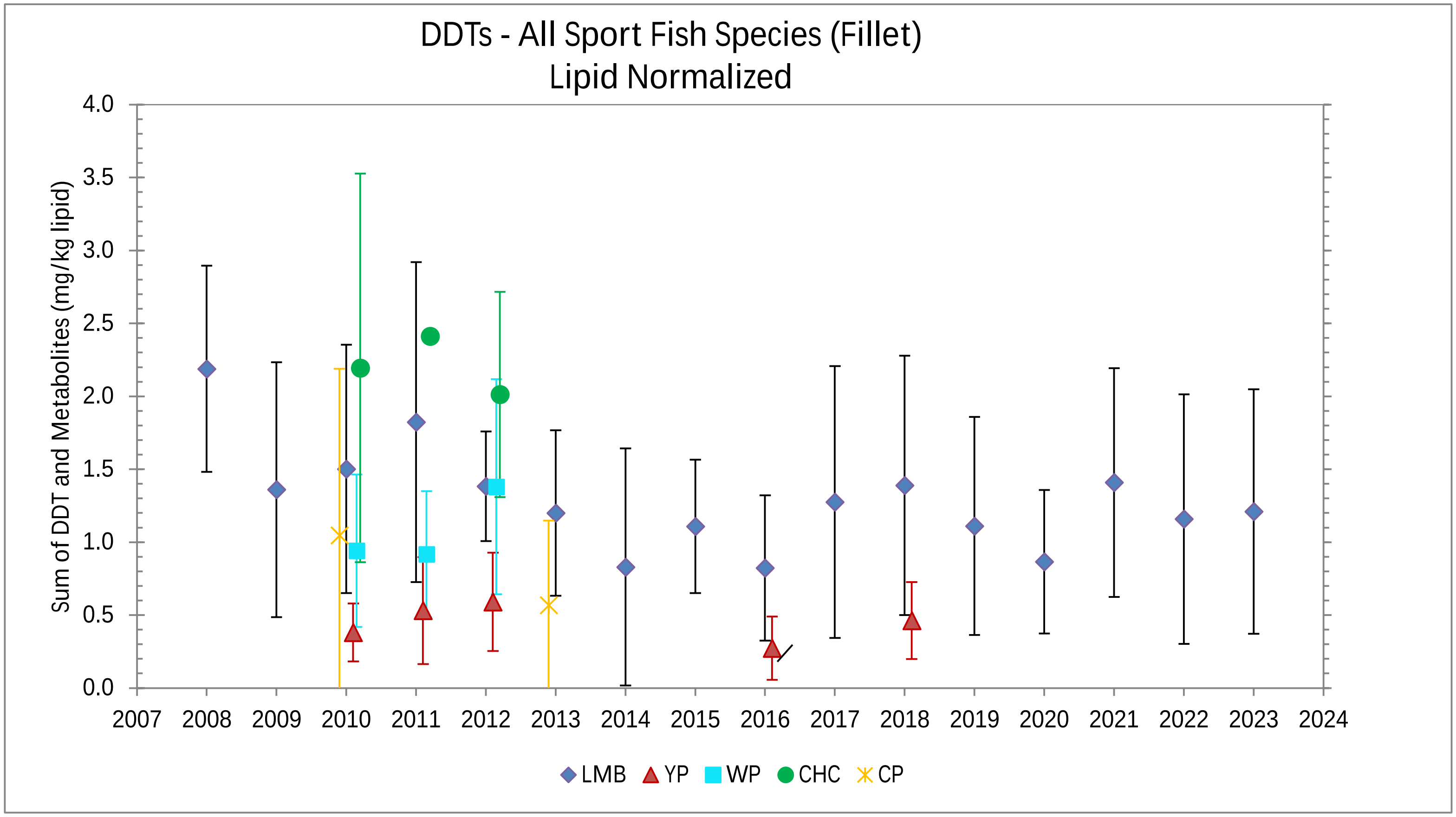
Set 4, DEC Figure 2

NYSDEC Lipid-Normalized Total PCBs Data



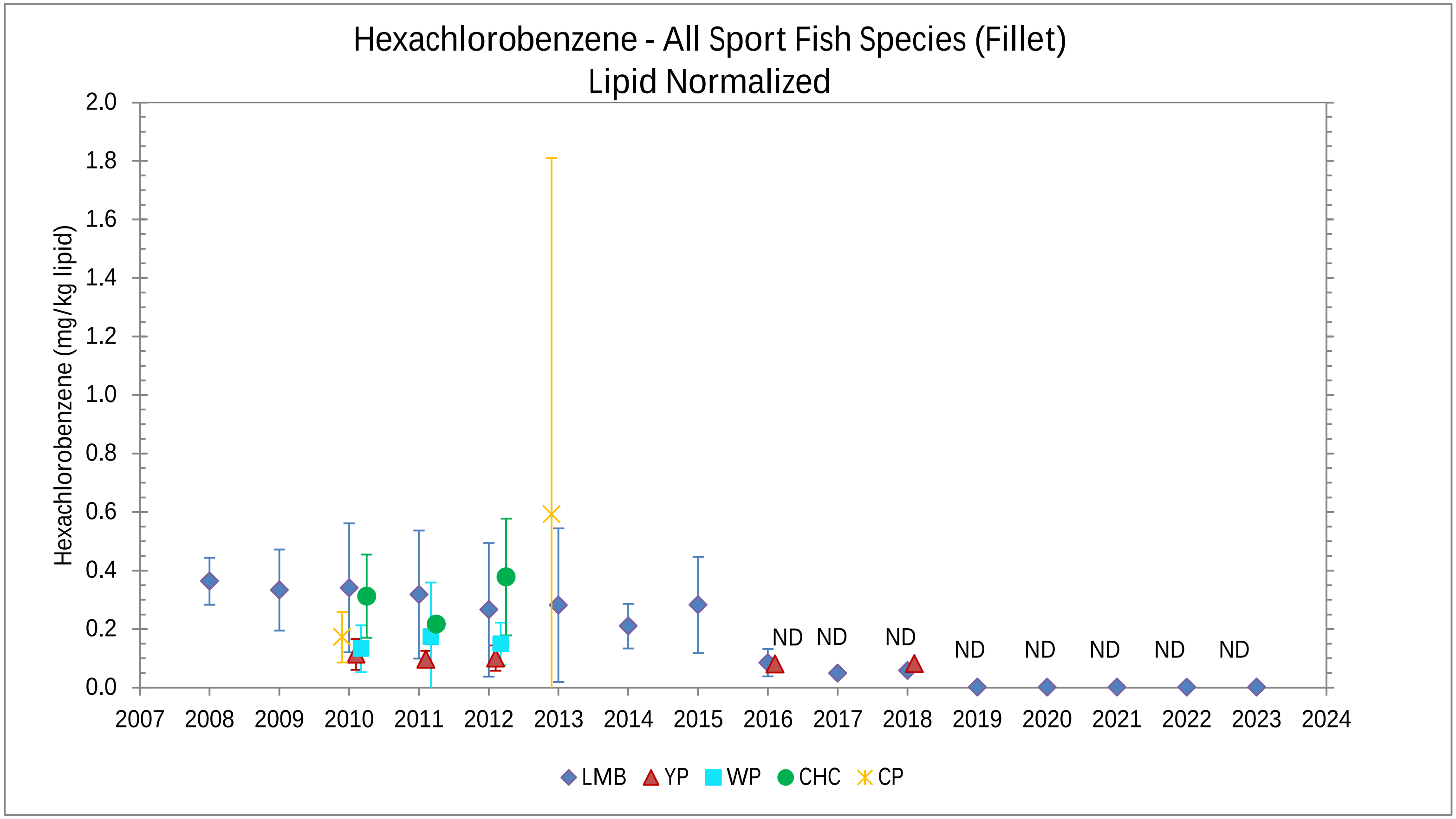
Set 4, DEC Figure 3

NYSDEC Lipid-Normalized DDT Data

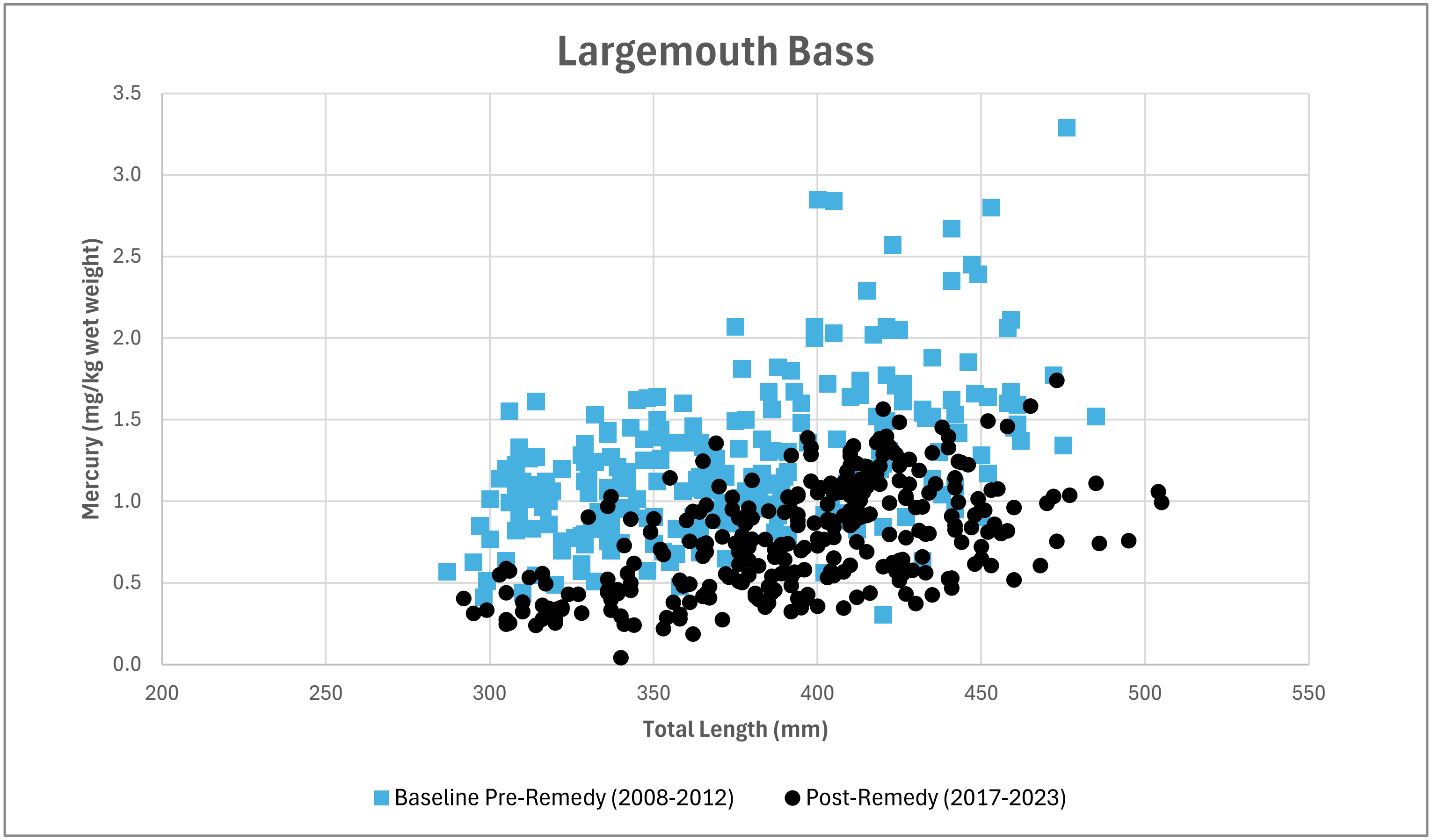


Set 4, DEC Figure 4

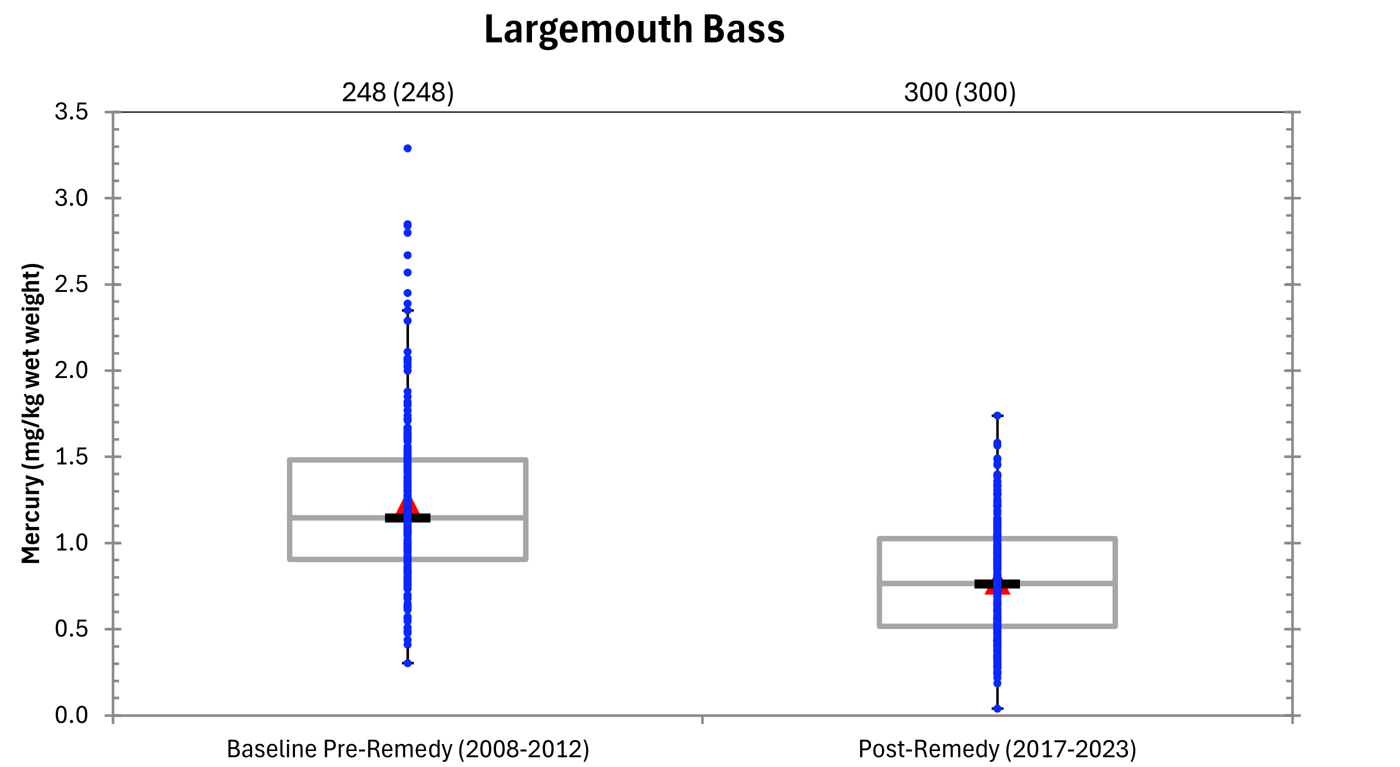
NYSDEC Lipid-Normalized Hexachlorobenzene Data



Set 4, DEC Figure 5
Mercury vs Length, Pre and Post Remedy



Set 4, DEC Figure 6
Mercury, Pre and Post Remedy



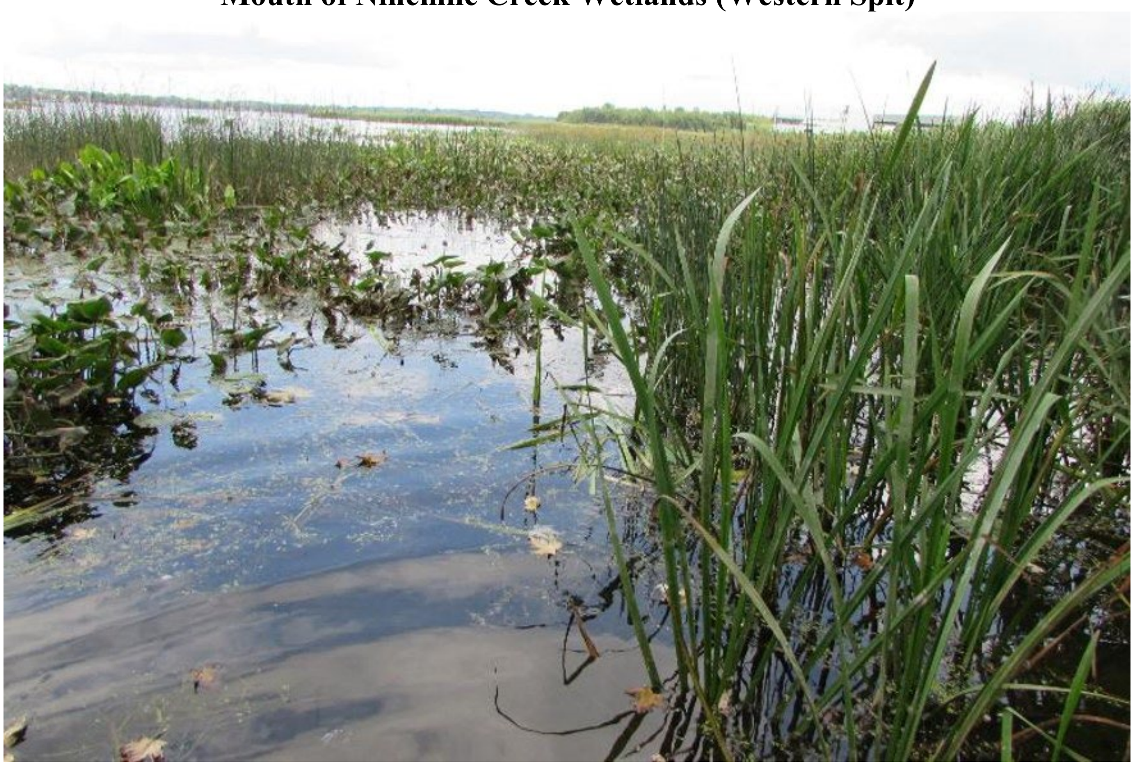
Number of samples provided above the plot with number of detected results in parentheses.
Points overlaid on the boxplots represent individual fish data.

Attachment 4 – Site Photographs

Wastebed B/Harbor Brook Outboard Area Wetlands

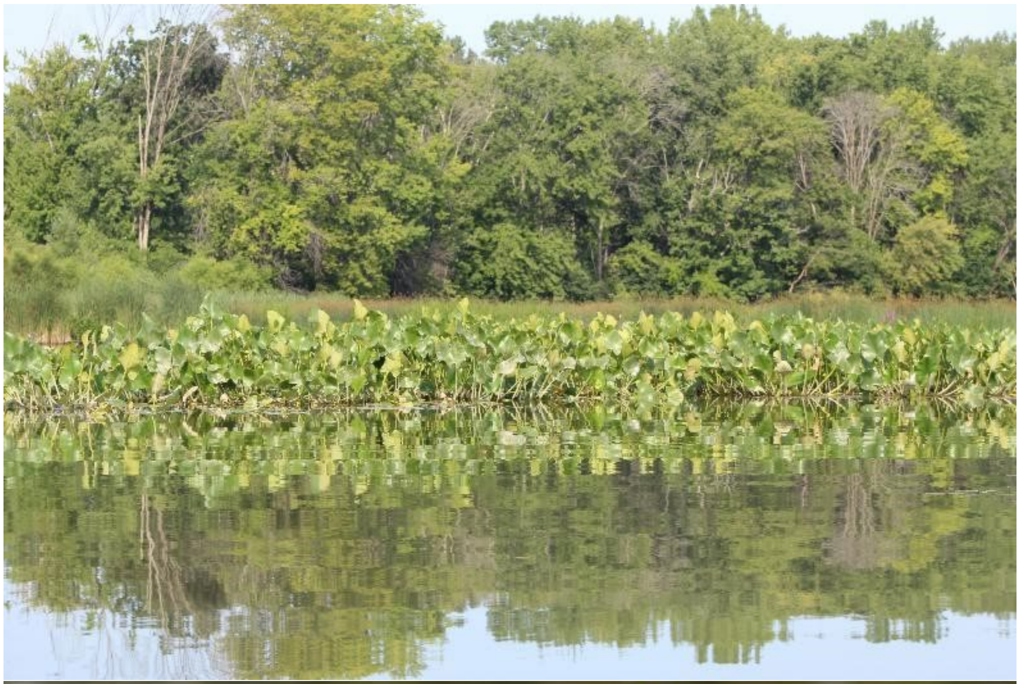
Wastebed B Outboard Area (Protective Berms)

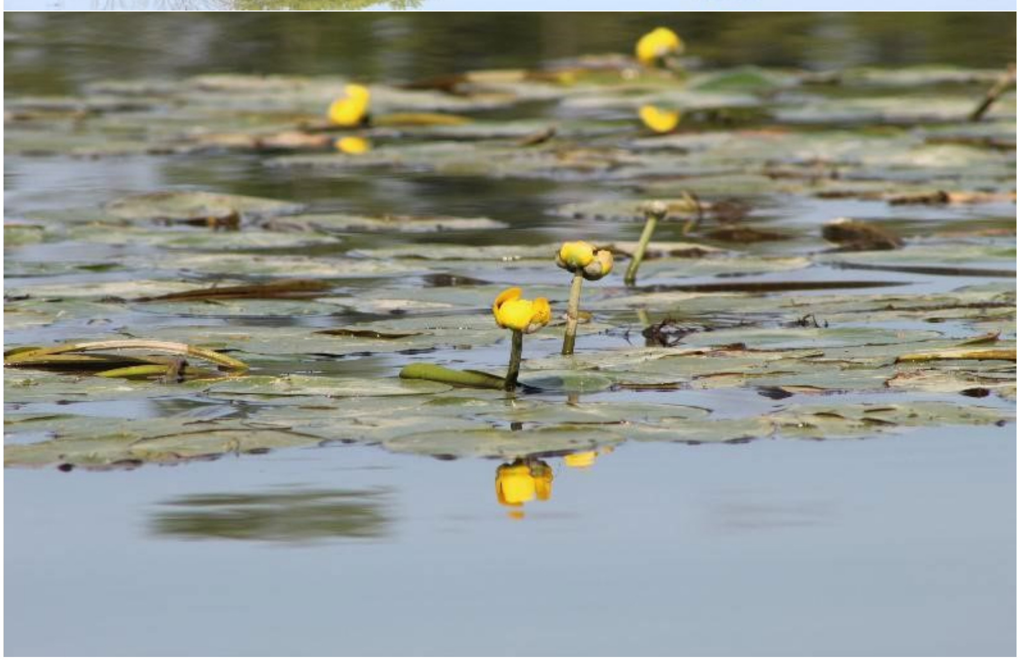

Mouth of Ninemile Creek Wetlands (Western Spit)



Mouth of Ninemile Creek Wetlands (Eastern Spit)

Mouth of Nine Mile Creek (In-Lake Emergent/Floating Aquatic Area Wetlands)





Sediment Consolidation Area