United States Environmental Protection Agency
Office of Water
Washington, DC
EPA No. 841-F-19-003

National Coastal Condition Assessment 2020

Quality Assurance Project Plan

Version 1.2 February 2021

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Approval Page

Management Approvals: Signature indicates approval for the National Coastal Condition Assessment 2020 Quality Assurance Project Plan (QAPP), related Field Operations Manual (FOM) and Laboratory Operations Manual (LOM).

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QUALITY ASSURANCE PROJECT PLAN

REVIEW & DISTRIBUTION ACKNOWLEDGMENT AND
COMMITMENT TO IMPLEMENT
for
National Coastal Condition Assessment 2020

I/We have read the QAPP and the methods manuals for the National Coastal Condition Assessment listed below. Our agency/organization agrees to abide by its requirements for work performed under the National Coastal Condition Assessment. Please check the appropriate documents.

Quality Assurance Project Plan	□
Field Operations Manual	□
Site Evaluation Guidelines	□
Laboratory Methods Manual	□

Field Crew leads: I also certify that I attended an NCCA 2020 training and that all members of my crew have received training in NCCA protocols

Print Name

Title
(Cooperator's Principal Investigator)

Organization

Signature Date

Field Crews: Please return this signed "QAPP Review & Distribution Acknowledgment and Commitment to Implement" form and return to the Contractor Field Logistics Coordinator, Chris Turner, Great Lakes Environmental Center, Inc.; 739 Hastings Street; Traverse City, MI 49686. cturner@glec.com.

Labs and others: Please return the signed original to Kendra Forde who will ensure all parties have signed the QA forms, compile them, and submit them to the EPA QA Coordinator. Send your forms to: Kendra Forde at forde.kendra@epa.gov; or by US Postal Service at EPA, 1200 Pennsylvania Ave, NW (4503T); Washington, DC 20460. Please retain a copy for your files.

Please save the QAPP locally upon completing this page, and then print this page only to PDF. Use the following naming convention for the file:
NCCA_2020_QAPPv1.1_ACK_[Lastname.Firstname_organization_YYYYMMDD].pdf"

* Handwritten or digital signatures are acceptable.

Version History

QAPP Version	Date Approved	Changes Made
1.0	April 10, 2020	Not Applicable
1.1	April 22, 2020	Section 3.4 Revisit Sites. text changed to indicate that revisits should occur at least two weeks after the first visit and preferably longer. Page 53. Section 5.1.4.3 Instrumentation. Corrected Table 5.3 so that Dissolved Oxygen callibration Acceptance Criteria reads "±0.5 mg/L or 10% of 100% saturation", to align with the DO data accuracy objective in Table 5.2, which is correct. p. 79. Section 5.10 Human Health Fish Tissue (HTIS) (Great Lakes Nearshore and Lake Michigan Enhancement Sites Only). Corrected name of indicator to "Great Lakes Human Health Fish Tissue Study". Corrected compounds to be analyzed for (removed "PFCs" and "PBDEs", and added "PFAS"). Pages 139-140, 142-144. **Table 0.1 Description of NCCA 2020 Indicators and location where indicators are collected updated to clarify the sites at which Human Health fish specimens will be collected. P. 73**
1.2	March 9, 2021	Table 5.13 changed Average absorbance value, $\bar{A}0$, for S0 to ≥0.80 from > 0.80.

Notices

The National Coastal Condition Assessment (NCCA) 2020 Quality Assurance Project Plan (QAPP) and related documents are based on the previous Environmental Monitoring and Assessment Program's (EMAP) National Coastal Assessment (NCA) conducted in 2001 – 2004 as well as the National Coastal Condtion Assessments in 2010 and 2015.

The complete documentation of overall NCCA project management, design, methods, and standards is contained in four companion documents, including:

- *National Coastal Condition Assessment: Quality Assurance Project Plan (EPA # 841-F-19-003)*
- *National Coastal Condition Assessment: Field Operations Manual (EPA # 841-F-19-005)*
- *National Coastal Condition Assessment: Laboratory Methods Manual (EPA # 841-F-19-004)*
- *National Coastal Condition Assessment: Site Evaluation Guidelines (EPA # 841-B-20-001)*

This document (QAPP) contains elements of the overall project management, data quality objectives, measurement and data acquisition, and information management for the NCCA 2020. Methods described in this document are to be used specifically in work relating to the NCCA 2020 and related projects. All Project Cooperators should follow these guidelines. Mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use. More details on specific methods for site evaluation, field sampling, and laboratory processing can be found in the appropriate companion document(s).

The citation for this document is:

U.S. EPA. National Coastal Condition Assessment Quality Assurance Project Plan. United States Environmental Protection Agency, Office of Water, Office of Wetlands, Oceans and Watersheds. Washington, D.C.*EPA # 841-F-19-003*. 2020.

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Acronyms

ACESD	Atlantic Coastal Environmental Sciences Division
APHA	American Public Health Association
ASCII	American Standard Code for Information Interchange
BOM	Benthic Organic Matter
CAS	Chemical Abstracts Service
CRM	Certified Reference Material
CSDGM	Content Standards for Digital Geospatial Metadata
CV	Coefficient of Variation
DDT	dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DQOs	Data Quality Objectives
EMAP	Environmental Monitoring and Assessment Program
FGDC	Federal Geographic Data Committee
FOIA	Freedom of Information Act
GC	Gas Chromatograph
GEMMD	Gulf Ecosystem Measurement and Modeling Division Division
GLEC	Great Lakes Environmental Center, Inc.
GLTED	Great Lakes Toxicology and Ecology Division
GPS	Global Positioning System
GRTS	Generalized Random Tessellation Stratified
ICP	Inductively Coupled Plasma
IDL	Instrument Detection Limit
IM	Information Management
ITIS	Integrated Taxonomic Information System
LDR	Linear Dynamic Range
LRL	Laboratory Reporting Level
LT-MDL	Long-term Method Detection Limit
MDLs	Method Detection Limits
MQOs	Measurement Quality Objectives
NARSIMS	National Aquatic Resource Surveys Information Management System
NARS	National Aquatic Resource Surveys
NCA	National Coastal Assessment (past surveys)
NCCA	National Coastal Condition Assessment (current survey)
NCCRs	National Coastal Condition Reports
NELAC	National Environmental Laboratory Accreditation Conference
NEP	National Estuary Programs

NHD	National Hydrography Dataset
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NRCC	National Research Council of Canada
NWQL	National Water Quality Laboratory
OARM	Office of Administrative Resource Management
ORD	Office of Research and Development
OST	Office of Science and Technology
OW	Office of Water
OWCD	Oceans, Wetlands and Communities Division
OWOW	Office of Wetlands, Oceans and Watersheds
PAHs	Polycyclic Aromatic Hydrocarbons
PAR	Photosynthetically Active Radiation
PBDE	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated biphenyl
PE	Performance Evaluation
PESD	Pacific Ecological Systems Divsion
PFC	Perfluorinated compound
PPT, ppt	parts per thousand
PSU	Practical Salinity Unit
PTD	Percent Taxonomic Disagreement
PTL	Phosphorus, total
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
qPCR	quantitative Polymerase Chain Reaction
R-EMAP	Regional Environmental Monitoring and Assessment Program
RSD	Relative Standard Deviation
SAS	Statistical Analysis System
SDTS	Spatial Data Transfer Standard
SQL	Structure Query Language
SRM	Standard Reference Material
STORET	Storage and Retrieval Data Warehouse
SWIMS	Surface Water Information Management System
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TSA	Technical Systems Audits
US EPA	United States Environmental Protection Agency
USGS	United Stated Geological Survey

WED	Western Ecology Division
WoRMS	World Register of Marine Species
WQX	Water Quality Exchange
WRAPD	Watershed Restoration, Assessment and Protection Division

Distribution List

This Quality Assurance Protection Plan (QAPP) and associated manuals or guidelines will be distributed to the following EPA and contractor staff participating in the NCCA and to State Water Quality Agencies or cooperators who will perform the field sampling operations. The NCCA Project Quality Assurance (QA) Coordinator will distribute the QA Project Plan and associated documents to participating project staff at their respective facilities and to the project contacts at participating states, EPA offices, laboratories and any others, as they are determined.

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NCCA Executive Summary

Background

Several recent reports have identified the need for improved water quality monitoring and analysis at multiple scales. In response, the U.S. EPA Office of Water, in partnership with EPA's Office of Research and Development (ORD), EPA regional offices, states, tribes and other partners, has begun a program to assess the condition of the nation's waters using a statistically valid design approach. Often referred to as probability-based surveys, these assessments, known as the National Aquatic Resource Surveys (NARS), report on core indicators of water condition using standardized field and lab methods and utilize integrated information management plans, such as described in this Quality Assurance Project Plan, to ensure confidence in the results at national and ecoregional scales. NARS is made up of four assessments: coastal, lakes, rivers and streams, and wetlands.

NCCA, which builds upon previous National Coastal Assessments led by ORD and the National Coastal Condition Assessment in 2010 and 2015, aims to address three key questions about the quality of the Nation's coastal waters:

- What percent of the Nation's coastal waters are in good, fair, and poor condition for key indicators of water quality, ecological health, and recreation?
- What is the relative extent of key stressors such as nutrients and pathogens?
- How are conditions in coastal waters changing over time?

NCCA is also designed to help expand and enhance state monitoring programs. Through these surveys, states and tribes have the opportunity to collect data which can be used to supplement their existing monitoring programs or to begin development of new NCCA programs.

NCCA Project Organization

Overall project coordination is conducted by EPA's Office of Water (OW) in Washington, DC, with technical support from EPA's ORD. Each of the coastal EPA Regional Offices has identified regional coordinators to assist in implementing the survey and coordinate with the state crews who collect the water and sediment samples following NCCA protocols. As in 2010 and 2015, the Office of Science and Technology (OST) within OW is conducting the human health fish tissue study in the Great Lakes in partnership with the Great Lakes National Program Office. Region 5, ORD Great Lakes Toxicology and Ecology Division, and the Great Lakes National Program Office are collaborating with the Office of Water on enhancement studies of Green Bay, Great Lakes Islands and National Parks, and a Lake Erie Special Sudy.

Quality Assurance Project Plan

The purpose of this QAPP is to document the project data quality objectives and quality assurance/quality control measures that will be implemented in order to ensure that the data collected meets those needs. The plan contains elements of the overall project management, data quality objectives, measurement and data acquisition, and information management for the NCCA.

Information Management Plan

Environmental monitoring efforts that amass large quantities of information from various sources present unique and challenging data management opportunities. To meet these challenges, the NCCA employs a variety of well-tested information management (IM) strategies to aid in the functional organization and ensured integrity of stored electronic data. IM is integral to all aspects of the NCCA from initial selection of sampling sites through the dissemination and reporting of final, validated data.

A technical workgroup convened by the EPA Project Leader is responsible for development of a data analysis plan that includes a verification and validation strategy. General processes are summarized in the indicator-specific sections of this QAPP. Validated data are transferred to the central data base managed by EMAP information management support staff located at the Pacific Ecological Systems Division facilities in Corvallis. This database is known as the National Aquatic Resource Surveys Information Management (NARS IM) system. All validated measurement and indicator data from the NCCA are eventually transferred to EPA's Water Quality Exchange (WQX) for storage in EPA's STORET warehouse for public accessibility. NARS IM staff provides support and guidance to all program operations in addition to maintaining NARS IM.

Overview of NCCA Design

The NCCA is designed to be completed during the index period of June through the end of September 2020. EPA used an unequal probability design to select 725 estuarine sites along the coasts of the continental United States and 225 freshwater sites from the shores of the Great Lakes. As in previous NCCA surveys, enhancement studies will occur in the Great Lakes. The enhancement studies planned for 2020 are: Green Bay/Lake Michigan enhancement, a Lake Erie Basin Special Study, and a combined National Park Service and Great Lakes Islands enhancement. Additionally, related sampling will occur on reef flat (coastal areas) of American Samoa, Guam and the Northern Mariana Islands. More information can be found in Section 1.4 (Project Design) and Section 3.3 (Site Selection) of this QAPP.

Overview of Field Operations

Field data acquisition activities are implemented in a consistent manner across the entire country. Each site is given a unique ID which identifies it throughout the pre-field, field, lab, analysis, and data management phases of the project. Specific procedures for evaluating each sampling location and for replacing non-sampleable sites are documented in NCCA 2020: Site Evaluation Guidelines.

NCCA indicators include nutrients, light attenuation, sediment chemistry, sediment toxicitybenthic communities, fish tissue contaminants, algal toxins (microcystins and cylindrospermopsin), mercury in fish fillet tissue and pathogens. Research indicators for the NCCA 2020 are nitrogen isotopes in benthic organic matter, microplastics in sediment, and total alkalinity. Field measurements and samples are collected by trained teams following sampling methods described in the NCCA 2020: Field Operations Manual.. The field team leaders must be trained at an EPA-sponsored training session. Field sampling assisstance visits will be completed for each field team.

Overview of Laboratory Operations

NCCA laboratory analyses are conducted either by state-selected labs or "National Laboratories" contracted by EPA to conduct analyses for any state which so elects. All laboratories must comply with the QA/QC requirements described in this document. Any laboratory selected to conduct analyses with NCCA samples must demonstrate that they can meet the quality standards presented in this QAPP and the NCCA 2020: Laboratory Methods Manual.

Peer Review

The NARS program, including the NCCA, utilizes a three-tiered approach for peer review of the Survey.

- internal and external review by USEPA, states, other cooperators and partners;
- external scientific peer review (when applicable); and
- public review (when applicable).

Additioanlly, cooperators have been actively involved in the development of the overall project management, design, indicator selection, and methods. Outside scientific experts from universities, research centers, and other federal agencies have been instrumental in indicator development and will continue to play an important role in data analysis.

1 Project Planning and Management

1.1 Introduction

Several recent reports have identified the need for improved water quality monitoring and analysis at multiple scales. In 2000, the General Accounting Office (USGAO 2000) reported that EPA, states, and tribes collectively cannot make statistically valid inferences about water quality (via 305[b] reporting) and lack data to support key management decisions. In 2001, the National Research Council (NRC 2000) recommended EPA, states, and tribes promote a uniform, consistent approach to ambient monitoring and data collection to support core water quality programs. In 2002, the H. John Heinz III Center for Science, Economics, and the Environment (Heinz Center 2002) found there is inadequate data for national reporting on fresh water, coastal and ocean water quality indicators. The National Association of Public Administrators (NAPA 2002) stated that improved water quality monitoring is necessary to help states and tribes make more effective use of limited resources. EPA's Report on the Environment 2003 (USEPA 2003) said that there is not sufficient information to provide a national answer, with confidence and scientific credibility, to the question, 'What is the condition of U.S. waters and watersheds?'

In response to this need, the Office of Water (OW), in partnership with states and tribes, initiated a program to assess the condition of the nation's waters via a statistically valid approach. The current assessment, the National Coastal Condition Assessment 2020 (referred to as NCCA 2020 throughout this document), builds upon the National Coastal Condition Assessment 2010 and the original National Coastal Assessments implemented by EPA's Office of Research and Development, state and other partners. It also builds on other National Aquatic Resource Surveys (NARS) surveys such as the National Lakes Assessment (NLA), the National Rivers and Streams Assessment (NRSA) and the National Wetland Condition Assessment (NWCA). The NCCA 2020 effort will provide important information to states and the public about the condition of the nation's coastal waters and key stressors on a national and regional scale. It will also provide a trends assessment between five time periods: 2000-2001; 2005-2006; 2010; 2015 and 2020.

EPA developed this QAPP to support project participants and to ensure that the final assessment is based on high quality data and known quality for its intended use, and information. The QAPP contains elements of the overall project management, data quality objectives, measurement and data acquisition, and information management for NCCA 2020. EPA recognizes that states and tribes may add elements to the survey, such as supplemental indicators, that are not covered in the scope of this integrated QAPP. EPA requires that any supplemental elements are addressed by the states, tribes, or their designees, in a separate approved QAPP. This document covers all core NCCA QA activities. The NCCA 2020 participants have agreed to follow this QAPP and the protocols and design laid out in this document, and its associated documents – the NCCA 2020 Field Operations Manual (FOM), Lab Operations Manual (LOM), and Site Evaluation Guidelines (SEG).

This cooperative effort between states, tribes, and federal agencies makes it possible to produce a broad-scale assessment of the condition of the Nation's coastal waters with both a known confidence and scientific credibility. Through this survey, states and tribes have the opportunity to collect data that can be used to supplement their existing monitoring programs or to begin development of new programs.

The NCCA 2020 has three main objectives:

- Estimate the current status, trends, and changes in selected trophic, ecological, and recreational indicators of the condition of the nation's coastal waters with known statistical confidence;
- Identify the relative importance of key stressors; and
- Assess changes and trends from the earlier National Coastal Assessments and the NCCA 2010 and 2015.

Indicators for the 2020 survey will remain basically the same as those used in the past surveys, with a few modifications. This is critical so that EPA and partners can track not only condition but changes over time in the quality of coastal water resources. Modifications include expanding the area in which crews can collect samples to reduce the amount of missing data. In 2020, EPA and partneres are adding the algal toxin cylindropsermopsin, as well as three research indicators: nitrogen isotopes in benthic organic matter at all estuarine sites, total alkalinity at all estuarine sites, and microplastics in sediments at select estuarine sites in the northeast.

In the Great Lakes, The Office of Science and Technology (OST), in partnership with the Great Lakes National Program Office (GLNPO) is conducting an human health fish tissue study for the third time. Region 5, GLNPO and ORD's Great Lakes Toxicology and Ecology Division are teaming up to conduct enhanced assessments in the Great Lakes that add sites to the overall number of sites within the Great Lakes, but will otherwise follow procedures as outlined in the QAPP and other NCCA documents. See section 1.4 for more information.

1.2 Scope of the Quality Assurance Project Plan

This QAPP addresses the data acquisition efforts of NCCA, which focuses on the 2020 sampling of coasts across the United States. Data from approximately 950 coastal sites (selected with a probability design) located along the contiguous coastal marine and Great Lakes states will provide a comprehensive assessment of the Nation's coastal waters. Additionally, EPA is conducting special studies as described above. Companion documents to this QAPP that are relevant to the overall project include:

- National Coastal Condition Assessment 2020: Field Operations Manual (EPA 841-F-19-005)
- National Coastal Condition Assessment 2020: Laboratory Methods Manual (EPA 841-F-19-004)
- National Coastal Condition Assessment 2020: Site Evaluation Guidelines (EPA 841-F-20-001)

1.3 Project Organization

The responsibilities and accountability of the various principals and cooperators are described here and illustrated in Figure 1.1. Overall, the project will be coordinated by the Office of Water (OW) in Washington, DC, with support from EPA Office of Research and Development (ORD.) Specifically, OW is working with ORD's Pacific Ecological Systems Divsion (PESD), the EPA Gulf Ecolosystem Measurement and Modeling Division (GEMMD), the EPA Atlantic Coastal Environmental Sciences Division (ACESD) and the Great Lakes Toxicology and Ecology Division (GLTED). Each EPA Regional Office has identified a Regional EPA Coordinator who is part of the EPA team providing a critical link with state and tribal partners. Cooperators will work with their Regional EPA Coordinator to address any technical issues. A comprehensive quality assurance (QA) program has been established to ensure data integrity and provide support for the reliable interpretation of the findings from this project.

Contractor support is provided for all aspects of this project. Contractors will provide support ranging from implementing the survey, sampling and laboratory processing, data management, data analysis, and report writing. Cooperators will interact with their Regional EPA Coordinator and the EPA Project Leader regarding contractual services.

The primary responsibilities of the principals and cooperators are as follows:

Project Leader: Hugh Sullivan, EPA Office of Water

- Provides overall coordination of the project and makes decisions regarding the proper functioning of all aspects of the project.
- Makes assignments and delegates authority, as needed to other parts of the project organization.
- Leads the NCCA Steering Committee and establishes needed technical workgroups.
- Interacts with EPA Project Team on technical, logistical, and organizational issues on a regular basis.

EPA Field Logistics Coordinator: Brian Hasty, EPA Office of Water

- EPA employee who functions to support implementation of the project based on technical guidance established by the EPA Project Leader and serves as point-of-contact. for questions from field crews and cooperators for all activities.
- Tracks progress of field sampling activities.

EPA Project QA Coordinator: Danielle Grunzke, EPA Office of Water

- Provides leadership, development, and oversight of project-level quality assurance for NARS.
- Assembles and provides leadership for a NCCA 2020 Quality Team.
- Maintains official, approved QAPP.
- Maintains all training materials and documentation.
- Maintains all laboratory accreditation files.

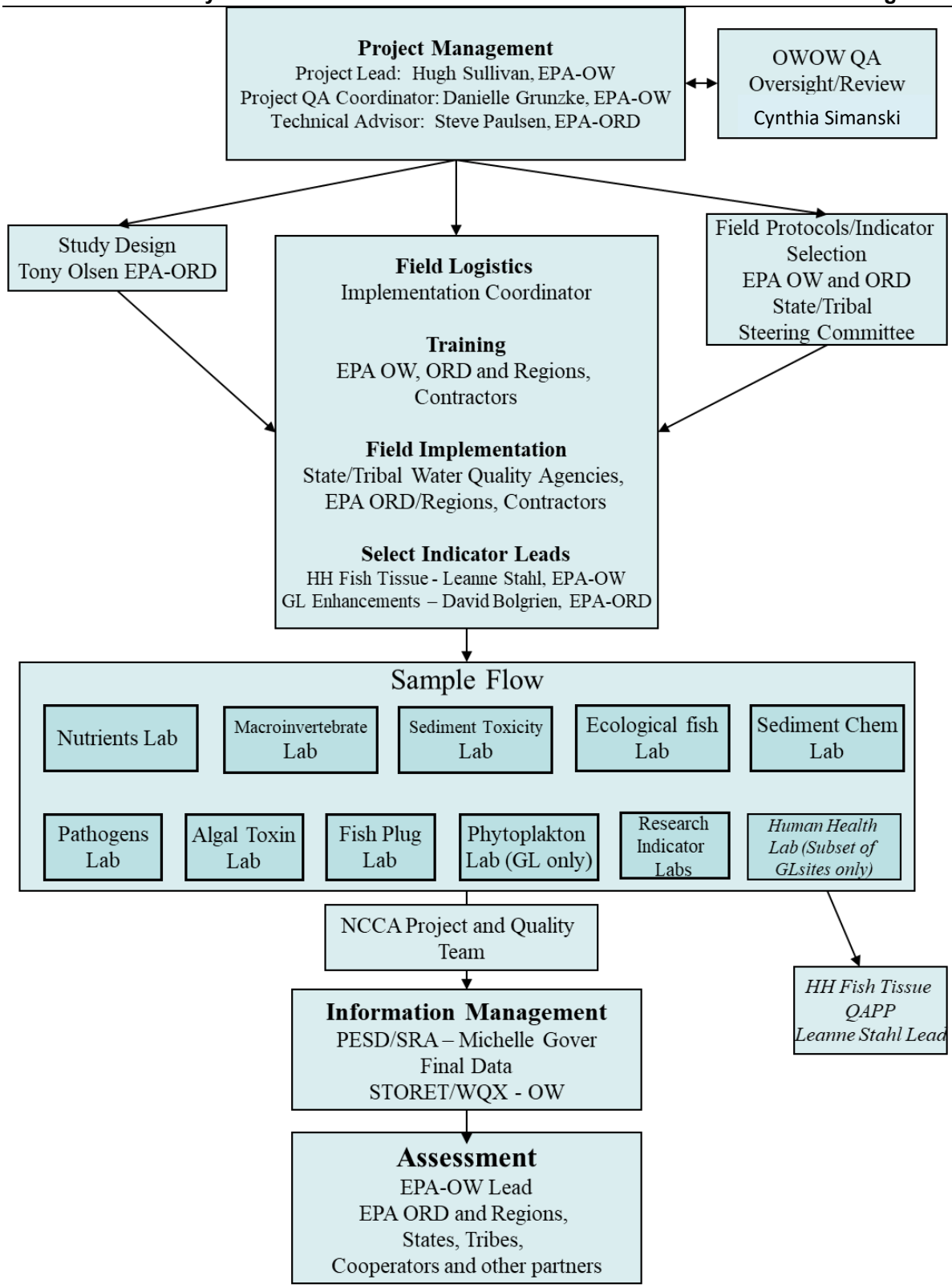

Figure 1.1 NCCA Project Organization and Flow

EPA Technical Advisor: Steven Paulsen, EPA Office of Research and Development

- Advises the Project Leader on the relevant experiences and technology developed within the Office of Research and Development (ORD) that may be used in this project.
- Facilitates consultations between NCCA personnel and ORD scientists.

Laboratory Review Coordinator: Kendra Forde, EPA Office of Water

- Ensures participating laboratories complete sample analysis following LOM.
- Ensures participating laboratories follow QA activities.
- Ensures data submitted within the specified timelines.
- Coordinates activities of individual lab Task Order Project Officers to ensure methods are followed and QA activities take place.

QA Assistance Visit Coordinator: Brian Hasty, EPA Office of Water

- The EPA employee who will supervise the implementation of the QA audit program; and
- Directs the field and laboratory audits and ensures the field and lab auditors are adequately trained to correct errors immediately to avoid erroneous data and the eventual discarding of information from the assessment.

Human Health Fish Tissue Indicator Lead: Leanne Stahl, EPA Office of Water

- The EPA Employee who will coordinate implementation of the human health fish tissue effort on the Great Lakes;
- Interacts with the EPA Project Leads, EPA regional coordinators, contractors and cooperators to provide information and respond to questions related to the human health fish tissue indicator; and
- Responsible for lab analysis phase of the project.

Great Lakes Enhancement Coordinator: Dave Bolgrien, EPA Office of Research and Development

- The EPA Employee who will coordinate the embayment enhancement component of the Great Lakes NCCA; and
- Interacts with the EPA Project Leads, EPA regional coordinators, contractors and cooperators to provide information and respond to questions related to embayment enhancement effort.

Information Management Coordinator Michelle Gover, SRA International, Inc.

- A contractor who functions to support implementation of the project based on technical guidance established by the EPA Project Leader and Alternate EPA Project Leader.
- Under scope of the contract, oversees the NARS Information Management team.
- Oversees all sample shipments and receives data forms from the Cooperators.
- Oversees all aspects of data entry and data management for the project.

OWOW QA Officer: Cynthia **Simanski***, EPA Office of Water*

- Functions as an independent officer overseeing all quality assurance (QA) and quality control (QC) activities.

- Responsible for ensuring that the QA program is implemented thoroughly and adequately to document the performance of all activities.

Endangered Species Act (ESA) Lead: Lareina Guenzel, EPA Office of Water

- Primary ESA contact for the U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA/NMFS).
- Works with the EPA Project Lead to ensure that survey manuals and protocols include appropriate responses and reporting requirements in the event that a crew encounters federally listed species when conducting field work.
- Prepares the Biological Evaluation to support Section 7 consultations.
- Works with the survey logistics lead to implement the conservation measures, reasonable and prudent measures, and reporting requirements identified in the Biological Opinion.
- Maintains library of NCCA ESA documents.

Regional EPA Coordinators

- Assists EPA Project Leader with regional coordination activities.
- Serves on the Technical Experts Workgroup and interacts with Project Facilitator on technical, logistical, and organizational issues on a regular basis.
- Serves as primary point-of-contact for the Cooperators.

Steering Committee (Technical Experts Workgroup): States, EPA, academics, other federal agencies

- Provides expert consultation on key technical issues as identified by the EPA Coordination crew and works with Project Facilitator to resolve approaches and strategies to enable data analysis and interpretation to be scientifically valid.

Cooperator(s): States, Tribes, USGS, others

- Under the scope of their assistance agreements, plans and executes their individual studies as part of the cross jurisdictional NCCA 2013/14 and adheres to all QA requirements and standard operating procedures (SOPs).
- Interacts with the Grant Coordinator, Project Facilitator and EPA Project Leader regarding technical, logistical, organizational issues.

Field Sampling Crew Leaders

- Functions as the senior member of each Cooperator's field sampling crew and the point of contact for the Field Logistics Coordinator.
- Responsible for overseeing all activities of the field sampling crew and ensuring that the Project field method protocols are followed during all sampling activities.

National Laboratory Task Order Managers: EPA Office of Water

- EPA staff responsible for managing activities of the national contract laboratories.
- Provide direction to national and State labs on methods, timelines and QA activities to ensure all actions are followed.

- Provide updates to EPA Laboratory Review Coordinator, the EPA QA Project Lead, and the Project Leader on the sample processing status of labs and any questions or concerns raised by participating labs in regards to timelines and deliverables.

Field Logistics Coordinator: Chris Turner, Great Lakes Environmental Center

- A contractor who functions to support implementation of the project based on technical guidance established by the EPA Field Logistics Coordinator and the Project Leader.
- Serves as point-of-contact for questions from field crews and cooperators for all activities.
- Tracks progress of field sampling activities.

1.4 Project Design

The NCCA 2020 is designed to be completed during the index period of June through the end of September 2020. Field crews will collect a variety of measurements and samples from predetermined sampling locations (located with an assigned set of coordinates).

With input from the states and other partners, EPA used an unequal probability design to select 725 estuarine sites along the coasts of the continental United States. The design for the Great Lakes has 225 nearshore sites. See maps of estuarine and Great Lakes sites in Figure 1.2 and Figure 1.3, respectively.

Other EPA programs are conducting special studies in the Great Lakes in partnership with the NCCA:

- The Office of Science and Technology (OST) within OW is conducting a human health fish tissue study in partnership with the Great Lakes National Program Office at all 225 sites in the Great Lakes NCCA. A brief description of the study is provided in Section **Error! Reference source not found.**.

- Region 5, GLNPO and ORD's Great Lakes Toxicology and Ecology Division in Duluth, MN are teaming up to conduct enhanced assessments in the Great Lakes that add sites to the overall number of sites within the Great Lakes but will otherwise follow procedures as outlined in the QAPP and other NCCA documents.

    - Green Bay and Lake Michigan Enhancement
    - Lake Erie Basin Special Study, which adds sites to be sampled (for water only) so that 30 total sites are sampled in each of the Lake Erie Basins
    - a combined National Park Service and Great Lakes Islands enhancement, which samples an additional Great Lakes Island and National Park Service Sites.

Additionally, NCCA-related sampling will occur in reef flat (coastal areas) of American Samoa, Guam and the Northern Mariana Islands, during the 2020 field season.

For more information about the primary and enhancement survey designs, please see Section 3.

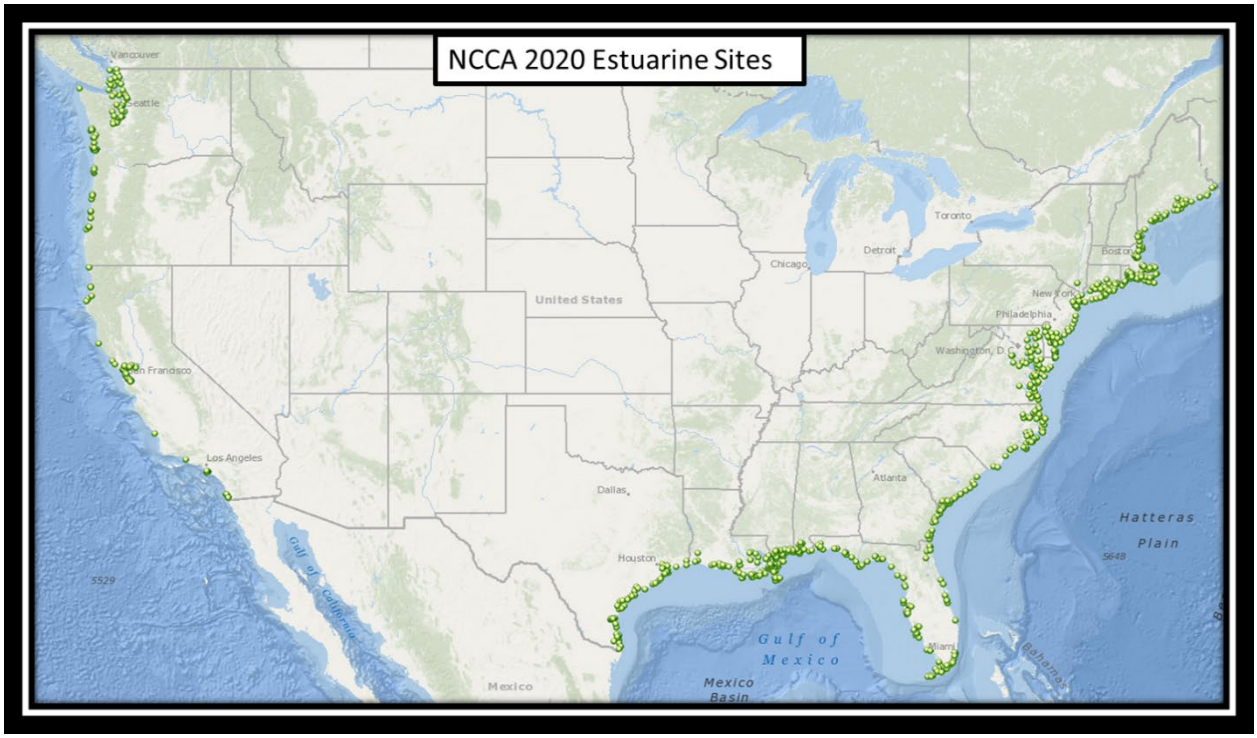

Figure 1.2 NCCA Estuarine Base Sites

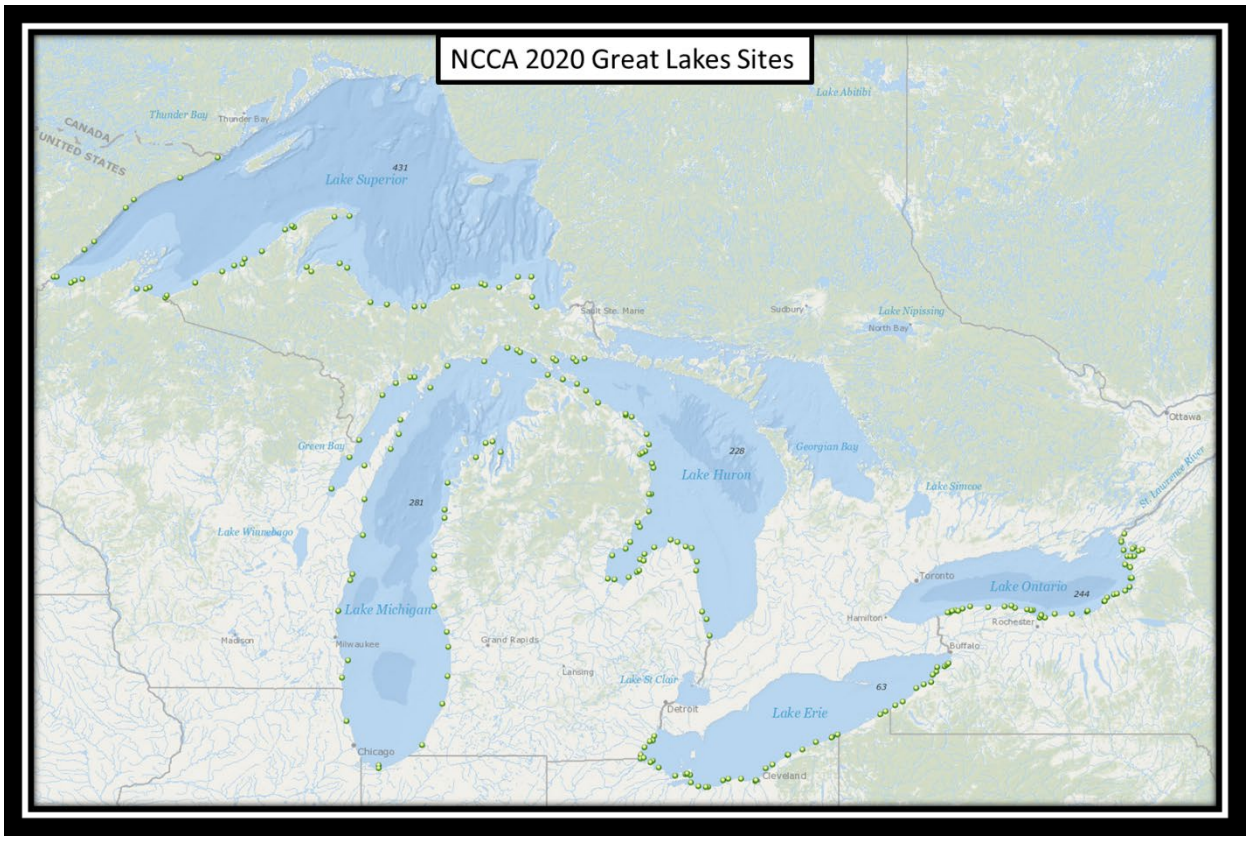

Figure 1.3 NCCA Great Lakes Coastal Base Sites

1.5 Project Schedule

Training and field sampling will be conducted in spring and summer of 2020. Sample processing and data analysis are planned for 2021 to support publication of results in 2022 (planned). Figure 1.4 gives an overview of the major tasks leading up to the final report.

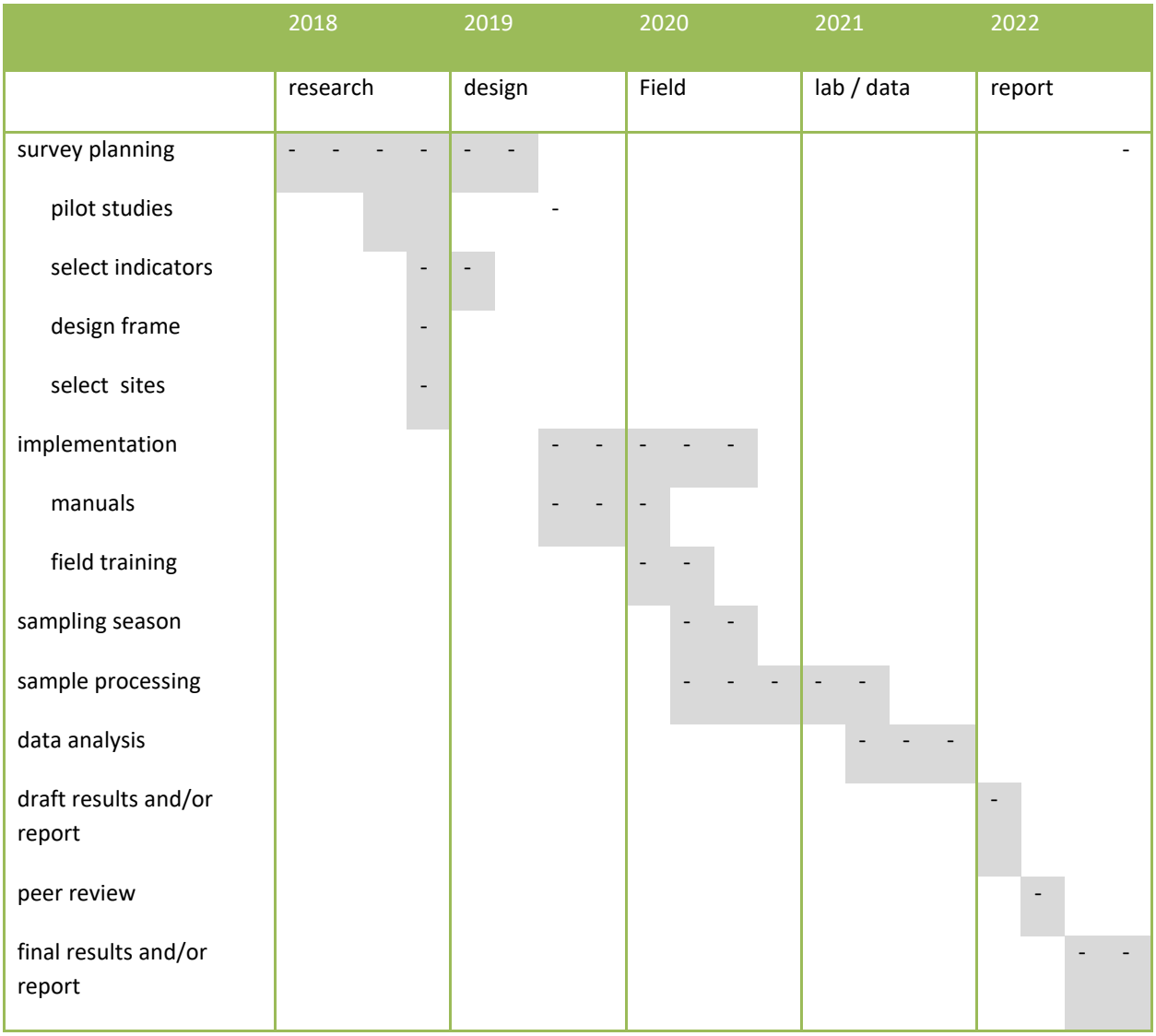

Figure 1.4 Schedule for the NCCA 2020

1.6 Overview of Field Operations

Field data acquisition activities are implemented for the NCCA, based on guidance originally developed for the NCA and for the NCCA 2010 and 2015 surveys. Funding for states and tribes to conduct field data collection activities are provided by EPA under Section 106 of the Clean Water Act. Survey preparation is initiated with selection of the sampling locations by the Design Team (ORD in Corvallis).

The Design Team gives each site a unique ID which identifies it throughout the pre-field, field, lab, analysis, and data management phases of the project. The Project Lead distributes the list of sampling locations to the EPA Regional Coordinators, states, and tribes. With the sampling location list, state and tribal field crews can begin site reconnaissance on the primary sites and alternate replacement sites and begin work on obtaining access permission to each site. EPA provides specific procedures for evaluating each sampling location and for replacing non-sampleable sites in NCCA: Site Evaluation Guidelines. Each crew is responsible for procuring, as needed, scientific collecting permits from State/Tribal and Federal agencies, and if necessary, permission from landowners. The field teams will use standard field equipment and supplies as identified in the Equipment and Supplies List (Appendix A of the Field Operations Manual). Field crews will work with Field Logistics Coordinators to coordinate equipment and supply requests. This helps to ensure comparability of protocols across all crews. EPA has documented detailed lists of equipment required for each field protocol, as well as guidance on equipment inspection and maintenance, in the Field Operations Manual.

Field measurements and samples are collected by trained teams/crews. The field crews leaders must be trained at an EPA-sponsored training session. Ideally, all members of each field crews should attend one EPA-sponsored training session before the field season. The training program stresses hands-on practice of methods, consistency among crews, collection of high quality data and samples, and safety. Training documentation will be maintained by the Project QA Coordinator. Field Crew leaders will maintain records indicating that members of their team that did not attend and EPA training were properly trained to follow the NCCA protocols. Field crew leaders will provide EPA with this documentation if requested by the NCCA Project Leader or QA Coordinator. EPA or other designated personnel (e.g. contractors) will conduct field sampling assistance visits for each field crew early in the sampling season.

For each site, crews prepare a dossier that contains the following applicable information: road maps; copies of written access permissions to boat launches; scientific collection permits; per field crew's standard operating procedures, information on federally listed species that may occur at the site, how to avoid them, and actions to be taken if they are encountered; coordinates of the coastal site; information brochures on the program for interested parties; and local area emergency numbers. Whenever possible, field crews leaders attempt to contact owners of private marinas or boat launches (as appropriate) approximately two days before the planned sampling date. As the design requires repeat visits to select sampling locations, it is important for the field crews to do everything possible to maintain good relationships with launch owners. This includes prior contacts, respect of special requests, closing gates, minimal site disturbance, and removal of all materials, including trash, associated with the sampling visit.

The site verification process is shown in **Figure 1.5**. Upon arrival at a site, crews verify the location by a Global Positioning System (GPS) receiver, landmark references, and/or local residents. Crews collect samples and measurements for various parameters in a specified order (See the Field Operations

Manual). This order has been set up to minimize the impact of sampling for one parameter upon subsequent parameters. All methods are fully documented in step-by-step procedures in the NCCA Field Operations Manual. The manual also contains detailed instructions for completing documentation, labeling samples, any field processing requirements, and sample storage and shipping. Field communications will be through Field Logistics Coordinator and may involve regularly scheduled conference calls or contacts.

After field sampling is complete (and wifi available), crews will submit all completed data forms in the NCCA App. If still reviewing data forms, the Site Verification and Tracking Forms (for any shipped samples) must be submitted if samples are shipped. All submitted data will be sent back to the field crew in a summary email from the database to the field crew's iPad.

Crews store and package samples for shipment in accordance with instructions contained in the Field Operations Manual. EPA developed the NCCA shipping instructions so that sample holding times are not exceeded. Samples which must be shipped are delivered to a commercial carrier; copies of bills of lading or other documentation are maintained by the team. Crews notify the Information Management Coordinator, as outlined in the FOM, that shipment has occured; thus, tracing procedures can be initiated quickly in the event samples are not received. Crews complete chain-of-custody forms for all transfers of samples, with copies maintained by the field team.

The field operations phase is completed with collection of all samples or expiration of the sampling window. Following the field seasons, EPA and the contractor field logisitcs coordinator will hold debriefings with crews and other project staff which cover all aspects of the field program and solicit suggestions for improvements.

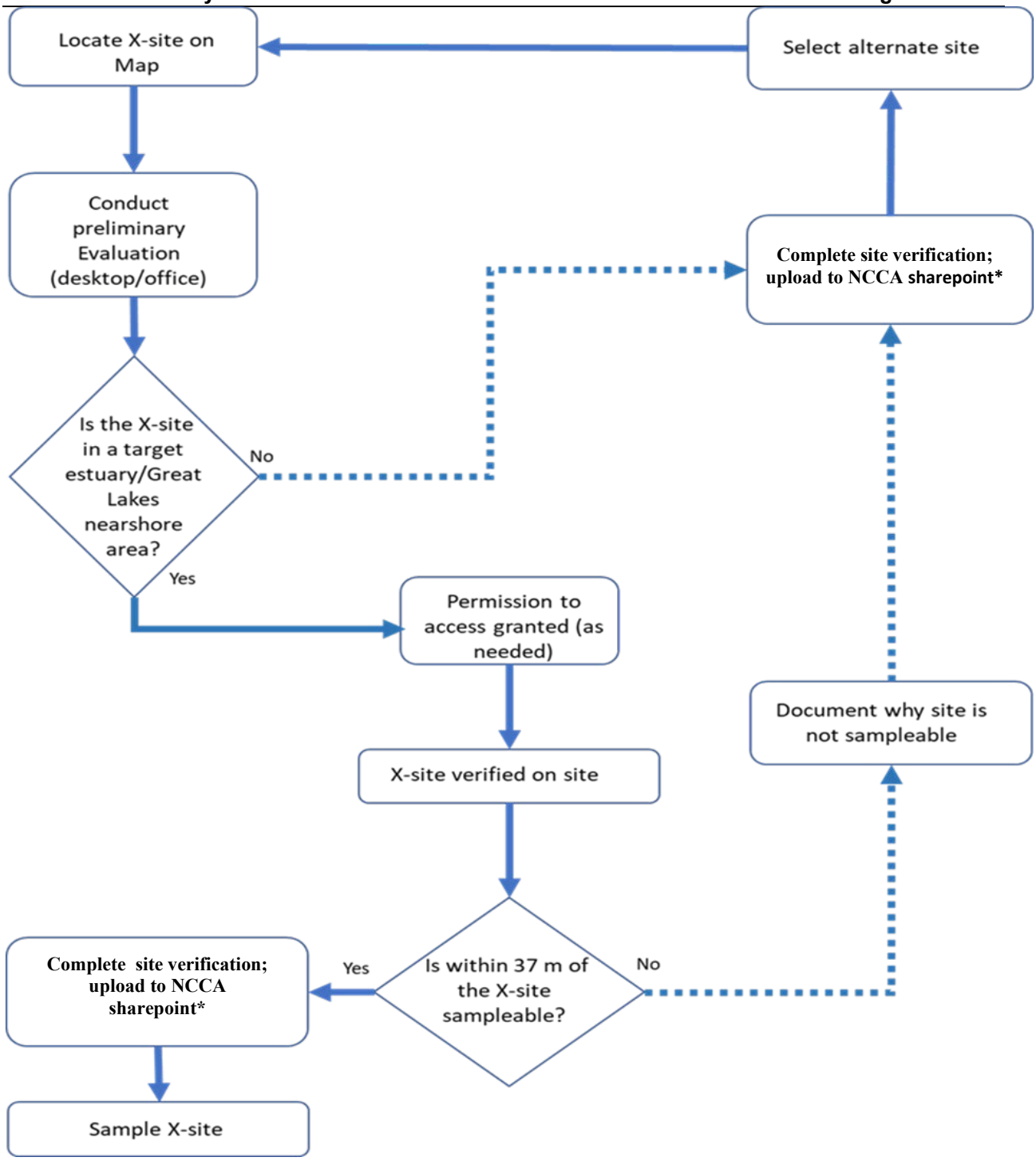

Figure 1.5 Site Evaluation Diagram

* If you need access to the SharePoint site, please send an email to Brian Hasty (hasty.brian@epa.gov),Kendra Forde (forde.kendra@epa.gov) and cc: Hugh Sullivan (sullivan.hugh@epa.gov). If you are having trouble with the SharePoint site, you may email interim and final spreadsheets to the Contract Logistics Coordinator and your Regional Coordinator (see page 19 for contact information).

1.7 Overview of Laboratory Operations

Holding times for surface water samples vary with the sample types and analyte. Field crews begin some analytical measurements during sampling (e.g., *in situ* measurements) while other analytical measurements are not initiated until sampling has been completed (e.g., water chemistry, microcystins, fecal indicators (Enterococci)). Analytical methods are summarized in the *NCCA 2020 Laboratory Operations Manual (LOM)*. When available, standard methods are used and are referenced in the LOM. Where experimental methods are used or standard methods are modified by the laboratory, these methods are documented in the laboratory methods manual by EPA or in internal documentation by the appropriate laboratory. The laboratory coordinator will work with appropriate experts to describe them in Standard Operating Procedures (SOPs) developed by the analytical laboratories.

Contractor and/or cooperator laboratories will perform chemical, physical, and biological analyses. National contract labs will process most samples. Where those labs are currently in place, EPA has identified the prime contractor here.

- Dynamac, a lab managed by the ORD Western Ecology Division, will analyze water chemistry and chlorophyll-a samples.
- Great Lakes Environmental Center, a national contractor,will analyze benthic invertebrates.
- Great Lakes Environmental Center, a national contractor, will analyze sediment chemistry.
- Avanti, a national contractor will analyze sediment toxicity.
- Great Lakes Environmental Center, a national contractor, will analyze whole fish tissue samples.
- ESS Group, Inc., a national contractor, will analyze fish tissue plugs.
- Great Lakes Environmental Center, a national contractor, will analyze algal toxin samples.
- EPA's Office of Research and Development lab in Cincinnati, OH will analyze samples for enterococci.
- Tetratech and CSRA, national contractors, will prepare and analyze fish tissue fillet samples for the Great Lakes Human Health Fish Sillet Tissue Study for the Office of Science and Technology.
- EPA anticipates that a few pre-approved state labs may opt to analyze samples for various non-research indicators.

Labs analyzing research indicator samples:

- ORD-AESCD, Narragansett, RI: microplastics in sediment; nitrogen isotope in benthic organic matter; and approximately half of the total alkalinity samples.
- ORD-PESC, Newport, OR: The remaining half of the total alkalinity samples.

Laboratories providing analytical support must have the appropriate facilities to properly store and prepare samples and appropriate instrumentation and staff to provide data of the required quality within the time period dictated by the project. Laboratories are expected to conduct operations using good laboratory practices. The following are general guidelines for analytical support laboratories:

- A program of scheduled maintenance of analytical balances, water purification systems, microscopes, laboratory equipment, and instrumentation.
- Verification of the calibration of analytical balances using class "S" weights which are certified by the National Institute of Standards and Technology (NIST) (http://www.nist.gov/).
- Verification of the calibration of top-loading balances using NIST-certified class "P" weights.
- Checking and recording the composition of fresh calibration standards against the previous lot of calibration standards. Participating laboratories will keep a percentage of the previous lot of calibration standard to check against the next batch of samples processed. This will ensure that a comparison between lots can occur. Acceptable comparisons are less than or equal to two percent of the theoretical value. (This acceptance is tighter than the method calibration criteria.)
- Recording all analytical data in bound logbooks in ink, or on standardized recording forms.
- Verification of the calibration of uniquely identified daily use thermometers using NIST-certified thermometers.
- Monitoring and recording (in a logbook or on a recording form) temperatures and performance of cold storage areas and freezer units (where samples, reagents, and standards may be stored). During periods of sample collection operations, monitoring must be done on a daily basis.
- An overall program of laboratory health and safety including periodic inspection and verification of presence and adequacy of first aid and spill kits; verification of presence and performance of safety showers, eyewash stations, and fume hoods; sufficiently exhausted reagent storage units, where applicable; available chemical and hazardous materials inventory; and accessible material safety data sheets for all required materials.
- An overall program of hazardous waste management and minimization, and evidence of proper waste handling and disposal procedures (90-day storage, manifested waste streams, etc.).
- If needed, having a source of reagent water meeting American Society of Testing and Materials (ASTM) Type I specifications for conductivity (< 1 µS/cm at 25 °C; ASTM 2011) available in sufficient quantity to support analytical operations.
- Appropriate microscopes or other magnification for biological sample sorting and organism identification.
- Approved biological identification and taxonomic keys/guides for use in biological identification (benthic macroinvertebrates) as appropriate.
- Labeling all containers used in the laboratory with date prepared contents, and initials of the individual who prepared the contents.
- Dating and storing all chemicals safely upon receipt. Chemicals are disposed of properly when the expiration date has expired.
- Using a laboratory information management system to track the location and status of any sample received for analysis.
- Reporting results electronically using standard formats and units compatible with NARS IM (see LOM for data templates). These files will be labeled properly by referencing the indicator and/or analyte and date (see the LOM for file naming convention).

All laboratories providing analytical support to NCCA 2020 must adhere to the provisions of this integrated QAPP and LOM. Laboratories will provide information documenting their ability to conduct the analyses with the required level of data quality prior to data analysis. Different requirements will be provided based on the type of analysis being completed by the laboratory (i.e. chemistry vs. biological analyses).

Laboratories will send the documentation to the Project Quality Assurance Coordinator and the Laboratory Review Coordinator at EPA Headquarters (or other such designated parties). The Project QA Coordinator will maintain these files in NCCA QA files. Such information may include the following:

- Signed Quality Assurance Project Plan by the laboratory performing analysis;
- Signed Laboratory Form;
- Valid Accreditation or Certification;
- Laboratory's Quality Manual and/or Data Management Plan;
- Method Detection Limits (MDL);
- Demonstration of Capability;
- Results from inter-laboratory comparison studies;
- Analysis of performance evaluation samples; and
- Control charts and results of internal QC sample or internal reference sample analyses to Document achieved precision, bias, accuracy.

Other requirements may include:

- Participation in calls regarding laboratory procedures and processes with participating laboratories;
- Participation in a laboratory technical assessment or audit;
- Participation in performance evaluation studies; and
- Participation in inter-laboratory sample exchange.

1.7.1 Chemistry Lab Quality Evaluation

Participating laboratories will send requested documentation to the NCCA 2020 QA Team for evaluation of qualifications. The NCCA 2020 QA Team will maintain these records in the project QA file.

1.7.2 Biological Laboratory Quality Evaluation

The NCCA 2020 Quality Team will review the past performance of biological laboratories. The biological laboratories shall adhere to the quality assurance objectives and requirements as specified for the pertinent indicators in the LOM.

See Section 6 of this QAPP and Appendix A of the LOM for additional information related to laboratory certification. All qualified laboratories shall work with the NARS IM Center to track samples as specified by the NARS Information Managment Lead.

1.8 Data Analysis

A technical workgroup convened by the EPA Project Leader is responsible for development of a data analysis plan that includes a verification and validation strategy. General processes are summarized in the indicator-specific sections of this QAPP. The NCCA Quality team transfers validated data to the central data base managed by EMAP information management support staff located at WED in Corvallis. Information management activities are discussed further in Section 4. Data in the WED data base are available to Cooperators for use in development of indicator metrics. EPA will transfer all validated measurement and indicator data from the NCCA to EPA's Water Quality Exchange (WQX) for storage in EPA's STORET warehouse for public accessibility. Additionally, the NCCA team maintains data files on the internal project SharePoint site for partners and on the NCCA website for public accessibility. The Data Analysis plan is described in Section 7 of this QAPP.

1.9 Peer Review

The USEPA NARS program, including the NCCA 2020, utilizes a three-tiered approach for peer review of the Survey: (1) internal and external review by EPA, states, other cooperators and partners, (2) external scientific peer review, when applicable, and (3) public review, when applicable.

Once data analysis has been completed, cooperators examine the results. The NCCA team reviews comments and feedback from the cooperators and incorporate such feedback into the draft report, when appropriate. The NCCA Team follows Agency and OMB requirements for public and peer review. External scientific peer review and public review is initiated for new analyses or approaches as appropriate. Additionally, following applicable guidance, other aspects of the NCCA may undergo public and scientific peer review.

- Follow the Agency's Information Quality Guidelines (IQG) and complete the IQG checklist.
- Develop and maintain a public website with links to standard operating procedures, quality assurance documents, fact sheets, scientific peer review feedback, and final report.
- Conduct technical workgroup meetings composed of scientific experts, cooperators, and EPA to evaluate and recommend data analysis options and indicators.
- Complete data validation on all chemical, physical and biological data.
- Conduct final data analysis with workgroup to generate assessment results.
- Engage peer review contractor to identify external peer review panel (if applicable).
- Develop draft report presenting assessment results.
- Develop final draft report incorporating input from cooperators and results from data analysis group to be distributed for peer a review.
- Issue Federal Register (FR) Notice announcing document availability and hold public comment (30-45 days) (if applicable).
- Consider public comments and produce a final report (if applicable).

The proposed peer review schedule is provided below in Table 1.1 and is contingent upon timeliness of data validation and schedule availability for regional meetings and experts for data analysis workshop.

Table 1.1 Proposed schedule

Proposed Schedule	Activity
May 2020-November 2021	Data validation
November 2021-June 2022	Internal data analysis and review meetings (e.g., web conferences)
Summer 2022	Draft released for external peer review (if applicable)
December 2022	Draft released for public review (if applicable)

2 Data Quality Objectives

It is a policy of the U.S. EPA that Data Quality Objectives (DQOs) be developed for all environmental data collection activities following the prescribed DQO Process. DQOs are qualitative and quantitative statements that clarify study objectives, define the appropriate types of data, and specify the tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (EPA 2006B). Data quality objectives thus provide the criteria to design a sampling program within cost and resource constraints or technology limitations imposed upon a project or study. DQOs are typically expressed in terms of acceptable uncertainty (e.g., width of an uncertainty band or interval) associated with a point estimate at a desired level of statistical confidence. The DQO Process is used to establish performance or acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of a study. As a rule, performance criteria represent the full set of specifications that are needed to design a data or information collection effort such that, when implemented, generate newly-collected data that are of sufficient quality and quantity to address the project's goals. Acceptance criteria are specifications intended to evaluate the adequacy of one or more existing sources of information or data as being acceptable to support the project's intended use (EPA 2006B).

2.1 Data Quality Objectives for the National Coastal Condition Assessment

NCCA has established target DQOs for assessing the current status of selected indicators of condition for the conterminous U.S.coastal resources as follows:

- For each indicator of condition, estimate the proportion of the nation's estuaries and combined area of the Great Lakes in degraded condition within a ± 5% margin of error and with 95% confidence.
- For each indicator of condition, estimate the proportion of regional estuarine (Northeast, Southeast, Gulf of Mexico, and West Coast) or Great Lake resources in degraded condition within a ± 15% margin of error and with 95% confidence.
- For estimates of change, the DQOs are: Estimate the proportion of the nation's estuaries and combined area of the Great Lakes (± 7%) that have changed condition classes for selected measures with 95% confidence.

2.2 Measurement Quality Objectives

For each parameter, performance objectives (associated primarily with measurement error) are established for several different data quality indicators (following USEPA Guidance for Quality Assurance Plans EPA240/R-02/009). Specific measurement quality objectives (MQOs) for each parameter are shown in chapter 5 of this QAPP and in the LOM. The following sections define the

data quality indicators and present approaches for evaluating them against acceptance criteria established for the program.

2.2.1 Method Detection Limits (Laboratory Reporting Level (Sensitivity))

For chemical measurements, requirements for the MDL are typically established (see indicators in Section 5). The MDL is defined as the lowest level of analyte that can be distinguished from zero with 99 percent confidence based on a single measurement (Glaser et al., 1981). United State Geologic Survey (USGS) NWQL has developed a variant of the MDL called the long-term MDL (LT-MDL) to capture greater method variability (Oblinger Childress et al. 1999). Unlike MDL, it is designed to incorporate more of the measurement variability that is typical for routine analyses in a production laboratory, such as multiple instruments, operators, calibrations, and sample preparation events (Oblinger Childress et al. 1999). The LT-MDL determination ideally employs at least 24 spiked samples prepared and analyzed by multiple analysts on multiple instruments over a 6- to 12-month period at a frequency of about two samples per month (EPA 2004B). The LT-MDL uses "F-pseudosigma" (Fσ) in place of s, the sample standard deviation, used in the EPA MDL calculation. F-pseudosigma is a non-parametric measure of variability that is based on the interquartile range of the data (EPA 2004B). The LT-MDL may be calculated using either the mean or median of a set of long-term blanks, or from long-term spiked sample results (depending o the analyte and specific analytical method). The LT-MDL for an individual analyte is calculated as:

Equation 1a

$$LT\text{-}MDL = M + (t_{0.99,n-1} \times F_\sigma)$$

Where M is the mean or median of blank results; n is the number of spiked sample results; and Fσ is F-pseudosigma, a nonparametric estimate of variability calculated as:

Equation 1b

$$F_\sigma = \frac{Q_3 - Q_1}{1.349}$$

Where: Q3 and Q1 are the 75th percentile and 25th percentile of spiked sample results, respectively.

LT-MDL is designed to be used in conjunction with a laboratory reporting level (LRL; Oblinger Childress et al. 1999). The LRL is designed to achieve a risk of ≤1% for both false negatives and false positives (Oblinger Childress et al. 1999). The LRL is set as a multiple of the LT-MDL, and is calculated as follows:

LRL = 2 x LT–MDL

Therefore, multiple measurements of a sample having a true concentration at the LRL should result in the concentration being detected and reported 99 percent of the time (Oblinger Childress et al. 1999).

All laboratories will develop calibration curves for each batch of samples that include a calibration standard with an analyte concentration equal to the LRL. Estimates of LRLs (and how they are determined) are required to be submitted with analytical results. Analytical results associated with LRLs that exceed the objectives are flagged as being associated with unacceptable LRLs. Analytical data that are below the estimated LRLs are reported, but are flagged as being below the LRLs.

2.2.2 Sampling Precision and Bias

Precision and bias are estimates of random and systematic error in a measurement process (Kirchmer, 1983; Hunt and Wilson, 1986, USEPA 2002). Collectively, precision and bias provide an estimate of the total error or uncertainty associated with an individual measurement or set of measurements. Systematic errors are minimized by using validated methods and standardized procedures across all laboratories. Precision is estimated from repeated measurements of samples. Net bias is determined from repeated measurements of solutions of known composition, or from the analysis of samples that have been fortified by the addition of a known quantity of analyte. For analytes with large ranges of expected concentrations, MQOs for precision and bias are established in both absolute and relative terms, following the approach outlined in Hunt and Wilson (1986). At lower concentrations, MQOs are specified in absolute terms. At higher concentrations, MQOs are stated in relative terms. The point of transition between an absolute and relative MQO is calculated as the quotient of the absolute objective divided by the relative objective (expressed as a proportion, e.g., 0.10 rather than as a percentage, e.g., 10%). Precision and bias within each laboratory are monitored for every sample batch by the analysis of internal QC samples. Samples associated with unacceptable QC sample results are reviewed and re-analyzed if necessary. For selected analyses, precision and bias across all laboratories will be evaluated by EPA (or an EPA contractor) sending performance evaluation samples to each lab. For more information, see section 5 of this QAPP and the LOM. Equations used to calculate precision, bias and accuracy follow.

Equation 1 Standard Deviation. Precision in absolute terms is estimated as the sample standard deviation when the number of measurements is greater than two:

$$s = \sqrt{\frac{i = \sum_{1}^{n} (xi - \bar{x})^2}{n-1}}$$

where x_i is the value of the replicate, $\bar{x}$ is the mean of repeated sample measurements, and n is the number of replicates.

Equation 2 Relative Standard Deviation or Coefficient of Variation. Relative precision for such measurements is estimated as the relative standard deviation (RSD, or coefficient of variation, [CV]):

$$RSD = CV = \frac{s}{\bar{X}} \times 100$$

value for the set of measurements. Here s is the sample standard deviation of the set of measurements, and $\bar{x}$ equals the mean.

Equation 3 Relative Percent Difference. Precision based on duplicate measurements is estimated based on the range of measured values (which equals the difference for two measurements). The relative percent difference (RPD) is calculated as:

$$RPD = \left(\frac{|A - B|}{(A + B)/2} \right) \times 100$$

where A is the first measured value, B is the second measured value.

Equation 4 Net Bias. For repeated measurements of samples of known composition, net bias (B) is estimated in absolute terms as:

$$B = \bar{x} - T$$

where $\bar{x}$ equals the mean value for the set of measurements, and T equals the theoretical or target value of a performance evaluation sample.

Equation 5 Relative Bias. Bias in relative terms (B[%]) is calculated as:

$$B(\%) = \frac{\bar{x} - T}{T} \times 100$$

where $\bar{x}$ equals the mean value for the set of measurements, and T equals the theoretical or target value of a performance evaluation sample.

2.2.3 Sampling Accuracy

Accuracy is generally a qualitative description rather than a quantitative description. Therefore, accuracy is estimated for some analytes by calculating the percent recovery of a known quantity of an analyte from fortified or spiked samples. For example, for water chemistry and chlorophyll a, accuracy is estimated as the difference between the measured (across batches) and target values of performance evaluation and/or internal reference samples at the lower concentration range, and as the percent difference at the higher concentration range. See specific indicator sections in Chapter 5 for which analytes include accuracy calculations.

Equation 6 Percent Recovery. Percent recovery is calculated as:

$$\%recovery = \frac{C_{is} - C_{ii}}{C_s} \times 100$$

where C_{is} is the measured concentration of the spiked sample, C_{ii} is the concentration of the unspiked sample, and C_s is the concentration of the spike.

2.2.4 Taxonomic Precision and Accuracy

For the NCCA, taxonomic precision will be quantified by comparing whole-sample identifications completed by independent taxonomists or laboratories. Accuracy of taxonomy will be qualitatively evaluated through specification of target hierarchical levels (e.g., family, genus, or species); and the specification of appropriate technical taxonomic literature or other references (e.g., identification keys, voucher specimens). To calculate taxonomic precision, 10 percent of the samples will be randomly-selected for re-identification by an independent, outside taxonomist or laboratory.

Equation 7 Percent Taxonomic Disagreement. Comparison of the results of whole sample re-identifications will provide a Percent Taxonomic Disagreement (PTD) calculated as:

$$PTD = \left[1 - \left(\frac{comp_{pos}}{N}\right)\right] \times 100$$

where $comp_{pos}$ is the number of agreements, and N is the total number of individuals in the larger of the two counts. The lower the PTD, the more similar are taxonomic results and the overall taxonomic precision is better. A MQO of 15% is recommended for taxonomic difference (overall mean <15% is acceptable). Individual samples exceeding 15% are examined for taxonomic areas of substantial disagreement, and the reasons for disagreement investigated.

Sample enumeration is another component of taxonomic precision. Final specimen counts for samples are dependent on the taxonomist, not the rough counts obtained during the sorting activity.

Equation 8 Percent Difference in Enumeration. Comparison of counts is quantified by calculation of percent difference in enumeration (PDE), calculated as:

$$PDE = \left(\frac{|Lab1 - Lab2|}{Lab1 + Lab2} \right) \times 100$$

An MQO of 5% is recommended (overall mean of ≤5% is acceptable) for PDE values. Individual samples exceeding 5% are examined to determine reasons for the exceedance.

Corrective actions for samples exceeding these MQOs can include defining the taxa for which re-identification may be necessary (potentially even by third party), for which samples (even outside of the 10% lot of QC samples) it is necessary, and where there may be issues of nomenclatural or enumeration problems.

Taxonomic accuracy is evaluated by having individual specimens representative of selected taxa identified by recognized experts. Samples will be identified using the most appropriate technical literature that is accepted by the taxonomic discipline and reflects the accepted nomenclature. Where necessary, the Integrated Taxonomic Information System (ITIS, http://www.itis.usda.gov/) and the World Register of Marine Species (WoRMS, https://marinespecies.org/) will be used to verify nomenclatural validity and spelling. A reference collection will be compiled as the samples are identified. It is maintained by the contractor. Specialists in several taxonomic groups will verify selected individuals of different taxa, as determined by the NCCA workgroup.

2.2.5 Completeness

Completeness is defined as "a measure of the amount of data collected from a measurement process compared to the amount that was expected to be obtained under the conditions of measurement" (Stanley and Vener, 1985).

Completeness requirements are established and evaluated from two perspectives. First, valid data for individual parameters must be acquired from a minimum number of sampling locations in order to make subpopulation estimates with a specified level of confidence or sampling precision. The objective of this study is to complete sampling at 95% or more of the 1000 initial sampling sites. Percent completeness is calculated as:

Equation 9 Percent Completeness.

$$\%C = {}^{V}\!/_{T} \times 100$$

where V is the number of measurements/samples judged valid, and T is the total number of planned measurements/samples.

Within each indicator, completeness objectives are also established for individual samples or individual measurement variables or analytes. These objectives are estimated as the percentage of valid data obtained versus the amount of data expected based on the number of samples collected or number of measurements conducted. Where necessary, supplementary objectives for completeness are presented in the indicator-specific sections of this QAPP.

The completeness objectives are established for each measurement per site type (e.g., probability sites, revisit sites, etc.). Failure to achieve the minimum requirements for a particular site type results in regional population estimates having wider confidence intervals and may impact the ability to make some subnational assessments. Failure to achieve requirements for repeat sampling (10% of samples collected) and revisit samples (10% of sites visited) reduces the precision of estimates of index period and annual variance components, and may impact the representativeness of these estimates because of possible bias in the set of measurements obtained.

2.2.6 Comparability

Comparability is defined as “the confidence with which one data set can be compared to another” (Stanley and Vener, 1985). A performance-based methods approach is being utilized for water chemistry and chlorophyll-a analyses that defines a set of laboratory method performance requirements for data quality. Following this approach, participating laboratories may choose which analytical methods they will use for each target analyte as long as they are able to achieve the performance requirements as listed in the Quality Control section of each Indicator section. For all parameters, comparability is addressed by the use of standardized sampling procedures and analytical methods by all sampling crews and laboratories. Comparability of data within and among parameters is also facilitated by the implementation of standardized quality assurance and quality control techniques and standardized performance and acceptance criteria. For all measurements, reporting units and format are specified, incorporated into standardized data recording forms, and documented in the information management system. Comparability is also addressed by providing results of QA sample data, such as estimates of precision and bias, and conducting performance evaluation studies such as providing performance evaluation samples to all appropriate labs and implementing an independent verification of taxonomic identifications for 10% of samples processed at laboratories.

2.2.7 Representativeness

Representativeness is defined as "the degree to which the data accurately and precisely represent a characteristic of a population parameter, variation of a property, a process characteristic, or an

operational condition" (USEPA 2002). At one level, representativeness is affected by problems in any or all of the other data quality indicators.

At another level, representativeness is affected by the selection of the target surface water bodies, the location of sampling sites within that body, the time period when samples are collected, and the time period when samples are analyzed. The probability-based sampling design should provide estimates of condition of surface water resource populations that are representative of the region. The individual sampling programs defined for each indicator attempt to address representativeness within the constraints of the response design, (which includes when, where, and how to collect a sample at each site). Holding time requirements for analyses ensure analytical results are representative of conditions at the time of sampling. Use of duplicate (repeat) samples which are similar in composition to samples being measured provides estimates of precision and bias that are applicable to sample measurements.

3 Site Selection Design

The overall sampling program for the NCCA project requires a randomized, probability-based approach for selecting coastal sites where sampling activities are to be conducted. Details regarding the specific application of the probability design to surface waters resources are described in Paulsen et al. (1991) and Stevens (1994). The specific details for the collection of samples associated with different indicators are described in the indicator-specific sections of this QAPP.

3.1 Probability Based Sampling Design and Site Selection

Target Populations:

- Estuarine waters of the United States from the head-of-salt to confluence with ocean including inland waterways and major embayments river mouths, open and semi-enclosed estuaries, bays, embayments, and the more open shallow waters adjacent to East Coast and Gulf Coast shorelines. Excluded are the very deep waters adjacent to steep shorelines along the West Coast. For the purposes of this study the head of salt is generally defined as < 0.5 psu (ppt) and represents the landward/upstream boundary. The seaward boundary extends out to where an imaginary straight-line intersecting two land features would fully enclose a body of coastal water. All waters within the enclosed area are defined as estuarine, regardless of depth or salinity.

- Near shore waters of the Great Lakes of the United States and Canada. Near shore zone is defined as region from shoreline to 30m depth constrained to a maximum of 5 km from shoreline. Great Lakes include Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario. The NARS Great Lakes survey will be restricted to the United States portion.

3.2 Survey Design for the Estuarine Waters

Sample Frame: The sample frame was derived from the prior National Coastal Assessment sample frame developed by ORD Gulf Ecosystem Measurement and Modeling Division (GEMMD, Formerly the Gulf Ecology Division (GED)). The sample frame was derived from prior National Coastal Assessment sample frame developed by ORD Gulf Breeze Ecology Division. The prior GEMMD sample frame was enhanced as part of the National Coastal Monitoring Network design by including information from NOAA's Coastal Assessment Framework, boundaries of National Estuary Programs and identification of major coastal systems. For NCA 2010 information on salinity zones was obtained from NOAA. For Delaware Bay, Chesapeake Bay, Puget Sound and state of South Carolina, the prior NCA sample frames were replaced by GIS layers provided by those organizations, ensuring that no prior areas in NCA were excluded and any differences clearly identified in the new NCA 2010 sample frame. For the Californian Province excluding San Francisco Bay, the GED sample frame was changed to match 2004 sample frame used for NCA 2004 study. In 2013, the sample frame was updated to include information related to 1999-2001 and 2005-2006 NCA sample frames. This is necessary to provide the information required to estimate change between these periods, 2010 and 2015.

Survey Design: The NCCA 2020 survey design is a stratified probability design that is constructed from two independent designs. The first design consists of sites sampled in 2010 and again to 2015. It also includes sites that were evaluated but could not be sampled due to safety, too shallow or other reasons. A total of 305 sites (269 to be sampled once in 2020 and 36 sites to be sampled twice in 2020) are planned to be sampled from this design. The second design selects new sites and consists of 420 sites planned to be sampled (414 to be sampled once in 2020 and 6 to be sampled twice in 2020). A Generalized Random Tessellation Stratified (GRTS) survey design for an area resource was used for the second design. The first design uses all the sites evaluated in the 2015 panel of sites sampled from 2010. The details are given below.

Stratification: Stratification is based on a combination of states and a categorization of estuaries as small or large. The categorization was completed by ORD estuarine scientists and is based on classification used by EMAP estuaries and NCCA studies from 1999 to 2006. This results in 40 strata as two states, Georgia and New Hampshire do not have large estuaries. Note that the above directly applies to the selection of new sites for 2020. For sites to be sampled again from sites evaluated in both 2010 and 2015, the same stratification was used but the prior design was stratified by major estuary group within a state. Massachusetts has a state-level design that is stratified by their six regions. Texas has a state-level design that is stratified by their three regions and small/large estuaries; five extra sites will be sampled in Texas as part of a state level intensification. The South Carolina design combines 10 revisit sites from previous NCCA Surveys and 11 sites from the South Carolina Estuarine and Cosatal Assessment Program (SCECAP).

Multi-density categories: The design for the selection of new sites is equal probability within each stratum. Sites to be re-sampled from 2010/2015 were selected with unequal probability categories based on area of polygons within each major estuary group. The number of categories with a major estuary group ranged from 1 to 4. The categories were used to ensure that sites were selected in the smaller polygons.

3.3 Survey Design for the Great Lakes Nearshore Waters

Sample Frame: The sample frame was developed by the ORD Great Lakes Toxicology and Ecology Division (GLTED, formerly Mid-Continent Ecology Division) by Jonathon Launspach under the direction of David Bolgrien. The expected sample size is 225 Near Shore sites with 45 sites in each of the five Great Lakes. Five sites in each Great Lake will be sampled twice in 2020 for a total of 250 site visits. All sites that will be sampled twice in 2020 are sites that were sampled in 2010 and in 2015. Sample sizes were allocated proportional to shoreline length by state within each Great Lake.

Survey Design: The survey design consists of two independent designs. One design re-samples sites sampled during NCCA 2015 Great Lakes assessment, which were also sampled in 2010. The other design selects new sites using the same survey design used for NCCA 2015. Both designs use a Generalized Random Tessellation Stratified (GRTS) survey design for an area resource.

Stratification: Both designs are stratified by Great Lake.

Multi-Density Categories: Both designs use unequal probability categories where the categories are based on states within each Great Lake and the expected sample size is proportional to state shoreline length within each stratum.

3.3.1 Great Lakes Enhancement Study Designs

3.3.1.1 Lake Erie Special Study.

The Lake Erie Special Study follows on a similar study conducted in 2015. The goal of the special study is to collect water samples at enough additional sites drawn to have water quality at 30 sites per basin in each of the Lake Erie basins (East, Central and West). The existing design has 45 base sites in Lake Erie with 13 in East, 21 in Central and 11 in West basins. The enhanced design requires an additional 17 in the East, 9 in the Central and 19 in the West basin.

3.3.1.2 Green Bay Enhancement.

The goal of the Green Bay enhancement is to develop an assessment of the nearshore and offshore waters of Green Bay in Lake Michigan. The near shore zone is defined as region from shoreline to 30m depth constrained to a maximum of 5 km from shoreline. Offshore waters are all remaining water within Green Bay. The enhancement design incorporates existing NCCA 2020 sites in Green Bay (eight) sites plus over sample sites (five). The NCCA 2020 design was supplemented with a new design for Green Bay that includes 17 additional nearshore sites (for a total of 25 nearshore sites) and 25 offshore sites.

3.3.1.3 Great Lakes Islands and National Park Service Enhancement.

The goals of the Great Lakes Islands and National Park Service Enhancement are to create a reasonably-sized and coherently-defined population assessment of the nearshore areas of the large islands of Lake Michigan and to add data to the Lake Michigan nearshore assessment that will give NPS/stakeholders enough site-based data for analysis and comparisons with 2010 results. The Enhancement adds 50 additional sites, of which twelve are National Park Service sites.

3.4 Revisit Sites

Two NCCA estuarine sites in each state and five sites in each Great Lake Great Lakes nearshore site will be revisited, that is they will be sampled once, and then at least two weeks later, and preferably longer, will be visited a second time. The primary purpose of this revisit set of sites is to allow variance estimates that would provide information on the extent to which the population estimates might vary if they were sampled at a different time.

4 Information Management

Environmental monitoring efforts that amass large quantities of information from various sources present unique and challenging data management opportunities. To meet these challenges, the NCCA employs a variety of well-tested information management (IM) strategies to aid in the functional organization and ensured integrity of stored electronic data. IM is integral to all aspects of the NCCA from initial selection of sampling sites through the dissemination and reporting of final, validated data. And, by extension, all participants in the NCCA have certain responsibilities and obligations which also make them a part of the IM system. This "inclusive" approach to managing information helps to:

- Strengthen relationships among NCCA cooperators;
- Increase the quality and relevancy of accumulated data; and
- Ensure the flexibility and sustainability of the NARS IM structure.

This IM strategy provides a congruent and scientifically meaningful approach for maintaining environmental monitoring data that will satisfy both scientific and technological requirements of the NCCA 2020.

4.1 Roles and Responsibilities

At each point where data and information are generated, compiled, or stored, the NCCA 2020 IM team must manage the information (Table 4.1). Thus, the IM system includes all of the data-generating activities, all of the means of recording and storing information, and all of the processes which use data. The IM system also includes both hardcopy and electronic means of generating, storing, organizing and archiving data and the efforts to achieve a functional IM process is all encompassing. *To that end, all participants in the NCCA 2020 play an integral part within the IM system.* The following table provides a summary of the IM responsibilities identified by NCCA 2020 group. Specific information on the field crew responsibilities for tracking and sending information is found in the FOM.

Table 4.1 Summary of IM responsibilities.

NCCA 2020 Group	Contact	Primary Role	Responsibility
Field Crews	State/tribal partners and contractor or other field crews (regional EPA, etc.)	Acquire in-situ measurements and prescribed list of biotic/abiotic samples at each site targeted for the survey	Complete and review field data forms and sample tracking forms for accuracy, completeness, and legibility. Email/Ship/fax field and sample tracking forms to NARS IM Center so information can be integrated into the central database Work with the NARS IM Center staff to develop acceptable file structures and electronic data transfer protocols should there be a need to transfer and integrate data into the central database

			Provide all data as specified in FOM, SEG or as negotiated with the NCCA Project Leader. Maintain open communications with NARS IM Center regarding any data issues
Analytical Laboratories	State/tribal partners and contractors	Analyze samples received from field crews in the manner appropriate to acquire biotic/abiotic indicators/measurements requested.	Review all electronic data transmittal files for completeness and accuracy (as identified in the QAPP). Work with the NARS IM Center staff to develop file structures and electronic data transfer protocols for electronically-based data. Submit completed sample tracking forms to NCCA 2020 IM Center so information can be updated in the central database Provide all data and metadata as specified in the laboratory transmittal guidance section of the LOM, with specific templates for each indicator or as negotiated with the NCCA Project Leader. Maintain open communications with NCCA 2020 IM Center regarding any data issues. Whole fish tissue fillet responsibilities are specified in a separate QAPP developed by U.S EPA Office of Science and Technology
IM Center staff	USEPA ORD NHEERL Western Ecology Division-Corvallis, Contractors	Provides support and guidance for all IM operations related to maintaining a central data management system for NCCA 2020	Develop/update field data forms (electronic and paper versions). Plan and implement electronic data flow and management processes. Manage the centralized database and implement related administration duties. Receive, scan, and conduct error checking of field data forms. Monitor and track samples from field collection, through shipment to appropriate laboratory. Receive data submission packages (analytical results and metadata) from each laboratory. Run automated error checking, e.g., formatting differences, field edits, range checks, logic checks, etc. Receive verified, validated, and final indicator data files (including record changes and reason for change) from QA reviewers. Maintain history of all changes to data records from inception through delivery to WQX. Organize data in preparation for data verification and validation analysis and public dissemination.

			Implement backup and recovery support for central database. Implement data version control as appropriate.
Project Quality Assurance Coordinator	USEPA Office Of Water	Review and evaluate the relevancy and quality of information/data collected and generated through the NCCA 2020 surveys.	Monitor quality control information. Evaluate results stemming from field and laboratory audits. Investigate and take corrective action, as necessary, to mitigate any data quality issues. Issue guidance to NCCA 2020 Project Leader and IM Center staff for qualifying data when quality standards are not met or when protocols deviate from plan.
Steering Committee	NCCA Project Lead and other team members, EPA Regional and ORD staff, States, tribes, other federal agencies	Provide technical recommendations related to data analysis, reporting and overall implementation	Provide feedback and recommendations related to QA, data management, analysis, reporting and data distribution issues Review and comment on QA and information management documentation (QAPP, data templates, etc.).
Data Analysis and Reporting Team	USEPA Office of Water, ORD WED, Partners	Provide the data analysis and technical support for NCCA 2020 reporting requirements	Provide data integration, aggregation and transformation support as needed for data analysis. Provide supporting information necessary to create metadata. Investigate and follow-up on data anomalies using identified data analysis activities. Produce estimates of extent and ecological condition of the target population of the resource. Provide written background information and data analysis interpretation for report(s). Document in-depth data analysis procedures used. Provide mapping/graphical support. Document formatting and version control. Develops QA report for management.
Data Finalization Team	TBD	Provides data librarian support	Prepare NCCA 2020 data for transfer to USEPA public web-server(s).

			Generate data inventory catalog record (Science Inventory Record). Ensure all metadata is consistent, complete, and compliant with USEPA standards.

4.1.1 State/ Tribe-Based Data Management

Some state and tribal partners will be managing activities for both field sampling and laboratory analyses and may prefer to handle data management activities in-house. While the NARS program encourages states and tribes to use these in-house capabilities, it is imperative that NCCA 2020 partners understand their particular role and responsibilities for executing these functions within the context of the national program. If a state or tribe chooses to do IM in-house, the state or tribe must perform all of the functions associated with the following roles:

- Field Crew—including shipping/faxing of field data forms to the IM Coordinator (NCCA 2020) paper or electronic field forms must be used and the original field forms must be sent to the NARS IM Center as outlined in the NCCA 2020 FOM).
- Quality Control Team for laboratory data.
- NCCA QA Project Coordinator for ensuring that laboratory results meet specified QA requirements.
- All data will flow from the state or tribe to the NARS IM Center. Typically, the state or tribe will provide a single point of contact for all things related to NCCA 2020 data. However, it may be advantageous for the NARS IM Center staff to have direct communication with the state or tribe participating laboratories to facilitate the transfer of data, a point that may be negotiated between the primary state or tribal contact, the regional coordinator and the NCCA 2020 Project Leader (with input from the NARS IM Center staff).
- Data transfers to the NARS IM Center must be timely. States and tribes must submit all initial laboratory results (i.e., those that have been verified by the laboratory and have passed all internal laboratory QA/QC criteria) in the appropriate format to NARS IM Center by May 2020, in order to meet NCCA 2020 product deadlines.
- Data transfers must be complete. For example, laboratory analysis results submitted by a state or tribe must be accompanied by related quality control and quality assurance data, qualifiers code definitions, contaminant/parameter code cross-references/descriptions, test methods, instrumentation information and any other relevant laboratory-based assessments or documentation related to specific analytical batch runs.
- The state or Tribe will ensure that data meet minimum quality standards and that data transfer files meet negotiated content and file structure standards.

The NARS IM Center will provide the necessary guidance for IM requirements. Each group that will perform in-house IM functions will incorporate these guidelines as is practicable or as previously negotiated.

4.2 Overview of System Structure

In its entirety, the NARS IM system includes site selection and logistics information, sample labels and field data forms, tracking records, mapping and analytical data, data validation and analysis processes, reports, and archives. NARS IM staff provides support and guidance to all program operations in addition to maintaining a central database management system for the NCCA data.

The central repository for data and associated information collected for use by NCCA 2020 is a secure, access-controlled server located at WED-Corvallis. This database is known as the NARS IM. Data are stored and managed on this system using the Structured Query Language (SQL). Data review (e.g., verification and validation) and data analysis (e.g., estimates of status and extent) are accomplished primarily using programs developed in either Statistical Analysis System (SAS) or 'R' language software packages.

4.2.1 Data Flow

The NCCA 2020 will accumulate large quantities of observational and laboratory analysis data. To manage this information appropriately, it is essential to have a well-defined data flow model and documented approach for acquiring, storing, and summarizing the data. This conceptual model (**Figure 4.1**) helps focus efforts on maintaining organizational and custodial integrity, ensuring that data available for analyses are of the highest possible quality.

4.2.2 Simplified Description of Data Flow

There are several components associated with the flow of information, these are:

- Communication between the NARS IM Center and the various data contributors (e.g., field crews, laboratories and the data analysis and reporting team) is vital for maintaining an organized, timely, and successful flow of information and data.
- Data are captured or acquired from four basic sources; field data transcription, laboratory analysis reporting, automated data capture, and submission of external data files (e.g., Geographic Information Systems (GIS) data) encompassing an array of data types (site characterization, biotic assessment, sediment and tissue contaminants, and water quality analysis). Data capture generally relies on the transference of electronic data, e.g., optical character readers and email, to a central data repository. However, some data must be transcribed by hand in order to complete a record.
- Data repository or storage provides the computing platform where raw data are archived, partially processed data are staged, and the "final" data, assimilated into a final, user-ready data file structure, are stored. The raw data archive is maintained in a manner consistent with providing an audit trail of all incoming records. The staging area provides the IM Center

staff with a platform for running the data through all of its QA/QC paces as well as providing data analysts a first look at the incoming data. This area of the data system evolves as new data are gathered and user-requirements are updated. The final data format becomes the primary source for all statistical analysis and data distribution.

- Metadata—a descriptive document that contains information compliant with the Content Standards for Digital Geospatial Metadata (CSDGM) developed by the Federal Geographic Data Committee (FGDC).

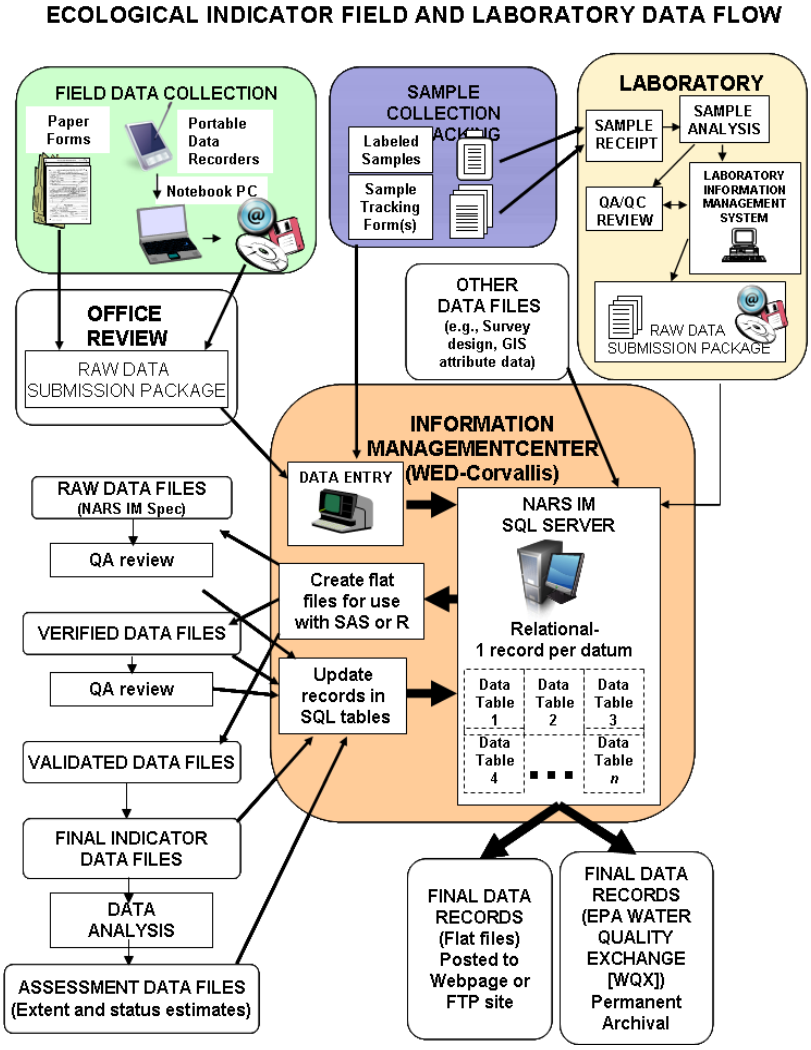

Figure 4.1 Conceptual model of data flow into and out of the master SQL

The following sections describe core information management standards, data transfer protocols, and data quality and results validation. Additionally, Section 4.4 describes the major data inputs to the central database and the associated QA/QC processes used to record, enter, and validate measurement and analytical data collected.

4.2.3 Core Information Management Standards

The development and organization of the NARS IM system is compliant with current EPA guidelines and standards. Areas addressed by these policies and guidelines include, but are not limited to, the following:

- Taxonomic nomenclature and coding;
- Locational data;
- Sampling unit identification and reference;
- Hardware and software; and
- Data catalog documentation.

NCCA 2020 is committed to compliance with all applicable regulations and guidance concerning hardware and software procurement, maintenance, configuration control, and QA/QC. To that end, the NCCA 2020 team has adopted several IM standards that help maximize the ability to exchange data within the study and with other aquatic resource surveys or similar large-scale monitoring and assessment studies (e.g. NARS, past EMAP and R-EMAP studies). Specific information follows.

4.2.4 Data Formats

4.2.4.1 Attribute Data

- SQL Tables;
- SAS Data Sets;
- R Data Sets[1]; and
- American Standard Code for Information Interchange (Ascii) Files: Comma-Separated values, or space-delimited, or fixed column.

4.2.4.2 GIS Data

- ARC/INFO native and export files; compressed .tar file of ARC/INFO workspace; and
- Spatial Data Transfer Standard (SDTS; FGDC 1999) (format available upon request).

4.2.4.3 Standard Coding Systems

- Sampling Site: (EPA Locational Data Policy; EPA 1991);
- Coordinates: Latitude and Longitude in decimal degrees (±0.002);
- Datum: NAD83;
- Chemical Compounds: Chemical Abstracts Service (CAS 1999) (http://www.cas.org/) ;
- Species Codes: Integrated Taxonomic Information System when possible; and
- Land cover/land use codes: Multi-Resolution Land Characteristics; National Hydrography Dataset Plus Version 2.0.

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[1] ***R*** *is a free software programming language and* a software environment for statistical computing and graphics. The R language is widely used among statisticians and data miners for developing statistical software and data analysis.

4.2.5 Public Accessibility

While any data created using public funds are subject to the Freedom of Information Act (FOIA), some basic rules apply for general public accessibility and use. Briefly, those rules are:

- Program must comply with Data Quality Act before making any data available to the public and person generating data must fill out and have a signed Information Quality Guidelines package before any posting to the Web or distribution of any kind.
- Data and metadata files are made available to the contributor or participating group for review or other project-related use from NARS IM or in flat files before moving to an EPA-approved public website.
- Data to be placed on a public website will undergo QA/QC review according to the approved QAPP.
- Only "final" data (those used to prepare the final project report) are readily available through an EPA-approved public website.

As new guidance and requirements are issued, the NARS IM staff will assess the impact upon the IM system and develop plans for ensuring timely compliance.

4.3 Data Transfer Protocols

Field crews are expected to send in hard copies of field forms or use the provided electronic field forms containing *in situ* measurement and event information to the NARS IM Center defined in the FOM for submission. Laboratories will submit electronic data files. Field crews and laboratories must submit all sample tracking and analytical results data to the NARS IM Center in electronic form using a standard software package to export and format data. Data submission templates for laboratories are included in the LOM. Examples of software and the associated formats are:

Table 4.2 Summary of software

Software	Export Options (file extensions)
Microsoft Excel®	xls, xlsx, csv, formatted txt delimited
Microsoft Access®	mdb, csv, formatted txt delimited
SAS®	csv, formatted txt delimited
R	csv, formatted txt delimited

All electronic files must be accompanied by appropriate documentation (e.g., metadata, laboratory reports, QA/QC data and review results). This documentation must contain sufficient information to identify field contents, field formats, qualifier codes, etc. It is very important to keep EPA informed of the completeness of the analyses. Labs may send files periodically, before all samples are analyzed, but

EPA must be informed that more data are pending if a partial file is submitted. All data files sent by the labs must be accompanied by text documentation describing the status of the analyses, any QA/QC problems encountered during processing, and any other information pertaining to the quality of the data. Following is a list of general transmittal requirements each laboratory, state, or tribal based IM group should consider when packaging data for electronic transfer to the IM Center:

- Provide data in row/column data file/table structure – see data templates. All cooperators and contractors should further consider the following:
    a. Include NCCA site and sample ID provided on the sample container label in a field for each record (row) to ensure that each data file/table record can be related to a site visit.
    b. Use a consistent set of column labels.
    c. Use file structures consistently.
    d. Use a consistent set of data qualifiers.
    e. Use a consistent set of units.
    f. Include method detection limit (MDL) as part of each result record.
    g. Include reporting limit (RL) as part of each result record for water chemistry.
    h. Provide a description of each result/QC/QA qualifier.
    i. Provide results/measurements/MDL/RL in numeric form.
    j. Maintain result qualifiers (e.g., <, Not Detected (ND)) in a separate column.
    k. Use a separate column to identify record-type. For example, if QA or QC data are included in a data file, there should be a column that allows the IM staff to readily identify the different result types.
    l. Include laboratory sample identifier.
    m. Include batch numbers/information so results can be paired with appropriate QA/QC information.
    n. Include “true value” concentrations, if appropriate, in QA/QC records.
    o. Include a short description of preparation and analytical methods used to analyze samples (where appropriate) either as part of the record or as a separate description for the test(s) performed on the sample. For example, EPAxxxx.x, ASTMxxx.x, etc. Provide a broader description (e.g., citation) if a non-standard method is used.
    p. Include a short description of instrumentation used to acquire the test result (where appropriate). This may be reported either as part of the record or as a separate description for each test performed on the sample. For example, GC/MS-ECD, ICP-MS, etc.
    q. Ensure that data ready for transfer to NARS IM are verified and validated, and results are qualified to the extent possible (final verification and validation are conducted by EPA).
    r. Data results must meet the specified requirements for each indicator found in the LOM as specified by contract or agreement.
    s. Identify and qualify missing data (why are the data missing?).
    t. Submit any other associated quality assurance assessments and relevant data related to laboratory results (i.e., chemistry, nutrients). Examples include summaries of QC sample analyses (blanks, duplicates, check standards, matrix spikes) standard

or certified reference materials, etc.), results for external performance evaluation or proficiency testing samples, and any internal consistency checks conducted by the laboratory. For requirements, please see specific indicator sections of this QAPP and LOM.

Laboratories will work with the NARS IM Coordinator to establish a data load process into NARS IM.

4.4 Data Quality and Results Validation

Data quality is integrated throughout the life cycle of the data. This includes development of appropriate forms, labels etc. for capturing data as well as verifying data entry, results, and other assessments. Indicator workgroup experts, the data analysis and reporting team submit any recommended changes to the Project QA Coordinator who recommends and submits any changes (deletions, additions, corrections) to the NARS IM data center for inclusion in the validated data repository. All explanation for data changes is included in the record history.

4.4.1 Design and Site Status Data Files

The site selection process described in **Section 3** produces a list of candidate sampling locations, inclusion probabilities, and associated site classification data (e.g., target status, ecoregion, etc.). The Design Team provides this file to the NCCA 2020 Project Leader, who in turn distributes to the IM staff, and field coordinators. Field coordinators determine ownership and contacts for acquiring permission to access each site, and conduct site evaluation and reconnaissance activities. Field Crews document information from site evaluation and reconnaissance activities following the SEG and the FOM. The site evaluation spreadsheets are submitted to the Project Lead by the field crews. The NARS IM Center compiles all information such as ownership, site evaluation, and reconnaissance information for each site into a "site status" data file. Any missing information from the site status data file is identified and a request is made by the NARS IM Center to the field crew (or site evaluator) to complete the record.

4.4.2 Sample Collection and Field Data

Field crews record sampling event observational data in a standard and consistent manner using field data collection forms (see the NCCA 2020 FOM). Prior to initiation of field activities, the NARS IM staff works with the indicator leads and analytical support laboratories to develop standardized field data forms and sample labels. Adhesive labels, completed by the field crews, have a standard recording format and are affixed to each sample container. Field protocols include precautions to ensure that label information remains legible and the label remains attached to the sample.

The NCCA App is the required format for field data submission. Paper field forms are only to be used if the App fails. A few copies will be provided to crews prior to the field season. In the event that the App fails, the crew lead must continue sampling and record field data on paper forms and contact the EPA Contractor Logistics Coordinator as quickly as possible. Paper forms are printed for field crews on water resistant paper. Copies of the field data forms and instructions for completing each form are documented in the NCCA 2020 FOM. Recorded data whether through the NCCA App or on paper are

reviewed upon completion of data collection and recording activities by the Field Crew Leader. Field crews check completed data forms and sample labels before leaving a sampling site to ensure information and data were recorded legibly and completely. Errors are corrected by field crews if possible, and data considered as suspect are qualified using a flag variable. The field sampling crew enters explanations for all flagged data in a comments section. Field crews transmit forms to the NARS IM Staff by selecting the "submit" button as described in the FOM. Alternately, field crews, ship completed paper field data forms to the NARS IM staff for entry into the central database management system.

All samples are tracked from the point of collection. Tracking of samples refers to the documentation of the specified location of each sample in the centralized NARS IM Center database. This is done by requiring that field crews ensure that copies of the shipping and custody record accompany all sample transfers; other copies are transmitted to the IM Center. Each sample has a custody record that laboratory manager is required to enter into NARS IM Center upon receipt of sample. The IM Center tracks samples to ensure that they are delivered to the appropriate laboratory, that lost shipments can be quickly identified and traced, and that any problems with samples observed when received at the laboratory are reported promptly so that corrective action can be taken, if necessary. Detailed procedures on shipping and sample tracking can be found in the FOMs.

Procedures for completion of sample labels and field data forms and use of personal computers (PCs) are covered extensively in training sessions. General QC checks and procedures associated with sample collection and transfer, field measurements, and field data form completion for most indicators are listed in Table 4.3. Additional QA/QC checks or procedures specific to individual indicators are described in the LOM.

Table 4.3 Summary sample and field data quality control activities: sample tracking

Quality Control Activity	Description and/or Requirements
Contamination Prevention	All containers for individual site sealed in plastic bags until use; specific contamination avoidance measures covered in training
Sample Identification	Pre-printed labels with unique ID number on each sample
Data Recording	Data recorded on pre-printed forms of water-resistant paper; field sampling crew reviews data forms for accuracy, completeness, and legibility
Data Qualifiers	Defined qualifier codes used on data form; qualifiers explained in comments section on data form
Sample Custody Records	Unique sample ID and tracking form information entered in LIMS; sample shipment and receipt confirmed

Quality Control Activity	Description and/or Requirements
Sample Tracking	Sample condition inspected upon receipt and noted on tracking form with copies sent to NCCA Field Logistics Coordinator and/or IM
Data Entry	Data entered using customized entry screens that resemble the data forms; entries reviewed manually or by automated comparison of double entry
Data Submission	Standard format defined for each measurement including units, significant figures, and decimal places, accepted code values, and required field width
Data Archival	All data records, including raw data, archived in an organized manner. For example, following verification/validation of the last submission into the NARS database, it is copied to a terabit external hard drive and sent to the Project Leader for inclusion in his project file, scheduled as 501, permanent records. Processed samples and reference collections of taxonomic specimens submitted for cataloging and curing at an appropriate museum facility

4.4.3 Laboratory Analyses and Data Recording

Upon receipt of a sample shipment, analytical laboratory receiving personnel check the condition and identification of each sample against the sample tracking record. Each sample is identified by information written on the sample label. The lab reports any discrepancies, damaged samples, or missing samples to the NARS IM staff and N NCCA 2020 Project Lead electronically.

Most of the laboratory analyses for the NCCA 2020 indicators, particularly chemical and physical analyses, follow or are based on standard methods. Standard methods generally include requirements for QC checks and procedures. General laboratory QA/QC procedures applicable to most NCCA 2020 indicators are described in Section 5. Additional QA/QC procedures specific to individual indicator and parameter analyses are described in the LOM and the QAPP. Biological sample analyses are generally based on current acceptable practices within the particular biological discipline. Some QC checks and procedures applicable to most NCCA 2020 biological samples are described in the LOM and the QAPP. **Table 4.4** provides a summary of the lab data QC activities for NCCA 2020.

Table 4.4 Summary laboratory data quality control activities

Quality Control Activity	Description and/or Requirements
Instrument Maintenance	Follow manufacturer's recommendations and specific guidelines in methods; maintain logbook of maintenance/repair activities
Calibration	Calibrate instruments according to manufacturer's recommendations for each specific indicator; recalibrate or replace before analyzing any samples

Quality Control Activity	Description and/or Requirements
QC Data	Maintain control charts, determine LT-MDLs and achieved data attributes; include QC data summary (narrative and compatible electronic format) in submission package
Data Recording	Use software compatible with NARS IM system. Check all data entered against the original bench sheet to identify and correct entry errors. Review other QA data (e.g., condition upon receipt, etc.) for possible problems with sample or specimen.
Data Qualifiers	Use defined qualifier codes; explain all qualifiers
Data Entry	Automated comparison of double entry or 100% manual check against original data form
Submission Package	Includes: ▪ Letter by laboratory manager ▪ Data ▪ Data qualifiers and explanations ▪ Electronic format compatible with NARS IM ▪ Documentation of file and database structures ▪ Metadata: variable descriptions and formats ▪ Summary report of any problems and corrective actions implemented

A laboratory's IM system may consist of only hardcopy records such as bench sheets and logbooks, an electronic laboratory information management system (LIMS), or some combination of hardcopy and electronic records. Laboratory data records are reviewed at the end of each analysis day by the designated laboratory onsite QA coordinator or by supervisory personnel. Errors are corrected by laboratory personnel if possible, and data considered as suspect by laboratory analysts are qualified with a flag variable. All flagged data are explained in a comments section. Private contract laboratories generally have a laboratory Quality Assurance Project Plan and established procedures for recording, reviewing, and validating analysis data.

Once analytical data have passed all of the laboratory's internal review procedures, the lab prepares and transfers a submission package using the prescribed templates in the LOM. The contents of the submission package are largely dictated by the type of analysis (physical, chemical, or biological).

Remaining sample material and voucher specimens may be transferred to EPA's designated laboratory or facilities as directed by the NCCA 2020 Project Lead. All samples and raw data files (including logbooks, bench sheets, and instrument tracings) are to be retained by the laboratory for 3 years or until authorized for disposal, in writing, by the EPA Project Leader. Deliverables from contractors and

cooperators, including raw data, are permanent as per EPA Record Schedule 258 (http://www.epa.gov/records/policy/schedule/sched/258.htm). EPA's project records are scheduled 501 (http://www.epa.gov/records/policy/schedule/sched/501.htm) and are also permanent.

4.4.4 Data Review, Verification, and Validation Activities

Raw data files are created from entry of field and analytical data, including data for QA/QC samples and any data qualifiers noted on the field forms or analytical data package.

4.4.4.1 Paper Forms

The NARS IM Center either optically scans or transcribes information from field collection forms into an electronic format (sometimes using a combination of both processes). During the scanning process, incoming data are subjected to a number of automated error checking routines. Obvious errors are corrected immediately at the time of scanning. Suspected errors that cannot be confirmed at the time of scanning are qualified for later review by someone with the appropriate background and experience (e.g., a chemist or aquatic ecologist). The process continues until the transcribed data are 100% verified or no corrections are required.

4.4.4.2 Electronic Forms

The NARS IM Center directly uploads information from the electronic field collection forms into their database. During the upload process, incoming data are subjected to a number of automated error checking routines. Omissions and errors are automatically noted in an email message to the field crew lead.

4.4.4.3 Additional Review

Additional validation is accomplished by the NARS IM Center staff using a specific set of guidelines and executing a series of programs (computer code) to check for: correct file structure and variable naming and formats, outliers, missing data, typographical errors and illogical or inconsistent data based on expected relationships to other variables. Data that fail any check routine are identified in an "exception report" that is reviewed by an appropriate scientist for resolution.

The NARS IM Center brings any remaining questionable data to the attention of the EPA Project QA Coordinator and individuals responsible for collecting the data for resolution. The EPA Project QA Coordinator reviews all data to determine completeness and validity. Additionally, the data are run through a rigorous inspection using SQL queries or other computer programs such as SAS or R to check for anomalous data values that are especially large or small, or are noteworthy in other ways. Focus is on rare, extreme values since outliers may affect statistical quantities such as averages and standard deviations.

The EPA Project QA Coordinator examines all laboratory quality assurance (QA) information to determine if the laboratory met the predefined data quality objectives - available through the QAPP.

Some of the typical checks made in the processes of verification and validation are described in **Table 4.5**.

Automated review procedures may be used. The primary purpose of the initial checks is to confirm that each data value present in an electronic data file is accurate with respect to the value that was initially recorded on a data form or obtained from an analytical instrument. In general, these activities focus on individual variables in the raw data file and may include range checks for numeric variables, frequency tabulations of coded or alphanumeric variables to identify erroneous codes or misspelled entries, and summations of variables reported in terms of percent or percentiles. In addition, associated QA information (e.g., sample holding time) and QC sample data are reviewed to determine if they meet acceptance criteria. Suspect values are assigned a data qualifier. They will either be corrected, replaced with a new acceptable value from sample reanalysis, or confirmed suspect after sample reanalysis. For biological samples, species identifications are corrected for entry errors associated with incorrect or misspelled codes. Errors associated with misidentification of specimens are corrected after voucher specimens have been confirmed and the results are available. Files corrected for entry errors are considered to be raw data files. Copies of all raw data files are maintained in the centralized NARS IM System**.** Any suspect data will be flagged for data qualification.

The NARS IM staff, with the support of the NCCA 2020 Quality Team, correct and qualify all questionable data. Copies of the raw data files are maintained in NARS IM, generally in active files until completion of reporting and then in archive files. Redundant copies of all data files are maintained and all files are periodically backed up to the EPA HQ shared G drive system.

Table 4.5 Data review, verification, and validation quality control activities

Quality Control Activity	Description and/or Requirements
Review any qualifiers associated with variable	Determine if value is suspect or invalid; assign validation qualifiers as appropriate
Determine if Measurement Quality Objective (MQOs) and project DQOs have been achieved	Determine potential impact on achieving research and/or program objectives
Exploratory data analyses (univariate, bivariate, multivariate) utilizing all data	Identify outlier values and determine if analytical error or site-specific phenomenon is responsible
Confirm assumptions regarding specific types of statistical techniques being utilized in development of metrics and indicators	Determine potential impact on achieving research and/or program objectives

In the final stage of data verification and validation, exploratory data analysis techniques may be used to identify extreme data points or statistical outliers in the data set. Examples of univariate analysis techniques include the generation and examination of box-and-whisker plots and subsequent statistical

tests of any outlying data points. Bivariate techniques include calculation of Spearman correlation coefficients for all pairs of variables in the data set with subsequent examination of bivariate plots of variables having high correlation coefficients. Multivariate techniques have also been used in detecting extreme or outlying values in environmental data sets (Meglen, 1985; Garner et al., 1991; Stapanian et al., 1993).

The Quality Team reviews suspect data to determine the source of error, if possible. If the error is correctable, the data set is edited to incorporate the correct data. If the source of the error cannot be determined, the Quality Team qualifies the data as questionable or invalid. Data qualified as questionable may be acceptable for certain types of data analyses and interpretation activities. The decision to use questionable data must be made by the individual data users. Data qualified as invalid are considered to be unacceptable for use in any analysis or interpretation activities and will generally be removed from the data file and replaced with a missing value code and explanatory comment or flag code. After completion of verification and validation activities, a final data file is created, with copies transmitted for archival and for uploading to the centralized IM system.

Once verified and validated, data files are made available for use in various types of interpretation activities; each activity may require additional restructuring of the data files. These restructuring activities are collectively referred to as "data enhancement." In order to develop indicator metrics from one or more variables, data files may be restructured so as to provide a single record per site.

4.5 Data Transfer

Field crews may transmit data electronically; hardcopies of completed data and sample tracking forms are sent via express courier service. Copies of raw, verified, and validated data files are transferred from the Project QA Coordinator to the IM staff for inclusion in the central IM system. All transfers of data are conducted using a means of transfer, file structure, and file format that has been approved by the EPA IM Project lead. Data files that do not meet the required specifications will not be incorporated into the centralized data access and management system.

4.5.1 Database Changes

The NARS IM Center staff complete data corrections at the lowest level to ensure that any subsequent updates will contain only the most correct data. The NARS IM Center sends back laboratory results found to be in error to the originator (e.g., analysis laboratory) for correction. After the originator makes any corrections, the entire batch or file is resubmitted to the NARS IM Center. The NARS IM Center uses these resubmissions to replace any previous versions of the same data.

The NARS IM Center uses a version control methodology when receiving files. This methodology is explained in the following sentences. Incoming data are not always immediately transportable into a format compatible with the desired file structures. When this situation occurs, the IM staff creates a copy of the original data file, which then becomes the working file in which any formatting changes will

take place. The original raw data will remain unchanged. This practice further ensures the integrity of the data and provides an additional data recovery avenue, should the need arise.

All significant changes are documented by the NARS IM Center staff. The NARS IM Center includes this information in the final summary documentation for the database (metadata).

After corrections have been applied to the data, the NARS IM Center will rerun the validation programs to re-inspect the data.

If requested by the NARS Project QA Coordinator and funds are available, the NARS IM Center will implement database auditing features to track changes.

4.6 Metadata

All metadata will be kept according to the Federal Geographic Data Committee, Content standard for digital geospatial metadata, version 2.0. FGDC-STD-001-1998 (FGDC 1998).

4.6.1 Parameter Formats

The following parameter formats will be used:

- Sampling Site (EPA Locational Data Policy (USEPA 1991)
- Latitude and Longitude in decimal degrees (+/- 7.4), Negative longitude values (west of the prime meridian),
- Datum: NAD83;
- Date: YYYYMMDD (year, month, day)
- Hour: HHMMSS (hour, minute, second), Greenwich mean time, Local time
- Data loaded to STORET will take on the STORET formats upon loading.

4.6.2 Standard Coding Systems

The following standard coding systems will be used:

- Chemical Compounds: Chemical Abstracts Service (CAS 1999)
- Taxonomic Names: USGS BioData (https://aquatic.biodata.usgs.gov/landing.action)
- Land cover/land use codes: Multi-Resolution Land Characteristics (MRLC 1999)

4.7 Information Management Operations

4.7.1 Computing Infrastructure

Electronic data are collected and maintained within a central server housed at WED using a Windows Server (current configuration) or higher computing platform in SQL native tables for the primary data repository and SAS® native data sets or R datasets for data analysis. Official IM functions are conducted in a centralized environment.

4.7.2 Data Security and Accessibility

The NARS IM Center ensures that all data files in NARS IM are protected from corruption by computer viruses, unauthorized access, and hardware and software failures. Guidance and policy documents of EPA and management policies established by the IM Technical Coordination Group for data access and data confidentiality are followed. Raw and verified data files are accessible only to the NCCA 2020 collaborators. Validated data files are accessible only to users specifically authorized by the NCCA 2020 Project Leader. Data files in the central repository used for access and dissemination are marked as read-only to prevent corruption by inadvertent editing, additions, or deletions.

Data generated, processed, and incorporated into the IM system are routinely stored as well as archived on redundant systems by the NARS IM Center. This ensures that if one system is destroyed or incapacitated, IM staff can reconstruct the databases. Procedures developed to archive the data, monitor the process, and recover the data are described in IM documentation.

Data security and accessibility standards implemented for NCCA 2020 IM meet EPA's standard security authentication (i.e., username, password) process in accordance to EPA's *Information Management Security Manual* (1999; EPA Directive 2195 A1) and EPA Order 2195.1 A4 (2001D). Any data sharing requiring file transfer protocol (FTP) or internet protocol is provided through an authenticated site.

4.7.3 Life Cycle

Data may be retrieved electronically by the NCCA 2020 team, partners and others throughout the records retention and disposition lifecycle or as practicable (Section 4.4).

4.7.4 Data Recovery and Emergency Backup Procedures

The NARS IM Center maintains several backup copies of all data files and of the programs used for processing the data. Backups of the entire system are maintained off-site by the NARS IM Center. The IM process used by the NARS IM Center for NCCA 2020 uses system backup procedures. The NARS IM Center backs up and archives the central database according to procedures already established for EPA Western Ecology Division and NARS IM. All laboratories generating data and developing data files are expected to establish procedures for backing up and archiving computerized data.

4.7.5 Long-Term Data Accessibility and Archive

All data are transferred by OW's Water Quality Exchange (WQX) team working with the NARS IM Team to U.S. EPA's agency-wide WQX data management system for archival purposes. WQX is a repository for water quality, biological, and physical data and is used by state environmental agencies, EPA and other federal agencies, universities, and private citizens. Data from the NCCA 2020 project will be run through an Interface Module in an Excel format and uploaded to WQX by the WQX team. Once uploaded, states and tribes and the public will be able to download data (using Oracle software) from their region. Data will also be provided in flat files on the NARS website.

4.8 Records Management

Removable storage media (i.e., CDs, USB Drives) and paper records are maintained in a centrally located area at the NARS IM Center. Paper records will be returned to OW once the assessment is complete. The IM Team identifies and maintains files using standard divisional procedures as established by EPA Western Ecology Division. Records retention and disposition comply with U.S. EPA directive 2160 Records Management Manual (July, 1984) in accordance with the Federal Records Act of 1950.

5 Indicators

This section of the QAPP provides summary information on laboratory and field performance and quality control measures for the NCCA 2020 indicators. Additional details are described in the NCCA 2020 Field Operations Manual and Laboratory Operations Manual. A description of the NCCA indicators are found in Table 5.1.

Table 5.1 Description of NCCA 2020 Indicators and location where indicators are collected

Indicator	Description	Location of sample collection
In Situ measurements [Salinity (estuarine), temperature, DO Depth, Conductivity (freshwater), pH]	Measurements taken to detect extremes in condition that might indicate impairment and depth at location	One set of measurements taken at the index site; readings are taken on a profile through the water column at the index site
Secchi/light measurements PAR	Measurements to look at clarity	Measured at the index site
Water chemistry filtered sample for dissolved inorganic NO_2 NO_3, NH_4, PO_4; Unfiltered sample for Total N and P	Water chemistry measurements will be used to determine nutrient enrichment/eutrophication	Collected from a depth of 0.5 m at the index site
Chlorophyll-a	Chlorophyll-a is used to determine algal biomass in the water	Collected as part of water chemistry sample
Microcystins, Cylindrospermopsin	Measurement used to determine the presence of algal toxins in the water	Collected from a depth of 0.5 m at the index site
Benthic invertebrate assemblage	Benthic invertebrate community information is used to assess the biological health of estuarine and Great lake waters. The NCCA will measure attributes of the overall structure and function of the	Collected from a sediment grab at the index site

	benthic community, diversity, abundances, etc to evaluate biological integrity	
Sediment Chemistry	Measurement to determine contaminant levels in sediment	Collected from a sediment grab at the index site
Sediment toxicity	Measurement to determine level of toxicity of sediment	Collected from a sediment grab at the index site
Nitrogen Isotopes (Research Indicator)	Research indicator to determine the utility of nitrogen isotope for tracking of waste sources in estuaries	Collected from a sediment grab at the index site in estuaries only
Microplastics in sediment (research indicator)	Research indicator to help develop methods for microplastics detection, separation and quantification in estuarine sediments	Collected from a sediment grab at the index site from select sites in the Northeast only
Whole fish tissue	Measurement to determine contaminant levels in whole body fish for ecological assessment	Target species collected within 500 meter radius of the X-site (may expand to 1000 meters if needed)
Fecal indicator (*Enterococci*)	*Enterococci* are bacteria that are endemic to the guts of warm blooded creatures. These bacteria, by themselves, are not considered harmful to humans but often occur in the presence of potential human pathogens (the definition of an indicator organism)	Collected from a depth of 0.5 m at the index site
Fish Tissue Plug	Fish Tissue plugs will provide information on the national distribution of Hg, a	Target species collected within a 500 meter radius of the X-site (may expand to 1000 meters if needed)

	bioaccumulative and toxic chemical in fish species	
Great Lakes Human Health Fish Tissue Samples	Fish Tissue fillet samples will be analyzed for mercury, PCBs, and PFAS because of associated human health risk implications	Target species collected at a subset of Great Lakes sites within a 500 meter radius of the X-site, if possible, and up to a 1500 meter radius, if needed

5.1 In Situ Measurements

The first activities that should be conducted by crews upon arriving onsite are those that involve water column measurements; these data need to be collected before disturbing bottom sediments.

5.1.1 Introduction

Crews make in situ measurements using field meters, and data are recorded utilizing the NCCA App. Field crews will measure dissolved oxygen (DO), pH, conductivity (fresh water) or salinity (marine), and temperature using a multi-parameter water quality meter. Crews use a meter to read photosynthetically active radiation (PAR) throughout the photic zone. Crews measure secchi disk depth as well. At Great Lakes sites, crews will also take underwater video at each site.

5.1.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in NCCA 2020 Field Operation Manual.

5.1.3 Pertinent Laboratory QA/QC Procedures

Not applicable for in situ measurements.

5.1.4 Pertinent Field QA/QC Procedures

Several pieces of equipment that may be utilized by crews to collect or analyze environmental data for NCCA should have periodic maintenance and calibration verification performed by manufacturer's representatives or service consultants. These procedures should be documented by date and the signature of the person performing the inspection. Examples include:

- CTDs or multiparameter probes - annual (or as needed) maintenance and calibration check by manufacturer or certified service center;
- Light (PAR) Meters - biannual verification of calibration coefficient by manufacturer;
- Video cameras- as needed maintenance as described in the manufacturer information.

Crews will maintain all other sampling gear and laboratory instrumentation in good repair as per manufacturer's recommendations to ensure proper function.

5.1.4.1 Field Performance Requirements

Measurement data quality objectives (measurement DQOs or MQOs) are given in Table 5.2**.** General requirements for comparability and representativeness are addressed in Section 2.

Table 5.2 Measurement data quality objectives: water indicators.

Variable or Measurement	Maximum allowable Accuracy Goal (Bias)	Maximum Allowable Precision Goal (%RSD)	Completeness
Oxygen, dissolved	±0.5 mg/L	10%	95%
Temperature	±1 ±C	10%	95%
Conductivity	±1 µS/cm	10%	95%
Salinity	±1 ppt	10%	95%
Depth	±0.5 m	10%	95%
pH	±0.3 SU	10%	95%
PAR	0.01 µmol s^{-1} m^{-2} *	5%	95%
Secchi Depth	±0.5 m	10%	95%

*Determined by biannual manufacturer calibration.

5.1.4.2 Field Quality Control Requirements

For in situ measurements, each field instrument (e.g., multi-probe) used by the crews must be calibrated, inspected prior to use, and operated according to manufacturer specifications. Figure 5.1 illustrates the general scheme for field chemistry measurement procedures.

5.1.4.3 Instrumentation

Seabird CTDs and Multiparameter Probes: SeaBird CTDs and multiparameter probes are routinely used in estuarine, Great Lakes, deep water or oceanographic surveys to measure and electronically log various water column parameters. When properly maintained and serviced, they have an established history of dependable utilization. The units can be configured with different arrays of probes; for the purposes of the NCCA, when used, crews will equip them to measure DO, temperature, salinity/conductivity, pH, and depth. Crews will follow the NCCA Field Operations Manual and manufacturer's instructions for use of these instruments.

For instruments that are factory calibrated and checked (e.g. Sea-Bird Electronics meters, etc.), crews must ensure that factory-certified diagnostics have been completed according to manufacturer specifications (preferably conducted immediately prior to the sampling season) and provide

documentation copies during assistance visits. Meters such as these do not require the daily calibration steps or the weekly diagnostic/QCS (Quality Check Solution) checks. Table 5.3 includes field quality control measures for multiparameter probes.

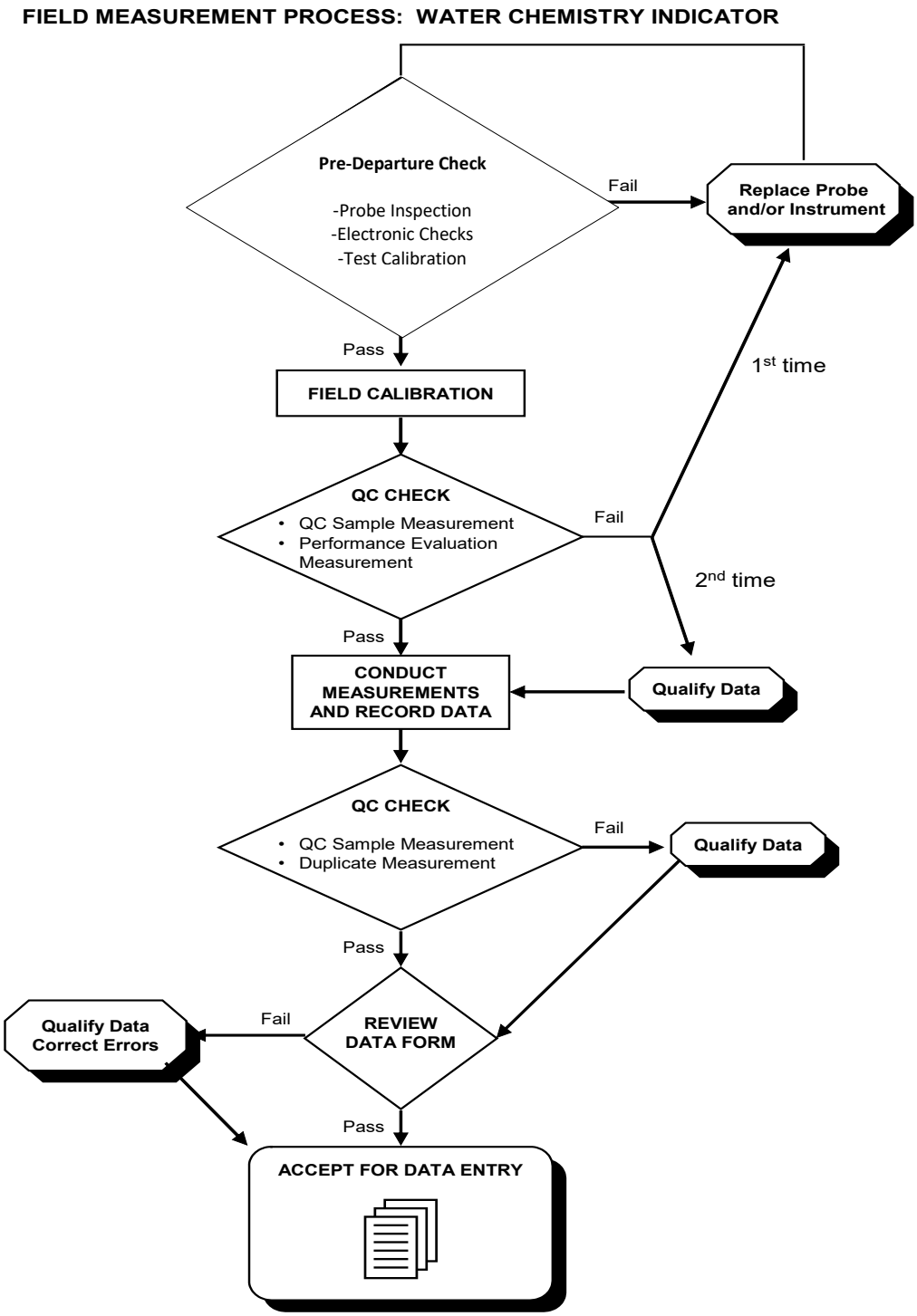

Figure 5.1 Field Measurement Process for Water Chemistry Samples.

Table 5.3 Field quality control: multiparameter indicator.

Check Description	Frequency	Acceptance Criteria	Corrective Actions
Verify performance of temperature probe using wet ice	Prior to initial sampling, daily thereafter	Functionality = ± 0.5°C	See manufacturer's directions
Verify depth against markings on cable	Daily	± 0.2 m	Re-calibrate
pH - Internal electronic check if equipped; if not check against Quality Check Solution	At the beginning and end of each day	Alignment with instrument manufacturer's specifications; or QCS measurement in range	AM: Re-calibrate PM: Flag day's data. pH probe may need maintenance
Conductivity (Great Lakes only) – internal electronic check if equipped; if not check against Quality Check Solution	At the beginning and end of each day	Alignment with intrument manufacturer's specifications or within ±2 µS/cm or ±10% of QCS value	AM: Re-calibrate PM: Flag day's data. Instrument may need repair
Salinity (marine only) – internal electronic check if equipped; if not check against Quality Check Solution	At the beginning and end of each day	Alignment with instrument manufacturer's specifications or within ± 0.2 ppt of QCS value	AM: Re-calibrate PM: Flag day's data. Instrument may need reapair
Check DO calibration in field against atmospheric standard (ambient air saturated with water)	At the beginning and end of each day	±0.5 mg/L or 10% of 100% saturation	AM: Re-calibrate PM: Flag day's data. Change membrane and re-check

LICOR PAR meter: No daily field calibration procedures are required for the LICOR light meter; however, the manufacturer recommends that the instrument be returned to the factory for bi-annual calibration check and resetting of the calibration coefficient. Calibration kits are available from LICOR and this procedure can be performed at the laboratory (see LICOR operation manual). There are several field QC measures that crews will take to help ensure taking accurate measurements of light penetration.

1. The "deck" sensor must be situated in full sunlight (i.e., out of any shadows).

2. Likewise, the submerged sensor must be deployed from the sunny side of the vessel and care should be taken to avoid positioning the sensor in the shadow of the vessel.

3. For the comparative light readings of deck and submerged sensors, (ratio of ambient vs. submerged), the time interval between readings should be minimized (approximately 1 sec).

Secchi Disk: No field calibration procedures are required for the Secchi disk. QC procedures that crews will implement when using the Secchi disk to make water clarity measurements include designating a specific crew member as the Secchi depth reader; taking all measurements from the shady side of the boat (unlike LICOR measurements which are taken from the sunny side); and not wearing sunglasses or hats while taking Secchi readings.

Underwater Video (Great Lakes only): No field calibration of camera is required but crews should check the equipment prior to each field day to assure that it is operational. Crews will charge the battery regularly.

5.1.4.4 **Data Reporting**

Data reporting units and significant figures are summarized in Table 5.4.

Table 5.4 Data reporting criteria: field measurements.

Measurement	Units	No. Significant Figures	Maximum No. Decimal Places
Dissolved Oxygen	mg/L	2	1
Temperature	°C	2	1
pH	pH units	3	
Conductivity	µS/cm at 25 °C	3	1
Salinity	ppt	2	1
PAR	$mE/m^2/s$	2	1
Depth	meters	3	1
Secchi Depth	meters	3	1

5.1.5 Data Review

Table 5.5 Data Validation Quality Control for In-Situ Indicator.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid
Review data from calibration and field notes	Determine impact and possible limitations on overall usability of data

5.2 Water Chemistry Measurements (Including chlorophyll-*a*)

5.2.1 Introduction

Water chemistry indicators based on field and laboratory methods evaluate estuarine and Great Lake condition with respect to nutrient over-enrichment and eutrophication. Data are collected for a variety of physical and chemical constituents to provide information on the water clarity, primary productivity, and nutrient status. Data are collected for chlorophyll-*a* to provide information on the algal loading and gross biomass of blue-greens and other algae.

5.2.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in NCCA 2020 Field Operation Manual. Detailed laboratory methods are in the NCCA 2020 Laboratory Operations Manual.

5.2.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some state laboratories will analyze the water chemistry samples. The specific quality control procedures used by each laboratory are implemented to ensure that:

- Objectives established for various data quality indicators being met.
- Results are consistent and comparable among all participating laboratories.

The central laboratory demonstrated in previous studies that it can meet the required Laboratory Reporting Levels(RLs) (USEPA 2004). All laboratories will follow the QA/QC procedures outlined in the NCCA 2020 QAPP and the LOM. A summary and diagram of the QA processes related to water chemistry samples for the NCCA 2020 are found in **Figure 5.2**.

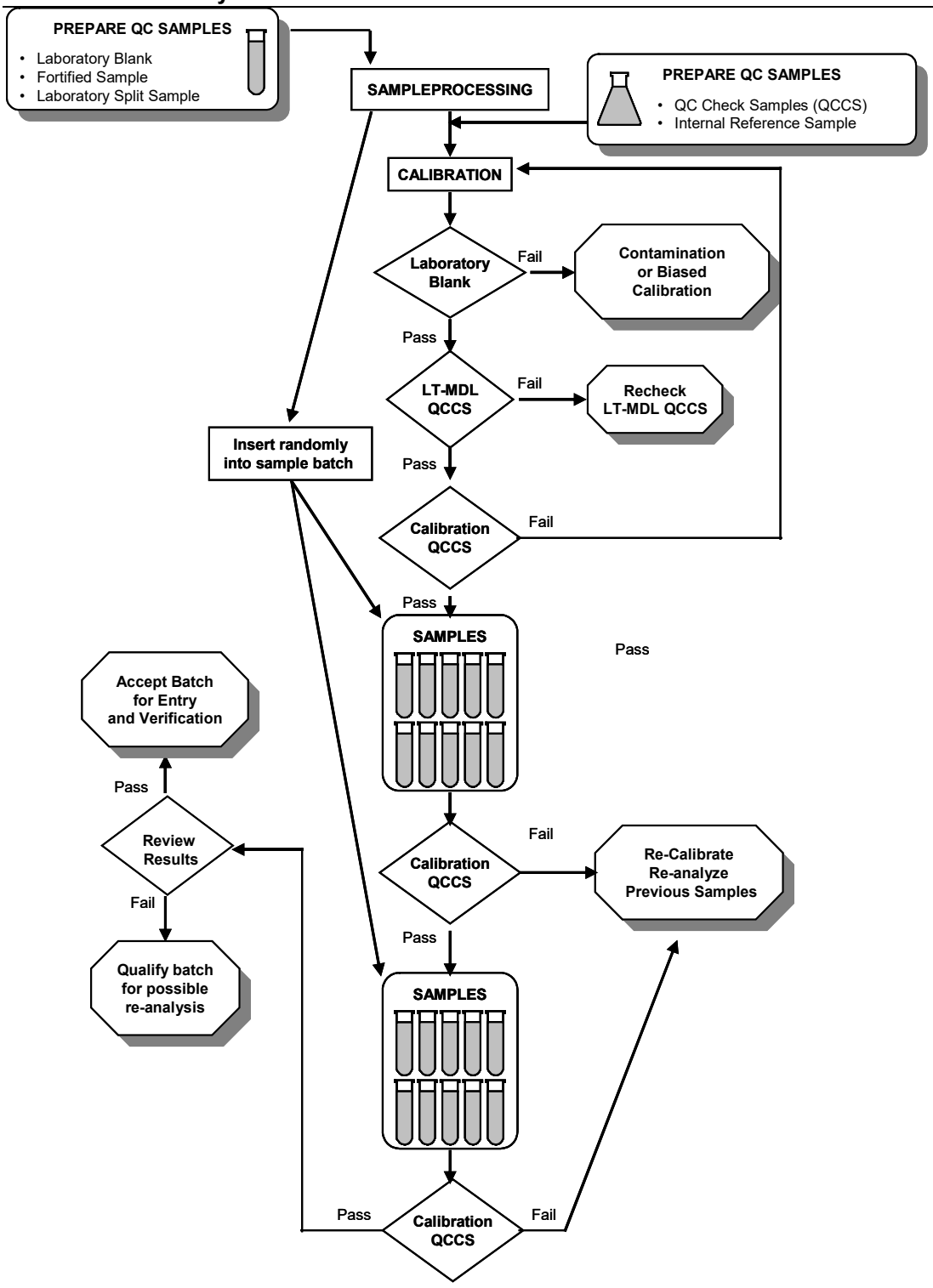

Figure 5.2 Analysis Activities for Water Chemistry Samples

5.2.3.1 Laboratory Performance Requirements

Table 5.6 summarizes the pertinent laboratory measurement data quality objectives for the water chemistry indicators.

Table 5.6 Measurement data quality objectives: water chemistry indicator and chlorophyll *a*.

Parameter	Units	Potential Range of Samples[1]	Method Detection Limit Objective[2]	Transition Value[3]	Precision Objective[4]	Accuracy Objective[5]
Ammonia (NH_3)	mg N/L	0 to 17	marine (0.7 µeq/L) 0.02 freshwater	0.10	± 0.01 or ±10%	± 0.01 or ±10%
Chloride (Cl) (Great Lakes only)	mg Cl/L	0 to 5,000	0.20 (6 µeq/L)	1	± 0.10 or ±10%	± 0.10 or ±10%
Conductivity	µS/cm at 25˚C	1-66,000	1.0	20	±2 or ±10%	±2 or ± 5%
Nitrate-Nitrite (NO_3-NO_2)	mg N/L	0 to 360 (as nitrate)	marine 0.02 freshwater	0.10	± 0.01 or ±10%	± 0.01 or ±10%
pH (Laboratory)	Std Units	3.5-10	N/A	5.75, 8.25	≤5.75 or ≥ 8.25 = ±0.07; 5.75-8.25 = ±0.15	≤5.75 or ≥ 8.25 =±0.15; 5.75-8.25 = ±0.05
Total Nitrogen (TN)	mg N/L	0.1 to 90	0.01	0.10	± 0.01 or ±10%	± 0.01 or ±10%
Total Phosphorous (TP) and ortho-Phosphate	mg P/L	0 to 22 (as TP)	0.002	0.02	± 0.002 or ±10%	± 0.002 or ±10%
Nitrate (NO_3)	mg N/L	0. to 360	marine (10.1 µeq/L) 0.03 freshwater	0.1	± 0.01 or ±5%	± 0.01 or ±5%
Sulfate (SO_4)	mg/L	0 to 5000	0.5 freshwater (10.4 ueq/L)	2.5	±0.25 or ±10%	±0.25 or ±10%
Chlorophyll-*a*	µg/L in extract	0.7 to 11,000	1.5	15	± 1.5 or ±10%	± 1.5 or ±10%

[1] Estimated from samples analyzed at the EPA Western Ecological Division-Corvallis laboratory between 1999 and 2005

[2] The method detection limit is determined as a one-sided 99% confidence interval from repeated measurements of a low-level standard across several calibration curves.

[3] Value for which absolute (lower concentrations) vs. relative (higher concentrations) objectives for precision and accuracy are used.

[4] For duplicate samples, precision is estimated as the pooled standard deviation (calculated as the root-mean square) of all samples at the lower concentration range, and as the pooled percent relative standard deviation of all samples at the higher concentration range. For standard samples, precision is

estimated as the standard deviation of repeated measurements across batches at the lower concentration range, and as percent relative standard deviation of repeated measurements across batches at the higher concentration range.

[5] Accuracy is estimated as the difference between the measured (across batches) and target values of performance evaluation and/or internal reference samples at the lower concentration range, and as the percent difference at the higher concentration range.

5.2.3.2 **Laboratory Quality Control Requirements**

Table 5.7 summarizes the pertinent laboratory quality control samples for the water chemistry indicators.

Table 5.7 Laboratory Quality Control Samples: Water Chemistry Indicator.

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
Demonstrate competency for analyzing water samples to meet the performance measures	All	Demonstration of past experience with water samples in achieving the method detection limits	Once	See LOM	EPA will not approve any laboratory for NCCA sample processing if the laboratory cannot demonstrate competency. In other words, EPA will select another laboratory that can demonstrate competency for its NCCA samples
Check condition of sample when it arrives.	All	Sample issues such as cracked container; missing label; temperature; adherence to holding time requirements; sufficient volume for test.	Once	No sample issues or determination that sample can still be analyzed	Lab determines if the sample can be analyzed or has been too severely compromised (e.g., contamination). Assign appropriate condition code identified in the LOM
Store sample appropriately.	All	Check the temperature of the	Record temperature of sample upon	While stored at the laboratory, the	If at any time samples are warmer than

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
		refrigerator per laboratory's standard operating procedures	arrival at the laboratory. Check temperature of the refrigerator/freezer where samples are stored at least daily if using a continuous temperature logger and twice daily (once at beginning of the day and once at the end) not using a continuous logger	sample must be kept at a maximum temperature of 4° C. (for aliquots except chlorophyll *a*) and -20° C for the chlorophyll *a* sample	required, note temperature and duration (either from the continuous temperature log or from the last manual reading) in comment field. Lab will still perform test. EPA expects that the laboratory will exercise every effort to maintain samples at the correct temperature
Analyze sample within holding time	All			The test must be completed within the holding time specified in the analytical method	Perform test in all cases, but note reason for performing test outside holding time. EPA expects that the laboratory will exercise every effort to perform tests before the holding time expires
Analyze Laboratory/ Reagent Blank	All		Once per day prior to sample analysis	Control limits ≤MDL	Prepare and analyze new blank. Determine and correct problem (e.g., reagent contamination, instrument calibration, or contamination introduced during filtration) before proceeding with

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
					any sample analyses. Reestablish statistical control by analyzing three blank samples
Analyze Filtration Blank	All dissolved analytes	ASTM Type II reagent water processed through filtration unit	Prepare once per week and archive Prepare filter blank for each box of 100 filters, and examine the results before any other filters are used from that box	Measured concentrations <MDL	Measure archived samples if review of other laboratory blank information suggest source of contamination is sample processing
Determine LT-MDL Limit for Quality Control Check Sample (QCCS)	All	Prepared so concentration is four to six times the LT-MDL objective	Once per day	Target LT-MDL value (which is calculated as a 99% confidence interval)	Confirm achieved LRL by repeated analysis of LT-MDL QCCS. Evaluate affected samples for possible re-analysis
Analyze Calibration QCCS	All		Before and after sample analyses	±10% or method criteria	Repeat QCCS analysis. Recalibrate and analyze QCCS. Reanalyze all routine samples (including PE and field replicate samples) analyzed since the last acceptable QCCS measurement
Analyze Laboratory Duplicate Sample	All		One per batch	Control limits < precision objective	If results are below LRL: Prepare and analyze split from different

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
					sample (volume permitting). Review precision of QCCS measurements for batch. Check preparation of split sample. Qualify all samples in batch for possible reanalysis
Analyze Standard Reference Material (SRM)	When available for a particular indicator		One analysis in a minimum of five separate batches	Manufacturers certified range	Analyze standard in next batch to confirm suspected inaccuracy. Evaluate calibration and QCCS solutions and standards for contamination and preparation error. Correct before any further analyses of routine samples are conducted. Reestablish control by three successive reference standard measurements that are acceptable. Qualify all sample batches analyzed since the last acceptable reference

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
					standard measurement for possible reanalysis
Analyze Matrix Spike Samples	Only prepared when samples with potential for matrix interferences are encountered		One per batch	Control limits for recovery cannot exceed 100±20%	Select two additional samples and prepare fortified subsamples. Reanalyze all suspected samples in batch by the method of standard additions. Prepare three subsamples (unfortified, fortified with solution approximately equal to the endogenous concentration, and fortified with solution approximately twice the endogenous concentration)
Use consistent units for QC samples and field samples	All	Verify that all units are provided consistently within each indicator	Data reporting	For each indicator, all field and QC samples are reported with the same measurement units	If it is not possible to provide the results in consistent units, then assign a QC code and describe the reason for different units in the comments field of the database
Maintain completeness	All	Determine completeness	Data reporting	Completeness objective is 95% for all indicators (useable with	Contact EPA HQ NCCA Laboratory Review Coordinator*

QC Sample Type and Description	Indicators	Description	Frequency	Acceptance Criteria	Corrective Action
				or without flags)	immediately if issues affect laboratory's ability to meet completeness objective

*Chapter 2 of the LOM provides contact information for the EPA HQ NCCA Laboratory Review Coordinator. Laboratories under contract to EPA must contact the Task Order's Contracting Officer's Representative (TOCOR) instead of the Laboratory Review Coordinator.

5.2.3.3 **Data Reporting**

Data reporting units and significant figures are summarized in Table 5.8

Table 5.8 Data Reporting Criteria: Water Chemistry Indicator

Measurement	Units	No. Significant Figures	Maximum No. Decimal Places
Total phosphorus	mg P/L	3	3
Total nitrogen	Mg N/L	3	2
Nitrate-Nitrite	mg/L as N	3	2
Ammonia	mg/L as N	3	2
Chlorophyll-a	µg/L	2	1
pH (laboratory)	pH units	3	2
Conductivity (Laboratory)	µS/cm at 25 °C	3	1

5.2.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact.

Before leaving the field, the crews will:

- Check all labels to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the labels, covering the label completely.

- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the CHEM and NUTS indicators on wet ice in a cooler. Maintain CHLA filters frozen until shipping on wet ice.
- Recheck all forms and labels for completeness and legibility.

5.2.4.1 Field Performance Requirements

Not Applicable

5.2.4.2 Field Quality Control Requirements

See Table 5.9 and Table 5.10 for quality control activities and corrective actions.

Table 5.9 Sample field processing quality control activities: water chemistry indicator (CHEM).

Quality Control Activity	Description and Requirements	Corrective Action
Water Chemistry Container and Preparation	Rinse collection bottles 3x with ambient water before collecting water samples.	Discard sample. Rinse bottle and refill.
Sample Storage	Store samples in darkness at 4°C. Ship on wet ice within 24 hours of collection.	Qualify sample as suspect for all analyses.

Table 5.10 Sample field processing quality control: chlorophyll–a (CHLA) and dissolved nutrient (NUTS) indicators

Quality Control Activity	Description and Requirements	Corrective Action
Chlorophyll-a Containers and Preparation	Rinse collection bottles 3x with ambient water before collecting water samples.	Discard sample. Rinse bottle and refill.
Holding Time	Complete filtration of chlorophyll-a after all water samples are collected.	Qualify samples

Filtration (done in field)	Use Whatman 0.7 µm GF/F filter. Filtration pressure should not exceed 3.4 psig to avoid rupture of fragile algal cells. Rinse sample bottle for dissolved nutrient (NUTS) 3x with 10-20 mL of filtrate before collecting 250 mL of filtrate for analysis.	Discard and refilter
Sample Storage	CHLA: Filters are placed in centrifuge tube wrapped in foil square and stored on dry ice in field. NUTS: Filtrate is stored on wet ice in field. CHLA and NUTS are shipped within 24 hours of collection on wet ice along with water chemistry (CHEM).	Qualify sample as suspect for all analyses.

5.2.5 Data Review

Checks made of the data in the process of review and verification are summarized in Table 5.11**.** The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.11 Data Validation Quality Control for Water Chemistry Indicator.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review holding times	Qualify value for additional review
Review data from QA samples (laboratory PE samples, and interlaboratory comparison samples)	Determine impact and possible limitations on overall usability of data

5.3 Cylindrospermopsin

5.3.1 Introduction

Crews will collect a water sample at the index site to measure concentrations of total Cylindrospermopsin, an algal toxin.

5.3.2 Sample Design and Methods

Detailed sample collection and handling procedures are found in the NCCA 2020 Field Operations Manual. Detailed laboratory methods are in the NCCA 2020 Laboratory Operations Manual.

5.3.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some State laboratories will analyze the Cylindrospermopsin samples. The specific quality control procedures used by each laboratory are implemented to ensure that:

- Objectives established for various data quality indicators are being met.
- Results are consistent and comparable among all participating laboratories.

All laboratories will follow the procedures outlined in the NCCA 2020 QAPP and the LOM.

5.3.3.1 Laboratory Performance Requirements

Performance requirements for the Cylindrospermopsin indicator are listed in Table 5.12.

Table 5.12 Measurement Quality Objectives for Cylindrospermopsin.

Parameter	Units	Method Detection Limit Objective	Reporting Limit Objective
Cylindrospermopsin, undiluted samples with salinities <8 part per thousand (ppt)	µg/L	0.05	0.10
Cylindrospermopsin, undiluted samples with salinity ≥8 ppt must dilute 1:5 prior to running the kit	µg/L	0.05	Will vary

5.3.3.2 Laboratory Quality Control Requirements

Quality control requirements for the Cylindrospermopsin indicator are listed in Table 5.13. Sample receipt and other processing requirements are listed in Table 5.14.

Table 5.13 Sample analysis quality control activities and objectives for Cylindrospermopsin

Quality Control Activity	Description and Requirements	Corrective Action
Kit – Shelf Life	Is within its expiration date listed on kit box.	If kit has expired, then discard or set aside for training activities.
Kit – Contents	All required contents must be present and in acceptable condition. This is important	If any bottles are missing or damaged, discard the kit.

	because Abraxis has calibrated the standards and reagents separately for each kit.	
Calibration	All of the following must be met: Standard curve must have a correlation coefficient of ≥0.99; Average absorbance value, $\bar{A}_0$, for S0 must be ≥0.80; and Standards S0-S6 must have decreasing average absorbance values. That is, if $\bar{A}_i$ is the average of the absorbance values for S_i, then the absorbance average values must be: $\bar{A}_0 > \bar{A}_1 > \bar{A}_2 > \bar{A}_3 > \bar{A}_4 > \bar{A}_5 > \bar{A}_6$	If any requirement fails: Results from the analytical run are not reported. All samples in the analytical run are reanalyzed until calibration provides acceptable results. At its discretion, the laboratory may consult with USEPA for guidance on persistent difficulties with calibration.
Kit Control	The average concentration value of the duplicates (or triplicate) must be within the range of 0.75 +/- 0.15 µg/L. That is, results must be between 0.60 and 0.90.	If either requirement fails: Results from the analytical run are not reported The laboratory evaluates its processes, and if appropriate, modifies its processes to correct possible contamination or other problems. The laboratory reanalyzes all samples in the analytical run until the controls meet the requirements.
Negative Control	The values for the negative control replicates must meet the following requirements: All concentration values must be < 0.1 µg/L (i.e., the reporting limit); and One or more concentration results must be nondetectable (i.e., <0.05 µg/L)	
Sample Evaluations	All samples are run in duplicate. Each duplicate pair must have %CV≤15% between its absorbance values.	If %CV of the absorbance for the sample>15%, then: Record the results for both duplicates using different start dates and/or start times to distinguish between the runs. Report the data for both duplicate results using Quality Control Failure flag “QCF”; and

		Re-analyze the sample in a new analytical run. **No samples are to be run more than twice.** If the second run passes, then the data analyst will exclude the data from the first run (which will have been flagged with "QCF"). If both runs fail, the data analyst will determine if either value should be used in the analysis (e.g., it might be acceptable to use data if the CV is just slightly over 15%).
Results Within Calibration Range	All samples are run in duplicate. If both of the values are less than the upper calibration range (i.e., 2.0 µg/L for undiluted samples), then the requirement is met.	If a result registers as "HIGH", then record the result with a data flag of "HI." If one or both duplicates register as 'HIGH,' then the sample must be diluted and re-run. **No samples are to be run more than twice.** If samples are re-run, do not enter concentration information of the first run.
External Quality Control Sample	External QC Coordinator, supported by QC contractor, provides 1-2 sets of identical samples to all laboratories and compares results.	Based upon the evaluation, the External QC Coordinator may request additional information from one or more laboratories about any deviations from the method or unique laboratory practices that might account for differences between the laboratory and others. With this additional information, the External QC Coordinator will determine an appropriate course of action, including no action, flagging the data, or excluding some or all of the laboratory's data.

Table 5.14 Sample receipt and processing quality control: Cylindrospermopsin indicator indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Sample Log-in	Upon receipt of a sample shipment, record receipt of samples in the NARS IM system (within 24 clock hours) and the laboratory's Information Management System (LIMS).	Discrepancies, damaged, or missing samples are reported to the EPA HQs Laboratory QA Coordinator
Sample condition upon receipt	Sample issues such as cracked container; missing label; temperature (frozen); adherence to holding time requirements; sufficient volume for test.	Qualify samples

Sample Storage	Store sample frozen	Qualify samples
Holding time	Frozen samples can be stored for several months.	Qualify samples

5.3.3.3 Data Reporting

Data reporting units and significant figures are summarized in Table 5.15.

Table 5.15 Data Reporting Criteria: Cylindrospermopsin Indicator.

Measurement	Units	No. Significant Figures	Maximum No. Decimal Places
Cylindrospermopsin	ug/L	3	3

5.3.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect a single water sample for Cylindrospermopsin analyses. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact. While in the field, the crew will store samples in a cooler on ice and will then freeze the sample upon returning to the base site (hotel, lab, office). Before leaving the field, the crews will:

- Check all labels to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the labels, covering the label completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sample on ice in field.
- Recheck all forms and labels for completeness and legibility.

5.3.4.1 Field Performance Requirements

Not Applicable.

5.3.4.2 Field Quality Control Requirements

See Table 5.16 for quality control activities and corrective actions.

Table 5.16 Sample field processing quality control: Cylindrospermopsin indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Holding time	Hold sample on wet ice and freeze immediately upon return to the base site (hotel, lab, office) and keep frozen until shipping	Qualify samples
Sample Storage	Store samples in darkness and frozen (-20 °C) Monitor temperature daily	Qualify sample as suspect

5.3.5 Data Review

Checks made of the data in the process of review and verification are summarized in Table 5.17**.** The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.17 Data Validation Quality Control for Cylindrospermopsin Indicator.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review holding times	Qualify value for additional review
Review data from QA samples (laboratory PE samples, and interlaboratory comparison samples)	Determine impact and possible limitations on overall usability of data

5.4 Microcystins

5.4.1 Introduction

Crews will collect a water sample at the index site to measure concentrations of total microcystins, an algal toxin.

5.4.2 Sample Design and Methods

Detailed sample collection and handling procedures are found in the NCCA 2020 Field Operations Manual. Detailed laboratory methods are in the NCCA 2020 Laboratory Operations Manual.

5.4.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some State laboratories will analyze the microcystins samples. The specific quality control procedures used by each laboratory are implemented to ensure that:

- Objectives established for various data quality indicators are being met.
- Results are consistent and comparable among all participating laboratories.

All laboratories will follow the procedures outlined in the NCCA 2020 QAPP and the LOM.

5.4.3.1 Laboratory Performance Requirements

Performance requirements for the microcystins indicator are listed in Table 5.18**.**

Table 5.18 Measurement Quality Objectives for Microcystins.

Parameter	Units	Method Detection Limit Objective	Reporting Limit Objective
Microcystins, undiluted samples with salinities <3.5 part per thousand (ppt)	µg/L	0.1	0.15
Microcystins, undiluted samples with salinity greater than or equal to 3.5 ppt	µg/L	0.175	0.263
Microcystins, diluted samples with salinities <3.5 ppt	µg/L	0.1 times the dilution factor	Will vary
Microcystins, diluted samples with salinity greater than or equal to 3.5 ppt	µg/L	1.75 times the dilution factor	Will vary

5.4.3.2 Laboratory Quality Control Requirements

Quality control requirements for the microcystins indicator are listed in Table 5.19**.** Sample receipt and other processing requirements are listed in Table 5.20.

Table 5.19 Sample analysis quality control activities and objectives for microcystins

Quality Control Activity	Description and Requirements	Corrective Action
Kit – Shelf Life	Is within its expiration date listed on kit box.	If kit has expired, then discard or clearly label as expired and set aside for training activities.
Kit - Contents	All required contents must be present and in acceptable condition. This is important because Abraxis has calibrated the standards and reagents separately for each kit.	If any bottles are missing or damaged, discard the kit.

Calibration	All of the following must be met: Standard curve must have a correlation coefficient of ≥0.99; Average absorbance value, $\bar{A}_0$, for S0 must be ≥0.80; and Standards S0-S5 must have decreasing average absorbance values. That is, if $\bar{A}_i$ is the average of the absorbance values for S_i, then the absorbance average values must be: $\bar{A}_0 > \bar{A}_1 > \bar{A}_2 > \bar{A}_3 > \bar{A}_4 > \bar{A}_5$	If any requirement fails: Results from the analytical run are not reported. All samples in the analytical run are reanalyzed until calibration provides acceptable results.
Kit Control	The average concentration value of the duplicates must be within the range of 0.75 +/- 0.185 µg/L. That is, the average must be between 0.565 µg/L and 0.935 µg/L.	If either requirement fails: Results from the analytical run are not reported The lab evaluates its processes, and if appropriate, modifies its processes to correct possible contamination or other problems. The lab reanalyzes all samples in the analytical run until the controls meet the requirements. At its discretion, the lab may consult with EPA for guidance on persistent difficulties with calibration.
Negative Control	The values for the negative control replicates must meet the following requirements: All concentration values must be < 0.15 µg/L (i.e., the reporting limit; and one or more concentration results must be nondetectable (i.e., <0.10 µg/L)	
Sample Evaluations	All samples are run in duplicate. Each duplicate pair must have %CV≤15% between its absorbance values.	If %CV of the absorbances for the sample>15%, then: Record the results for both duplicates using different start dates and/or start times to distinguish between the runs. Report the data for both duplicate results using the Quality Control Failure flag “QCF”; and re-analyze the sample in a new analytical run. No samples are to be run more than twice. If the second run passes, then the data analyst will exclude the data from the first run (which will have been flagged with “QCF”). If both runs fail, the data analyst will determine if either value should be used in the analysis (e.g., it might be acceptable to use data if the CV is just slightly over 15%).
Results Within Calibration Range	All samples are run in duplicate. If both of the values are less than the upper calibration range (i.e., ≤ 5.0 µg/L for undiluted samples with salinity <3.5 ppt; ≤ 8.75 µg/L for undiluted samples with salinity ≥3.5 ppt), then the requirement is met.	If a result registers as ‘HIGH’, then record the result with a data flag of “HI.” If one or both duplicates register as ‘HIGH,’ then the sample must be diluted and re-run until both results are within the calibration range. No samples are to be run more than twice. The lab

		reports both the original and diluted sample results.
External Quality Control Sample	External QC Coordinator, supported by QC contractor, provides 1-2 sets of identical performance testing samples to all laboratories and compares results.	Based upon the evaluation, the External QC Coordinator may request additional information from one or more laboratories about any deviations from the method or unique laboratory practices that might account for differences between the laboratory and others. With this additional information, the External QC Coordinator will determine an appropriate course of action, including no action, flagging the data, or excluding some or all of the laboratory's data.

Table 5.20 Sample receipt and processing quality control: microcystins indicator indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Sample Log-in	Upon receipt of a sample shipment, record receipt of samples in the NARS IM system (within 24 clock hours) and the laboratory's Information Management System (LIMS).	Discrepancies, damaged, or missing samples are reported to the EPA HQs Laboratory QA Coordinator
Sample condition upon receipt	Sample issues such as cracked container; missing label; temperature (frozen); adherence to holding time requirements; sufficient volume for test.	Qualify samples
Sample Storage	Store sample frozen	Qualify samples
Holding time	Frozen samples can be stored for several months.	Qualify samples

5.4.3.3 Data Reporting

Data reporting units and significant figures are summarized in Table 5.21.

Table 5.21 Data Reporting Criteria: Microcystins Indicator.

Measurement		Units	No. Significant Figures	Maximum No. Decimal Places
Microcystins		ug/L	3	3

5.4.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect a single water sample for microcystins analyses. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact. While in the field, the crew will store samples in a cooler on ice and will then freeze the sample upon returning to the base site (hotel, lab, office). Before leaving the field, the crews will:

- Check all labels to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the labels, covering the labels completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sample on ice in field.
- Recheck all forms and labels for completeness and legibility.

5.4.4.1 Field Performance Requirements

Not Applicable.

5.4.4.2 Field Quality Control Requirements

See Table 5.22 for quality control activities and corrective actions.

Table 5.22 Sample field processing quality control: microcystins indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Holding time	Hold sample on wet ice and freeze immediately upon return to the base site (hotel, lab, office) and keep frozen until shipping	Qualify samples
Sample Storage	Store samples in darkness and frozen (-20 °C) Monitor temperature daily	Qualify sample as suspect

5.4.5 Data Review

Checks made of the data in the process of review and verification are summarized in Table 5.23. The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.23 Data Validation Quality Control for Microcystins Indicator.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review holding times	Qualify value for additional review
Review data from QA samples (laboratory PE samples, and interlaboratory comparison samples)	Determine impact and possible limitations on overall usability of data

5.5 Benthic Invertebrates

5.5.1 Introduction

The Benthic invertebrates inhabit the sediment (infauna) or live on the bottom substrates or aquatic vegetation (epifauna) of coastal areas. The response of benthic communities to various stressors can often be used to determine types of stressors and to monitor trends (Klemm et al., 1990). The overall objectives of the benthic invertebrate indicators are to detect stresses on community structure in National coastal waters and to assess and monitor the relative severity of those stresses. The benthic invertebrate indicator procedures are based on various recent bioassessment litrature (Barbour et al. 1999, Hawkins et al. 2000, Klemm et al. 2003), previous coastal surveys (US EPA 2001C, US EPA 2004A, US EPA 2008,), and the procedures used in NCCA 2010, and 2015.

5.5.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in the NCCA 2020 Field Operations Manuals. Detailed information on the benthic processing procedure are described in the NCCA 2020 Laboratory Operations Manual.

5.5.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some State laboratories will analyze the benthic invertebrate samples. The specific quality control procedures used by each laboratory are implemented to ensure that:

- Objectives established for various data quality indicators are being met.
- Results are consistent and comparable among all participating laboratories.

All laboratories will follow the procedures outlined in the NCCA 2020 QAPP and the LOM.

For the NCCA 2020, laboratories and EPA will implement quality control in three primary ways. First, laboratories will conduct internal QC for sorters as described in the LOM (10% of all samples [minimum of 1] completed per sorter). Second, laboratories will conduct internal QC for taxonomists identifying benthic invertebrates as described in the LOM (1 in 10 samples per taxonomist). Finally, EPA will randomly select 10% of samples for identification by an independent, external taxonomist as described in the LOM (10% of all samples completed by each laboratory).

5.5.3.1 Laboratory Performance Requirements

Measurement quality objectives (MQOs) are given in Table 5.24**.** General requirements for comparability and representativeness are addressed in Section 2. Precision is calculated as percent efficiency, estimated from examination of randomly selected sample residuals by a second analyst and independent identifications of organisms in randomly selected samples. The MQO for sorting and picking accuracy is estimated from examinations (repicks) of randomly selected residues by an experienced QC Sorter.

Equation 5.1 Percent sorting efficiency (PSE)
Number of organisms found by the sorter (A) compared to the combined (total) number of organisms found by the sorter (A) and the number recovered by the QC Officer (B) from Sorter A's pickate for a sample. PSE should be ≥90%.

- $$PSE = \frac{A}{A+B} \times 100$$

Equation 5.2 Percent disagreement in enumeration (PDE)
Measure of taxonomic precision comparing the number of organisms, n_1, counted in a sample by the primary taxonomist with the number of organisms, n_2, counted by the internal or external QC taxonomist. PDE should be ≤5%.

$$PDE = \frac{|n_1 - n_2|}{n_1 + n_2} \times 100$$

Equation 5.3 Percent taxonomic disagreement (PTD)

Measure of taxonomic precision comparing the number of agreements (positive comparisons, $comp_{pos}$) of the primary taxonomist and internal or external QC taxonomists. In the following equation, *N* is the total number of organisms in the larger of the two counts. PTD should be ≤15%.

$$PTD = \left[1 - \left(\frac{comp_{pos}}{N}\right)\right] \times 100$$

Table 5.24 Benthic Macroinvertebrates: Measurement Data Quality Objectives

Variable or Measurement	Precision	Accuracy
Sort and Pick	90% [a]	90% [a]
Identification	85% [b]	95% [c]

NA = not applicable; [a] As measured by PSE; [b] As measured by (100%-PTD); [c] As measured by (100%-PDE)

5.5.3.2 Laboratory Quality Control Requirements

Quality Control Requirements for the benthic invertebrate indicator are provided in Table 5.25 and Table 5.26**.**

Table 5.25 Benthic Macroinvertebrates: Laboratory quality control

Check or Sample Description	Frequency	Acceptance Criteria	Corrective Action
SAMPLE PROCESSING AND SORTING			
Sample pickate examined by another sorter	10% of all samples (minimum of 1) completed per sorter	PSE ≥ 90%	If < 90%, examine all residuals of samples by that sorter and retrain sorter
IDENTIFICATION			
Duplicate identification by Internal Taxonomy QC Officer	1 in 10 samples per taxonomist,	PTD ≤15%	If PTD >15%, reidentify all samples completed by that taxonomist since last meeting the acceptance criteria, focusing on taxa of concern
Independent identification by outside, expert, taxonomist	All uncertain taxa	Uncertain identifications to be confirmed by expert in particular taxa	Record both tentative and independent IDs
External QC	10% of all samples completed per laboratory	PDE ≤ 5% PTD ≤ 15%	If PDE > 5%, implement recommended corrective actions. If PTD > 15%, implement recommended corrective actions.

Use of widely/commonly accepted taxonomic references by all NCCA labs	For all identifications	All keys and references used by each lab must be on bibliography prepared by one or more additional NCCA labs. This requirement demonstrates the general acceptance of the references by the scientific community.	If a lab proposes to use other references, the lab must obtain prior permission from External QC Officer before submitting the data with the identifications based upon the references.
Prepare reference collection[2]	Each new taxon per laboratory	Complete reference collection to be maintained by each individual laboratory	Internal Taxonomy QC Officer periodically reviews data and reference collection to ensure reference collection is complete and identifications are accurate
DATA VALIDATION			
Taxonomic "reasonableness" checks	All data sheets	Taxa known to occur for coastal waters or Great Lakes.	Second or third identification by expert in that taxon

Table 5.26 Sample receipt and processing quality control: benthic invertebrate indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Sample Log-in	Upon receipt of a sample shipment, record receipt of samples in the NARS IM system (within 24 clock hours) and the laboratory's Information Management System (LIMS).	Discrepancies, damaged, or missing samples are reported to the EPA HQs Laboratory QA Coordinator
Sample condition upon receipt	Sample issues such as cracked container; missing label; preservation.	Qualify samples
Sample Storage	Store benthic samples in a cool, dark place.	Qualify sample as suspect for all analyses
Preservation	Transfer storage to 70% ethanol for long term storage	Qualify samples
Holding time	Preserved samples can be stored indefinitely; periodically check jars and change the ethanol if sample material appears to be degrading.	Qualify samples

[2] If requested, EPA can return reference collection materials and/or other sample materials.

5.5.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 Field Operations Manuals. That quality is enhanced by the training and experience of project staff and documentation of sampling activities. Field Crews enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.

Before leaving the field, the crews will:

- Check the labels to ensure that all written information is complete and legible.
- Ensure the waterproof benthic infauna labels placed inside the jar contain the pertinent information (including the sample ID and jar number).
- Place a strip of clear packing tape over the labels, covering the labels completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Preserve the sample with formalin.
- Recheck all forms and labels for completeness and legibility.

5.5.4.1 Field Performance Requirements

Not Applicable

5.5.4.2 Field Quality Control Requirements

Specific quality control measures are listed in Table 5.27 for field quality control requirements.

Table 5.27 Sample Collection and Field Processing Quality Control: Benthic Invertebrate Indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels	Obtain replacement supplies
Sample Processing (field)	Use 0.5 mm mesh sieve. Preserve with ten percent buffered formalin. Fill jars no more than 1/2 full of material to reduce the chance of organisms being damaged.	Discard and recollect sample
Sample Storage (field)	Store benthic samples in a cool, dark place until shipment to analytical lab	Discard and recollect sample
Holding time	Preserved samples can be stored indefinitely; periodically check jars and change the ethanol (change from formalin to ethanol for long term	Change ethanol

	storage) if sample material appears to be degrading.[3]	
Preservation	Transfer storage to 70% ethanol for long term storage	Qualify samples

5.5.5 Data Review

Checks made of the data in the process of review and verification is summarized in Table 5.28. The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.28 Data Validation Quality Control for Benthic Macroinvetebrates.

Activity or Procedure	Requirements and Corrective Action
Review data and reports from Laboratories	Determine impact and possible limitations on overall usability of data
Review data and reports from External QC Coordinator	Determine impact and possible limitations on overall usability of data
Review taxonomic names and spellings	Correct and qualify

5.6 Sediment Contaminants, Total Organic Carbon (TOC) and Grain Size

5.6.1 Introduction

Field crews will collect sediment grabs for chemical contaminant analyses (organics/metals), TOC and grain size determination.

5.6.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in the NCCA 2020 Field Operations Manual. Detailed laboratory methods are in the NCCA 2020 Laboratory Operations Manual.

5.6.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some State laboratories will analyze the sediment contaminants, TOC and grain size samples. The specific quality control procedures used by each laboratory are implemented to ensure that:

[3] In most cases, crews will ship samples to the batch lab within 2 weeks, so long-term storage will not be an issue for field crews.

- Objectives established for various data quality indicators being met.
- Results are consistent and comparable among all participating laboratories.

All laboratories will follow the QA/QC procedures outlined in the NCCA QAPP and the LOM.

5.6.3.1 Laboratory Performance Requirements

The laboratory shall perform analysis of the sediment samples to determine the moisture content, grain size, and concentrations of TOC, metals, pesticides, PAHs, and PCBs.

To demonstrate its competency in analysis of sediment samples, the laboratory shall provide analyte and matrix specific information to EPA. EPA will accept one or more of the following as a demonstration of competency:

- Memorandum that identifies the relevant services that the laboratory provided for the National Aquatic Resource Surveys in the past five years.
- Documentation detailing the competency of the organization, including professional certifications for water-related analyses, membership in professional societies, and experience with analyses that are the same or similar to the requirements of this method.
- Demonstration of competency with sediment samples in achieving the method detection limits, accuracy, and precision targets.

To demonstrate its competency in quality assurance and quality control procedures, the organization shall provide EPA with copies of the quality-related documents relevant to the procedure. Examples include Quality Management Plans (QMP), QAPPs, and applicable Standard Operating Procedures (SOPs). To demonstrate its ongoing commitment to quality assurance, the person in charge of quality issues for the organization shall sign the NCCA QAPP Certification Page.

Precision and accuracy objectives are identified in Table 5.29. Table 5.30 identifies the storage requirements. Laboratories may choose to use any analysis method, including those in Table 5.30, which measures the parameters to the levels of the method detection limits identified in Table 5.31.

Table 5.29 Sediment Contaminants, Grain size and TOC: Precision and Accuracy Objectives

Parameter	Precision Objective (measured by)	Accuracy Objective (measured by)
All Contaminants	30% (RPD between MS and MSD)	20% (average %Rs between MS and MSD)
TOC	10% (RPD between duplicates)	10% (CRM)
Grain Size	10% (LCS)	Not Applicable

*** RPD=Relative Percent Difference; %Rs=%Recovery; MS=Matrix Spike; MSD=Matrix Spike Duplicate; CRM=Certified Reference Material; LCS=Lab Control Sample.**

Table 5.30 Sediment Contaminants, Grain Size, and TOC: Analytical Methods

Storage Requirements	Type	Methods that Meet the QA/QC Requirements (any method that meets the QA/QC requirements is acceptable)
Freeze samples to a temperature ≤ -20° C	Metals (except Mercury)	Extraction: EPA Method 3051A Analysis: EPA Method 6020A[4]
	Mercury	EPA Method 245.7[5]
	PCBs, Pesticides, PAHs	Extraction: EPA Method 3540C Analysis: EPA Method 8270D[6]
	TOC	USEPA Method 9060
Refrigerate at 4° C (do not freeze)	Grain Size	Any method that reports the determination as percent silt, sand and clay and meets QA/QC requirements

[4] For example, see:
- Method 3051A "Microwave Assisted Acid Digestion of Sediments, Sludges, Soils, And Oils" retrieved November 13, 2018 from https://www.epa.gov/sites/production/files/2015-12/documents/3051a.pdf ; and
- Method 6020A "Inductively Coupled Plasma-Mass Spectrometry" retrieved April 28, 2018 from https://www.epa.gov/sites/production/files/2015-07/documents/epa-6020a.pdf.

[5] For example, see Method 245.7 "Mercury in Water by Cold Vapor Atomic Fluorescence Spectrometry, Revision 2.0" (EPA-821-R-05-001, February 2005), retrieved March 13, 2019 from https://www.nemi.gov/methods/method_summary/9629/.

[6] For example, see:
- Method 3540C "Soxhlet Extraction" retrieved June 27, 2014 from https://www.epa.gov/sites/production/files/2015-12/documents/3540c.pdf; and
- Method 8270D "Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) retrieved March 13, 2019 from https://www.epa.gov/sites/production/files/2015-07/documents/epa-8270d.pdf

Table 5.31 Sediment Contaminants, Grain Size, and TOC: Required Parameters.

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
	% silt, % sand, % clay		Grain Size			0.05%	0.05		10% (LCS)
	mg/kg or %		Total Organic Carbon		54.5	0.01%	0.02%	10%	10%
METAL	dry weight µg/g, (ppm)	7429-90-5	Aluminum		162000	1500	5	20	30
		7440-36-0	Antimony		38.1	0.2	0.05	20	30
		7440-38-2	Arsenic		147.61	1.5	0.05	20	30
		7440-43-9	Cadmium		9.9	0.05	0.005	20	30
		7440-47-3	Chromium		1078.78	5	0.005	20	30
		7440-50-8	Copper		2290	5	0.005	20	30
		7439-89-6	Iron		169000	500	5	20	30
		7439-92-1	Lead		461	1	0.005	20	30
		7439-96-5	Manganese		6587.02	1	0.01	20	30
		7439-97-6	Mercury		3.12	0.01	0.00002	20	30
		7440-02-0	Nickel		360.17	1	0.02	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		7782-49-2	Selenium		121.019	0.1	0.05	20	30
		7440-22-4	Silver		35.34	0.3	0.02	20	30
		7440-31-5	Tin		258	0.1	0.05	20	30
		7440-62-2	Vanadium		4734	1	0.05	20	30
		7440-66-6	Zinc		1750	2	0.05	20	30
PCB	dry weight ng/g, (ppb)	2051-24-3	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	209	22.4	1	5	20	30
		34883-43-7	2,4'-Dichlorobiphenyl	8	10.7	1	5	20	30
		35065-30-6	2,2',3,3',4,4',5-Heptachlorobiphenyl	170	115.4	1	5	20	30
		52663-68-0	2,2',3,4',5,5',6-Heptachlorobiphenyl	187	56.8	1	5	20	30
		35065-29-3	2,2',3,4',5,5',6-Heptachlorobiphenyl	180	249.4	1	5	20	30
		38380-07-3	2,2',3,3',4,4'-Hexachlorobiphenyl	128	61.3	1	5	20	30
		35065-28-2	2,2',3,4,4',5'-Hexachlorobiphenyl	138	362	1	5	20	30
		35065-27-1	2,2',4,4',5,5'-Hexachlorobiphenyl	153	168.7	1	5	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		40186-72-9	2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	206	75.5	1	5	20	30
		52663-78-2	2,2',3,3',4,4',5,6-Octachlorobiphenyl	195	40	1	5	20	30
		32598-14-4	2,3,3',4,4'-Pentachlorobiphenyl	105	78.2	1	5	20	30
		37680-73-2	2,2',4,5,5'-Pentachlorobiphenyl	101	256	1	5	20	30
		31508-00-6	2,3,4,4',5-Pentachlorobiphenyl	118	201	1	5	20	30
		38380-03-9	2,3,3',4,6'-Pentachlorobiphenyl	110	249	1	5	20	30
		57465-28-8	3,3',4,4',5-Pentachlorobiphenyl	126	3.5	1	5	20	30
		41464-39-5	2,2',3,5'-Tetrachlorobiphenyl	44	54.3	1	5	20	30
		32598-13-3	3,3',4,4'-Tetrachlorobiphenyl	77	8.8	1	5	20	30
		35693-99-3	2,2',5,5'-Tetrachlorobiphenyl	52	123	1	5	20	30
		32598-10-0	2,3',4,4'-Tetrachlorobiphenyl	66	36.6	1	5	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		37680-65-2	2,2',5-Trichlorobiphenyl	18	18.4	1	5	20	30
		7012-37-5	2,4,4'-Trichlorobiphenyl	28	39.5	1	5	20	30
PEST	dry weight ng/g, (ppb)	53-19-0	2,4'-DDD		10.2	1	5	20	30
		3424-82-6	2,4'-DDE		6.4	1	5	20	30
		789-02-6	2,4'-DDT		114.1	1	5	20	30
		72-54-8	4,4'-DDD		100.6	1	5	20	30
		72-55-9	4,4'-DDE		29.5	1	5	20	30
		50-29-3	4,4'-DDT		59.3	1	5	20	30
		309-00-2	Aldrin		13.3	1	5	20	30
		319-84-6	Alpha-BHC		#N/A	1	5	20	30
		319-85-7	Beta-BHC		510.4	1	5	20	30
		319-86-8	Delta-BHC		7.2	1	5	20	30
		5103-71-9	Alpha-Chlordane		3.7	1	5	20	30
		5566-34-7	Gamma-Chlordane		5.1	1	5	20	30
		60-57-1	Dieldrin		2.3	1	5	20	30
		959-98-8	Endosulfan I		#N/A	1	5	20	30
		33213-65-9	Endosulfan II		21.2	1	5	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		1031-07-8	Endosulfan Sulfate		8.1	1	5	20	30
		72-20-8	Endrin		13.2	1	5	20	30
		7421-93-4	Endrin Aldehyde		#N/A	1	5	20	30
		53494-70-5	Endrin Ketone		#N/A	1	5	20	30
		76-44-8	Heptachlor		5.3	1	5	20	30
		1024-57-3	Heptachlor Epoxide		3.5	1	5	20	30
		118-74-1	Hexachlorobenzene		173.7	1	5	20	30
		58-89-9	Lindane		163.3	1	5	20	30
		2385-85-5	Mirex		9.1	1	5	20	30
		5103-73-1	Cis-Nonachlor		1.9	1	5	20	30
		26880-48-8	Oxychlordane		13.4	1	5	20	30
		39765-80-5	Trans-Nonachlor		3.6	1	5	20	30
PAH	dry weight ng/g, (ppb)	83-32-9	Acenaphthene		1437.9	1	5	20	30
		208-96-8	Acenaphthylene		1530	1	5	20	30
		120-12-7	Anthracene		4343	1	5	20	30
		56-55-3	Benz(a)anthracene		#N/A	1	5	20	30
		205-99-2	Benzo(b)fluoranthene		11125.6	1	5	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		207-08-9	Benzo(k)fluoranthene		8530.9	1	5	20	30
		191-24-2	Benzo(g,h,i)perylene		#N/A	1	5	20	30
		50-32-8	Benzo(a)pyrene		10158.6	1	5	20	30
		192-97-2	Benzo(e)pyrene		#N/A	1	5	20	30
		92-52-4	Biphenyl		#N/A	1	5	20	30
		218-01-9	Chrysene		13600	1	5	20	30
		53-70-3	Dibenz(a,h)anthracene		1513.5	1	5	20	30
		132-65-0	Dibenzothiophene		1000	1	5	20	30
		581-42-0	2,6-Dimethylnaphthalene		283.7	1	5	20	30
		206-44-0	Fluoranthene		38970	1	5	20	30
		86-73-7	Fluorene		1594.8	1	5	20	30
		193-39-5	Indeno(1,2,3-c,d)pyrene		6615.5	1	5	20	30
		90-12-0	1-Methylnaphthalene		487	1	5	20	30
		91-57-6	2-Methylnaphthalene		430.5	1	5	20	30
		832-69-9	1-Methylphenanthrene		903	1	5	20	30
		91-20-3	Naphthalene		694	1	5	20	30
		198-55-0	Perylene		2157	1	5	20	30

TYPE	UNITS	CAS NUMBER	PARAMETER	PCB NUMBER (WHERE APPLICABLE)	MAX CONC BASED UPON 2010 AND 2015 DATA	MDL TARGET*	REPORTING LIMIT TARGET**	TARGET ACCURACY	TARGET PRECISION
		85-01-8	Phenanthrene		20000	1	5	20	30
		129-00-0	Pyrene		30000	1	5	20	30
		2245-38-7	2,3,5-Trimethylnaphthalene		411	1	5	20	30

*For samples requiring dilution, the lowest possible dilution factor should be used to achieve a valid measurement. Labs must report the dilution factor for any diluted sample, and the MDL/RL may be adjusted by the dilution factor used to achieve a valid measurement.

**The reporting limits (RL) listed are those reported by the National Contract Lab in the NCCA 2015 data. The RLs are targets only. Inability to achieve the listed RL for any parameters will not be considered a QA failure. However, please contact the EPA Task Order Contracting Officer's Representative if you have any questions.

5.6.3.2 Laboratory Quality Control Requirements

The laboratory must conduct QC analyses for each batch of samples. Each batch shall consist of no more than 20 samples. Unique laboratory quality control lot numbers must be assigned to each batch of samples. The lot number must associate each batch of field samples to the appropriate measures such as laboratory control sample, matrix spike, laboratory duplicate, and method blank samples. Also, each laboratory QC samples (i.e., preparation and instrument blanks, laboratory control sample (LCS), spike/duplicate, etc.) must be given a unique sample identification. Table 5.32 provides a summary of the quality control requirements including sample receipt and processing.

Table 5.32 Sediment Chemistry, Grain Size, and TOC: Quality control activities for samples.

Activity	Evaluation	Corrective Action
Demonstrate competency for analyzing sediment samples to meet the performance measures	Demonstration of competency with sediment samples in achieving the method detection limits. accuracy, and precision targets	EPA will not approve any laboratory for NCCA sample processing if the laboratory cannot demonstrate competency. In other words, EPA will select another laboratory that can demonstrate competency for its NCCA samples.
Check condition of sample when it arrives.	Sample issues such as cracked container; missing label; sufficient volume for test.	Assign appropriate condition code identified in Table 7.4. of the LOM
Store sample appropriately. While stored at the laboratory, the sample must be kept at a temperature ≤-20° C except jars for grain analyses are refrigerated at 4°C.	Check the temperature of the freezer and refrigerator per laboratory's standard operating procedures.	Record temperature of sample upon arrival at the laboratory. If at any other time, samples are warmer than required, note temperature and duration in comment field. Data analyst will consider temperature deviations in evaluating the data. He/she will flag the deviations and determine whether the data appear to be affected and/or the data should be excluded from the analyses.
Analyze sample within holding time	The test must be completed within the holding time of 1 year. If the original test fails, then the retest also must be	Perform test but note reason for performing test outside holding time. EPA expects that the laboratory will exercise every

	conducted within the holding time.	effort to perform tests before the holding time expires.
Perform once at the start of each batch to evaluate the labeled compound recovery (LCR) in a Laboratory Control Sample (LCS). This tests the performance of the equipment.	Control limits for recovery cannot exceed 100±20%.	First, prepare and analyze one additional LCS. If the second blank meets the requirement, then no further action is required. If the second LCS fails, then determine and correct the problem before proceeding with any sample analyses.
Perform once at the start of each batch to evaluate the entire extraction and analysis process using a Method Blank	Control limits cannot exceed the laboratory reporting level (LRL).	First, prepare and analyze one additional blank. If the second blank meets the requirement, then no further action is required. If the second blank fails, then determine and correct the problem (e.g., contamination, instrument calibration) before proceeding with any sample analyses. Reestablish statistical control by analyzing three blank samples. Report values of all blanks analyzed.
Check calibration immediately before and immediately after the sample batch (abbreviated as QCCS for quality control check sample)	Results must be ±10% of each other or as specified in method criteria	If calibration fails before analysis, recalibrate and reanalyze QCCS until it passes. If check fails after all samples the batch have been analyzed, verify the QCCS reading. If the QCCS reading fails a second time, then reanalyze all samples in the batch and report only the set of results associated with the acceptable QCCS reading. Also report all QCCS readings for the batch.
Compare results of one laboratory duplicate sample (for TOC) or matrix spike duplicate (for contaminant) sample for each batch (not required for grain size)	Results must be within the target and precision goals in Table 7.3 of the LOM	If both results are below LRL, then conclude that the test has passed. Otherwise, prepare and analyze a split from different sample in the batch. If the second result is within the target precision goal of the original sample, then report the data and

		findings for both QC samples. However, if the two results differ by more than the target precision goal, review precision of QCCS measurements for batch; check preparation of split sample; etc. and report evaluation and findings in the case narrative. Consult with the EPA HQ NCCA Laboratory Review Coordinator to determine if reanalysis of the entire batch (at the laboratory's expense) is necessary. If no reanalysis is necessary, report and quantify all samples in batch. If reanalysis is necessary, then report all QC sample and the 2nd analysis of the batch. If the second set also is unacceptable, then assign a data code to each sample in the batch.
Compare results of one matrix spike sample per batch to evaluate performance in matrix (not required for TOC and grain size)	Evaluate performance after the first 3 batches; and then every subsequent batch. Ideally, control limits for recovery will not exceed the target accuracy goal, but this may not be realistic for all parameters with this matrix.	If both the original and duplicate results are below LRL, then conclude that the test has passed for the batch. Otherwise, if any results are not within the target accuracy goal for the first 3 batches, within 2 working days, contact the EPA HQ NCCA Laboratory Review Coordinator to discuss method performance and potential improvements. After achieving acceptable results or EPA's permission to continue, perform the test for every subsequent batch. For each batch, report the results from the original analysis and its duplicate and their RPD for TOC; the matrix spike, matrix spike duplicate, RPD and %recovery for contaminants.
Compare results of TOC Certified Reference Material once per each batch	Value must be within 10% of the certified value.	If value is outside the acceptable range, analyze a second CRM. If the second CRM also is

		measured outside the acceptable range, then determine and correct the problem (e.g., contamination, instrument calibration) before reanalyzing all samples in the batch.
Maintain the required MDL	Evaluate for each sample	If MDL could not be achieved, then provide dilution factor or QC code and explanation in the comment field.
Participate in External Quality Control	Evaluate QC samples provided by the External QC Coordinator	Based upon the evaluation, the External QC Coordinator may request additional information from one or more laboratories about any deviations from the Method or unique laboratory practices that might account for differences between the laboratory and others. With this additional information, the External QC Coordinator will determine an appropriate course of action, including no action, flagging the data, or excluding some or all of the laboratory's data.
Maintain completeness	Completeness objective is 95% for all parameters.	Contact EPA HQ NCCA Laboratory Review Coordinator immediately if issues affect laboratory's ability to meet completeness objective.

*Chapter 2 of the LOM provides contact information for the EPA HQ NCCA Laboratory Review Coordinator. Laboratories under contract to EPA must contact the Task Order's Contracting Officer's Representative (TOCOR) instead of the Laboratory Review Coordinator.

5.6.3.3 **Data Reporting**

Data reporting units and significant figures are summarized in Table 5.33**.**

Table 5.33 Data Reporting Criteria: Sediment Contaminants, TOC and Grain Size indicators.

Measurement	Units	Expressed to the Nearest
Sediment		
Pesticides and PCBs	ng/g; ppb (sediment: dry wt)	0.01
Metals	ug/g; ppm (sediment: dry wt)	0.01
Hg	ug/g; ppm (sediment: dry wt)	0.001
PAHs	ng/g; ppb (dry wt)	0.01
TOC	%	0.01
Grain Size	%	0.01

5.6.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect a sediment sample for sediment contamination, TOC and grain size analyses. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact.

Before leaving the field, the crews will:

- Check the label to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the label, covering the label completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sediment contaminants and TOC samples on dry ice. Store grain size samples on wet ice.
- Recheck all forms and labels for completeness and legibility.

5.6.4.1 Field Performance Requirements

Not Applicable

5.6.4.2 Field Quality Performance Requirements

Any contamination of the samples can produce significant errors in the resulting interpretation. Crews must take care not to contaminate the sediment with the tools used to collect the sample (i.e., the sampler, spoons, mixing bowl or bucket) and not to mix the surface layer with the deeper sediments.

Prior to sampling at each site, crews must clean the sampler and collection tools that will come into contact with the sediment with Alconox and rinse them with ambient water at the site. Field processing quality control requirements can be found in Table 5.34 and Table 5.35.

Table 5.34 Sample collection and field processing quality control: sediment contaminant indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels.	Obtain replacement supplies
Sample Storage (field)	Store sediment samples on dry ice and in a dark place (cooler).	Discard and recollect sample
Shipping time	Frozen samples must be shipped on dry ice within 2 weeks of collection.	Logistics coordinator contacts crew and requests samples be shipped every week

Table 5.35 Sample collection and field processing quality control: sediment TOC and grain size indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Check for homogeneity	Sample must be homogeneous.	Mix sample for a longer period of time
Sample Storage (field)	Store sediment (TOC) samples on dry ice and grain size indicators on wet ice. Store all samples in a dark place (cooler).	Discard and recollect sample
Holding time	TOC samples must be shipped on dry ice within 2 weeks of collection. Grain size indicators must be shipped on wet ice every week.	Qualify samples
Check integrity of sample containers and labels	Clean, intact containers and labels.	Obtain replacement supplies

5.6.5 Data Review

Checks made of the data in the process of review and verification is summarized in Table 5.36. The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.36 Data Validation Quality Control for Sediment Contaminants, TOC and Grain Size Indicators.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review holding times	Qualify value for additional review
Review data from QA samples (laboratory PE samples, and interlaboratory comparison samples)	Determine impact and possible limitations on overall usability of data

5.7 Sediment Toxicity

5.7.1 Introduction

Toxicity tests will be completed on sediments from both marine/estuarine and freshwater environments. Both tests determine toxicity, in terms of survival rate of amphipod crustaceans, in whole sediment samples.

5.7.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in the NCCA 2020 Field Operations Manual. Laboratory methods are in the NCCA 2020 Laboratory Operations Manual.

5.7.3 Pertinent Laboratory QA/QC Procedures

A single central laboratory and some State laboratories will analyze the sediment toxicity. The specific quality control procedures used by each laboratory are implemented to ensure that:

- Objectives established for various data quality indicators being met.
- Results are consistent and comparable among all participating laboratories.

All laboratories will follow the QA/QC procedures outlined in the NCCA QAPP and the LOM.

5.7.3.1 Laboratory Performance Requirements

Laboratories may choose to use any analysis method using the required organisms of *Hyalella azteca* (freshwater) or *Leptocheirus plumulosus* (estuarine). The laboratory's method must meet the quality requirements in Section 9.7 of the LOM, including mean survival of the control's freshwater and estuarine treatments must remain greater than or equal to 80% and 90%, respectively. It is essential that the contractor require that all of its laboratory technicians use the same procedures and meet the required quality elements. At a minimum, the laboratory must:

1. Perform the procedures using the 10-day tests. Possible methods include those described in the following documents:
    a. Estuarine: Test Method 100.4 in EPA 600/R-94/025[7] or ASTM E1367-03[8]
    b. Freshwater: Test Method 100.1 in EPA 600/R-99/064[9] or ASTM E1706[10]

2. Test the following number of replicates for each sample and control:
    a. Estuarine: 5 replicates with 20 organisms per replicate
    b. Freshwater: 4 replicates with 10 organisms per replicate
3. Test no more than 10 samples and one control within each batch.
4. Use the following organisms for the tests:
    a. Estuarine: *Leptocheirus plumulosus*
    b. Freshwater: *Hyalella azteca*
5. Select organisms for each batch of tests that are:
    a. From the same culture;
    b. Cultured at the same temperature as will be used for the tests;
    c. (optional) EPA would prefer but does not require that the organisms are cultured in the same water as that used for testing.
6. Use a water source (for the overlying water) demonstrated to support survival, growth, and reproduction of the test organisms.
    a. For estuarine sediments, 175 mL of sediment and 800 mL of overlying seawater
    b. For freshwater sediments, 100mL of sediment and 175mL of overlying freshwater
7. Use clean sediment for control tests.
8. Implement the following for exposure/feeding
    a. For estuarine sediments, exposure is static (i.e., water is not renewed), and the animals are not fed over the 10 d exposure period
    b. For freshwater, exposure is renewed (i.e., 2 volumes a day) and the animals are fed over the 10 day exposure period

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[7] Chapter 11 in *Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods*, June 1994, retrieved May 22, 2019 from https://nepis.epa.gov/Exe/ZyPDF.cgi/300032A9.PDF?Dockey=300032A9.PDF

[8] American Society for Testing and Materials (ASTM). 2008. E1367-03 "Standard Guide for Conducting 10-Day Static Sediment Toxicity Tests With Marine and Estuarine Amphipods." *Annual Book of Standards, Water and Environmental Technology*, Vol. 11.05, West Conshohocken, PA.

[9] Section 11 in *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates*, Second Edition, March 2000, retrieved from https://pdfs.semanticscholar.org/6876/ca3e48ad5ecdefd46b6600f9346d5be845b6.pdf

[10] ASTM 2009 E1706. "Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates."

5.7.3.2 **Follow the following procedure for homogenization/sieving:**

Water above the sediment is not discarded, but is mixed back into the sediment during homogenization. Sediments should be sieved for estuarine samples (following the 10 day method) and the sieve size should be noted. For freshwater samples, they should not be sieved to remove indigenous organisms unless there is a good reason to believe indigenous organisms may influence the response of the test organism. Large indigenous organisms and large debris can be removed using forceps

Laboratory Quality Control Requirements

The laboratory must conduct QC analyses for each batch of samples. Each batch shall consist of no more than 10 samples. Unique laboratory quality control lot numbers must be assigned to each batch of samples. The lot number must associate each batch of field samples to the appropriate measures such as laboratory control samples. Table 5.37 provides a summary of the quality control requirements including sample receipt and processing.

Table 5.37 Quality control activities for sediment toxicity samples.

Activity	Evaluation	Corrective Action
Laboratory demonstrates competency for conducting sediment toxicity analyses	EPA will review SOPs, lab certifications, past performance results, etc. as part of the lab verification process.	EPA will not approve any laboratory for NCCA sample processing if the laboratory cannot demonstrate competency. In other words, EPA will select another laboratory that can demonstrate competency for its NCCA samples.
Check condition of sample when it arrives.	Sample issues, such as cracked or leaking container; missing label; temperature; adherence to holding time requirements; insufficient volume for test.	Assign appropriate condition code identified in Table 9.1 of the LOM
Sample storage	All samples: 4 °C at arrival at the laboratory (temperature recorded at arrival) and while stored at the laboratory.	Record temperature upon arrival at the laboratory. Check temperature of the refrigerator where samples are stored at least daily if using a continuous temperature logger and twice daily (beginning and end of day) if the lab does not have a continuous logger. If refrigerator is warmer than required, note temperature and duration (either from the

		continuous temperature log or from the last manual reading) in comment field. Lab will still perform test. EPA expects that the laboratory will exercise every effort to maintain samples at the correct temperature.
Holding Time	The test must be completed within 8 weeks after sample collection. If the original test fails, then the retest also must be conducted within the 8 weeks after sample collection.	Perform test but note reason for performing test outside holding time. EPA expects that the laboratory will exercise every effort to perform tests before the holding time expires.
Check that the organisms are healthy before starting the test	Unhealthy organisms may appear to be discolored, or otherwise stressed (for example, greater than 20 percent mortality for the 48 hours before the start of a test).	Don't start test using unhealthy organisms.
Maintain conditions as required in Section 9.3 of the LOM	Check conditions (e.g., temperature, DO) each test day. Record conditions in bench sheet or in laboratory database.	Note any deviations in comments field. In extreme cases, conduct a new toxicity test for all samples affected by the adverse conditions.
Control survival rates	For a test of a batch of samples to be considered valid, the control's mean survival in *hyalella* and *leptocheirus* treatments must remain ≥80% and ≥90%, respectively.	Data template includes a field to record if a test passed or failed the control requirements. If a test fails, retest all samples in the batch. Report both the original and retest results. If both tests fail, submit data to EPA for further consideration. Include comments in the data template noting any particular factors that may have caused the test to fail twice.

*Chapter 2 of the LOM provides contact information for the EPA HQ NCCA Laboratory Review Coordinator. Laboratories under contract to EPA must contact the Task Order's Contracting Officer's Representative (TOCOR) instead of the Laboratory Review Coordinator.

5.7.3.3 **Data Reporting**

Data reporting units and significant figures are given in Table 5.38**.**

Table 5.38 Data Reporting Review Critera: Sediment Toxicity.

Measurement	Units	Expressed to the Nearest
Sediment toxicity	%	Survival integer

5.7.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect a sediment sample for sediment toxicity. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact.

Before leaving the field, the crews will:

- Check the label to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the label, covering the label completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sample on wet ice.
- Recheck all forms and labels for completeness and legibility.

5.7.4.1 Field Performance Requirements

Not Applicable

5.7.4.2 Field Quality Control Requirements

Any contamination of the samples can produce significant errors in the resulting interpretation. Crews must take care not to contaminate the sediment with the tools used to collect the sample (i.e., the sampler, spoons, mixing bucket) and not to mix the surface layer with the deeper sediments. Prior to sampling at each site, crews must clean the sampler and collection tools that will come into contact with the sediment with Alconox and rinse them with ambient water at the site. Field processing quality control requirements are summarized in Table 5.39.

Table 5.39 Sample collection and field processing quality control: sediment toxicity indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels.	Obtain replacement supplies
Sample Volume	Preferred maximum volume 2000 mL; minimum volume 900 mL (estuarine); For Great Lakes sites, preferred volume is 900 mL, minimum is 400 mL.	Qualify samples if less than 900 mL available to submit to lab (less than 400 mL for GL sites.
Sample Storage (field)	Store sediment samples on wet ice and in a dark place (cooler).	Discard and recollect sample
Holding time	Refrigerated samples must be shipped on wet ice within 1 week of collection.	Qualify samples

5.7.5 Data Review

Checks made of the data in the process of review, verification, and validation are summarized in Table 5.40. The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.40 Data validation quality control: sediment toxicity.

Activity or Procedure	Requirements and Corrective Action
Summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review data from reference toxicity samples	Determine impact and possible limitations on overall usability of data

5.8 Fecal Indicator: Enterococci

5.8.1 Introduction

The primary function of collecting water samples for Pathogen Indicator Testing is to provide a relative comparison of fecal pollution indicators for coastal waters. The concentration of Enterococci (the current bacterial indicator for fresh and estuarine waters) in a water body correlates with the level of more infectious gastrointestinal pathogens present in the water body. While some Enterococci are opportunistic pathogens among immuno-compromised human individuals, the presence of Enterococci is more importantly an indicator of the presence of more pathogenic microbes (bacteria, viruses and protozoa) associated with human or animal fecal waste.

5.8.2 Sampling Design and Methods

Detailed sample collection and handling procedures are described in the NCCA 2020 Field Operations Manual.

5.8.3 Pertinent Laboratory QA/QC Procedures

Pertinent laboratory QA/QC procedures are in the EPA ORD manuals/QAPP.

5.8.3.1 Data Reporting, Review and Management

Checks made of the data in the process of review, verification, and validations are summarized in Table 5.41**.** All raw data (including all standardized forms and logbooks) are retained in an organized fashion for seven years or until written authorization for disposition has been received from the NCCA Project Lead. Once data have passed all acceptance requirements, data is submitted to the NARS Project Lead and then to the NARS IM processing center.

Table 5.41 Data Validation Quality Control: Fecal Indicator.

Check Description	Frequency	Acceptance Criteria	Corrective Action
Duplicate sampling	Duplicate composite samples collected at 10% of sites	Measurements should be within 10 percent	Review data for reasonableness; determine if acceptance criteria need to be modified
Field filter blanks	Field blanks filtered at 10% of sites	Measurements should be within 10 percent	Review data for reasonableness; determine if acceptance criteria need to be modified
DATA PROCESSING & REVIEW			
100% verification and review of qPCR data	All qPCR amplification traces, raw and processed data sheets	All final data will be checked against raw data, exported data, and calculated data printouts before entry into LIMS and upload to NARS IM.	Second tier review by contractor and third tier review by EPA.

5.8.4 Pertinent Field QA/QC Procedures

5.8.4.1 Field Performance Requirements

Not Applicable

5.8.4.2 Field Quality Control Requirements

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 Field Operations Manual. That quality is enhanced by the training and experience of project staff and documentation of sampling activities. Specific quality control measures are listed in Table 5.42 for field measurements and observations.

Table 5.42 Sample Collection and Field Processing Quality Control: Fecal Indicator

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels	Obtain replacement supplies
Sterility of sample containers	Sample collection bottle and filtering apparatus are sterile and must be unopened prior to sampling. Nitrile gloves must be worn during sampling and filtering	Discard sample and recollect in the field.
Sample Collection	Collect sample at the last transect to minimize holding time before filtering and freezing	Discard sample and recollect in the field.
Sample holding	Sample is held in a cooler on wet ice until filtering.	Discard sample and recollect in the field.
Field Processing	Sample is filtered within 6 hours of collection and filters are frozen on dry ice.	Discard sample and recollect in the field
Field Blanks	Field blanks must be filtered at 10% of sites.	Review blank data and flag sample data.

5.9 Whole Fish Tissue Samples for Ecological Analysis

5.9.1 Introduction

Fish collected as indicators of ecological contamination (Eco-fish) will be collected at all sites to be analyzed for whole body concentrations of organic and inorganic contaminants. This will also include the analysis and reporting of lipid content, sample weight and percent moisture. Results from these analyses will be used to help determine the ecological integrity of U.S. coastal resources.

5.9.2 Sample Design and Methods

Detailed sample collection and handling procedures are described in the NCCA 2020 Field Operations Manual. Laboratory methods are in the NCCA 2020 Laboratory Operations Manual..

5.9.3 Pertinent Laboratory QA/QC Procedures

5.9.3.1 Laboratory Performance Requirements

A single central laboratory shall perform analysis of the homogenized composites to determine the lipid content, concentrations of metals, mercury, pesticides, and PCBs. EPA also may require the national contract laboratory to analyze the samples for PAHs; however, EPA will not require the State laboratories to analyze for them. **With the exception of sea urchins, NCCA does not provide support for analyses of any other invertebrates such as crustaceans (e.g., lobster, crabs).**

Laboratories may choose to use any analysis method that measures contaminants to the levels of the method detection limits identified in Table 5.43**.** In addition, the method must meet the target precision of 30% and the target accuracy identified in Table 5.44**.**

Table 5.43 Whole Fish Tissue: Precision and Accuracy Objectives.

Parameter	Precision Objective	Accuracy Objective
Metals	30%	20%
Organics (PCBs, pesticides, and PAHs)	30%	35%

Table 5.44 Whole Body Fish: Required Contaminants.

Type	Units	Parameter	CAS Number	PCB Number (where applicable)	MDL Target**	Reporting Limit Target***
LIPID	% Wet Weight	% LIPID				0.05
METAL	µg/wet g (mg/L)	Aluminum	7429-90-5		10.0	5
		Arsenic	7440-38-2		2.0	0.05
		Cadmium	7440-43-9		0.2	0.05
		Chromium	7440-47-3		0.1	0.05
		Copper	7440-50-8		5.0	0.05
		Iron	7439-89-6		50.0	5
		Lead	7439-92-1		0.1	0.05
		Mercury	7439-97-6		0.01	0.00002
		Nickel	7440-02-0		0.5	0.05
		Selenium	7782-49-2		1.0	0.05
		Silver	7440-22-4		0.3	0.05
		Tin	7440-31-5		0.05	0.05
		Vanadium	7440-62-2		1.0	0.05
		Zinc	7440-66-6		50.0	0.05

Type	Units	Parameter	CAS Number	PCB Number (where applicable)	MDL Target**	Reporting Limit Target***
PCB	ng/wet g (µg/L)	2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl	2051-24-3	209	2.0	5
		2,4'-Dichlorobiphenyl	34883-43-7	8	2.0	5
		2,2',3,4',5,5',6-Heptachlorobiphenyl	35065-29-3	180	2.0	5
		2,2',3,3'4,4',5,6-Octachlorobiphenyl	52663-78-2	195	2.0	5
		2,2',3,4 ,5,5',6-Heptachlorobiphenyl	52663-68-0	187	2.0	5
		2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	128	2.0	5
		2,2',3,3'4,4',5-Heptachlorobiphenyl	35065-30-6	170	2.0	5
		2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	138	2.0	5
		2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	153	2.0	5
		2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	206	2.0	5
		2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4	105	2.0	5
		2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	101	2.0	5
		2,3',4,4',5-Pentachlorobiphenyl	31508-00-6	118	2.0	5
		2,3,3',4,6'-Pentachlorobiphenyl	38380-03-9	110	2.0	5
		3,3',4,4',5-Pentachlorobiphenyl	57465-28-8	126	2.0	5
		2,2',3,5'-Tetrachlorobiphenyl	41464-39-5	44	2.0	5
		3,3',4,4'-Tetrachlorobiphenyl	32598-13-3	77	2.0	5
		2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	52	2.0	5
		2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	66	2.0	5
		2,2',5-Trichlorobiphenyl	37680-65-2	18	2.0	5
		2,4,4'-Trichlorobiphenyl	7012-37-5	28	2.0	5
PEST	ng/wet g (µg/L)	2,4'-DDD	53-19-0		2.0	5
		2,4'-DDE	3424-82-6		2.0	5
		2,4'-DDT	789-02-6		2.0	5
		4,4'-DDD	72-54-8		2.0	5
		4,4'-DDE	72-55-9		2.0	5

Type	Units	Parameter	CAS Number	PCB Number (where applicable)	MDL Target**	Reporting Limit Target***
		4,4'-DDT	50-29-3		2.0	5
		Aldrin	309-00-2		2.0	5
		Alpha-BHC	319-84-6		2.0	5
		Beta-BHC	319-85-7		2.0	5
		Delta-BHC	319-86-8		2.0	5
		Alpha-Chlordane	5103-71-9		2.0	5
		Gamma-Chlordane	5566-34-7		2.0	5
		Dieldrin	60-57-1		2.0	5
		Endosulfan I	959-98-8		2.0	5
		Endosulfan II	33213-65-9		2.0	5
		Endosulfan Sulfate	1031-07-8		2.0	5
		Endrin	72-20-8		2.0	5
		Endrin Aldehyde	7421-93-4		2.0	5
		Endrin Ketone	53494-70-5		2.0	5
		Heptachlor	76-44-8		2.0	5
		Heptachlor Epoxide	1024-57-3		2.0	5
		Hexachlorobenzene	118-74-1		2.0	5
		Lindane	58-89-9		2.0	5
		Mirex	2385-85-5		2.0	5
		Cis-Nonachlor	5103-73-1		2.0	5
		Oxychlordane	26880-48-8		2.0	5
		Trans-Nonachlor	39765-80-5		2.0	5
PAHs*		Acenaphthene	83-32-9		2.0	
		Acenaphthylene	208-96-8		2.0	
		Anthracene	120-12-7		2.0	
		Benz(a)anthracene	200-280-6		2.0	
		Benzo(b)fluoranthene	205-99-2		2.0	
		Benzo(k)fluoranthene	207-08-9		2.0	
		Benzo(g,h,i)perylene	191-24-27-2		2.0	
		Benzo(a)pyrene	50-32-8		2.0	
		Benzo(e)pyrene	192-97-2		2.0	
		Biphenyl	92-54-4		2.0	
		Chrysene	218-01-9		2.0	
		Dibenz(a,h)anthracene	53-70-3		2.0	
		Dibenzothiophene	132-65-0		2.0	
		2,6-Dimethylnaphthalene	581-42-0		2.0	
		Fluoranthene	205-99-2		2.0	
		Fluorene	86-73-7		2.0	
		Indeno(1,2,3-c,d)pyrene	193-39-5		2.0	

Type	Units	Parameter	CAS Number	PCB Number (where applicable)	MDL Target**	Reporting Limit Target***
		1-Methylnaphthalene	90-12-0		2.0	
		2-Methylnaphthalene	91-57-6		2.0	
		1-Methylphenanthrene	832-69-9		2.0	
		Naphthalene	91-20-3		2.0	
		Perylene	198-55-0		2.0	
		Phenanthrene	85-01-8		2.0	
		Pyrene	129-00-0		2.0	
		2,3,5-Trimethylnaphthalene	2245-38-7		2.0	

* EPA also may require the national contract laboratory to analyze the samples for PAHs; however, EPA will not require the State laboratories to analyze for them.
** For samples requiring dilution, the lowest possible dilution factor should be used to achieve a valid measurement. Labs must report the dilution factor for any diluted sample, and the MDL/RL may be adjusted by the dilution factor used to achieve a valid measurement.
*** The reporting limits (RL) listed are those reported by the National Contract Lab in the NCCA 2015 data. The RLs are targets only. Inability to achieve the listed RL for any parameters will not be considered a QA failure. However, please contact the EPA Task Order Contracting Officer's Representative if you have any questions.

5.9.3.2 Laboratory Quality Control Requirements

The laboratory must conduct QC analyses for each batch of samples. Each batch shall consist of no more than 20 samples. Unique laboratory quality control lot numbers must be assigned to each batch of samples. The lot number must associate each batch of field samples to the appropriate measures such as laboratory control sample, matrix spike, laboratory duplicate, and method blank samples. Also, each laboratory QC samples (i.e., preparation and instrument blanks, laboratory control sample (LCS), spike/duplicate, etc.) must be give a unique sample identification. Table 5.45 provides a summary of the quality control requirements, including sample receipt and processing.

Table 5.45 Whole Body Fish: Quality control activities.

Quality Control Activity	Description and Requirements	Corrective Action
Demonstrate competency for analyzing fish samples with the required methods	Demonstration of competency with fish samples in achieving the method detection limits, accuracy, and precision targets.	EPA will not approve any laboratory for NCCA sample processing if the laboratory cannot demonstrate competency. In other words, EPA will select another laboratory that can demonstrate competency for its NCCA samples.
Check condition of sample when it arrives	Sample issues, such as punctures or rips in wrapping; missing label; temperature; adherence to holding time requirements; sufficient volume for test. All samples should arrive at the laboratory in a frozen state.	Assign appropriate condition code identified in Table 6.1 of the LOM.
Store sample appropriately. While stored at the laboratory, the sample must be kept at a maximum temperature of -20° C	Check the temperature of the freezer per laboratory's standard operating procedures.	Record temperature of sample upon arrival at the laboratory. If at any other time, samples are warmer than required, note temperature and duration in comment field.
Determine if all fish meet the criteria	Evaluate if the sample contains fish of the same species and are similar in size (within 75%) and provides enough material to run the analysis.	Contact the EPA HQ NCCA Laboratory Review Coordinator* for a decision on fish selection and/or chemical analysis.
Analyze sample within holding time	The test must be completed within the holding time (i.e., 28 days for mercury; 6 months for other metals; and 1 year for all others). If the original test fails, then the retest also must be conducted within the holding time.	Perform test but note reason for performing test outside holding time. EPA expects that the laboratory will exercise every effort to perform tests before the holding time expires.
Perform once at the start of each batch to evaluate	Control limits for recovery cannot exceed 100±20%.	First, prepare and analyze one additional LCS. If the second blank meets the requirement, then no

the labeled compound recovery (LCR) in a Laboratory Control Sample (LCS). This tests the performance of the equipment		further action is required. If the second LCS fails, then determine and correct the problem before proceeding with any sample analyses.
Perform once at the start of each batch to evaluate the entire extraction and analysis process using a Method Blank	Control limits cannot exceed the laboratory reporting level (LRL).	First, prepare and analyze one additional blank. If the second blank meets the requirement, then no further action is required. If the second blank fails, then determine and correct the problem (e.g., homogenization, reagent contamination, instrument calibration, or contamination introduced during filtration) before proceeding with any sample analyses. Reestablish statistical control by analyzing three blank samples. Report values of all blanks analyzed.
Check calibration immediately before and immediately after the sample batch is run (abbreviated as QCCS for quality control check sample)	Results must be ±10% of each other or as specified in method criteria	If calibration fails before analysis, recalibrate and reanalyze QCCS until it passes. If check fails after all samples in the batch have been analyzed, verify the QCCS reading. If the QCCS reading fails a second time, then reanalyze all samples in the batch and report both sets of results. For the first run, include a data qualifier that indicates that the QCCS reading taken immediately following the first run failed. For the second run, include a data qualifier that indicates that it is the second set and whether the QCCS reading immediately following that second run passed. No sample is to be analyzed more than twice.
Evaluate rinsate for first sample in each batch. This evaluation is a surrogate for assessing cross-contamination	Results must be below laboratory's LRL.	If original rinsate was above LRL, analyze rinsate from a second sample. If second rinsate sample also has results above the LRL, then assign a data qualifier to all samples in the batch for the parameters with results above the LRL in the rinsates. Also, improve procedures for cleaning all surfaces, knives, and

		homogenization equipment between samples.
Compare lipids in triplicate for the first sample in each batch. This evaluation is a surrogate for assessing homogenization	Substitute the LRL for any value below the LRL before calculating the RSD. If the RSD of the triplicate results is ≤20%, then the homogenization effort is judged to be sufficient for all samples in the batch.	If the RSD could not be achieved, then regrind all samples in the batch one or more times as described in Section 6.5 of the LOM.
Compare results of one laboratory duplicate sample or matrix spike duplicate sample for each batch	Results must be within the target precision goal in Table 5.44 (30% for all analytes).	If both results are below LRL, then conclude that the test has passed. Otherwise, prepare and analyze a split from different sample in the batch. If the second result is within the target precision goal (see Table 5.44) of the original sample, then report the data and findings for both QC samples. However, if the two results differ by more than the target precision goal, review precision of QCCS measurements for batch; check preparation of split sample; etc. and report evaluation and findings in the case narrative. Consult with the EPA HQ NCCA Laboratory Review Coordinator* to determine if reanalysis of the entire batch (at the laboratory's expense) is necessary. If no reanalysis is necessary, report and quantify all samples in batch. If reanalysis is necessary, then report all QC sample and the 2nd analysis of the batch. If the second set also is unacceptable, then assign a data code to each sample in the batch.
Compare results of one matrix spike sample per batch to evaluate performance in matrix	Evaluate performance after the first 3 batches. Ideally, control limits for recovery will not exceed the target accuracy goal (Table 5.44), but this may not be realistic for all parameters with this matrix.	If both results are below LRL, then conclude that the test has passed for the batch. Otherwise, if any results are not within the target accuracy goal for the 3 batches, within 2 working days, contact the EPA HQ NCCA Laboratory Review Coordinator* to discuss method performance and potential improvements. Continue to perform the test for every batch. Report the results from the original analysis, the matrix spike, matrix spike duplicate, and %recovery.
Maintain the required MDL	Evaluate for each sample	If MDL could not be achieved, then provide dilution factor or QC code

identified in Table 5.44.		and explanation in the comment field.
Use consistent units for QC samples and field samples	Verify that all units are provided in wet weight units and consistently within each indicator type as follows: Metals in µg/g or ppm. PCBs, pesticides, and PAHs in ng/g or µg/L.	If dry units are reported for any sample (QC or field), reanalyze the sample and report only the reanalysis results. If it is not possible to provide the results in wet units, then assign a QC code and describe the reason for dry units in the comments field of the database.
Maintain completeness	Completeness objective is 95% for all parameters.	Contact EPA HQ NCCA Laboratory Review Coordinator* immediately if issues affect laboratory's ability to meet completeness objective.

*Chapter 2 of the LOM provides contact information for the EPA HQ NCCA Laboratory Review Coordinator. Laboratories under contract to EPA must contact the Task Order's Contracting Officer's Representative (TOCOR) instead of the Laboratory Review Coordinator.

5.9.3.3 **Data Reporting**

Data reporting units and significant figures are given in Table 5.46**.**

Table 5.46 Data Reporting Criteria: Eco-Fish Tissue Chemistry.

Measurement	Units	Expressed to the Nearest
Pesticides and PCBs	dry wt and fish tissue wet weight)	0.01
Metals	dry wt and fish tissue wet weight)	0.01
Hg	dry wt and fish tissue wet weight)	0.001
PAHs	ng/g; ppb (dry wt)	0.01

5.9.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect whole fish samples for analysis of organic and inorganic contaminants. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact.

Before leaving the field, the crews will:

- Check the label to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the label, covering the label completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sample frozen.
- Recheck all forms and labels for completeness and legibility.

5.9.4.1 Field Performance Requirements

Specific field performance requirements/checks are listed in Table 5.47**.**

Table 5.47 Method quality objectives for field measurement for eco-fish indicator.

Quality Control Activity	Description and Requirements	Corrective Action
75% rule	Length of smallest fish in the composite must be at least 75% of the length of the longest fish.	Indicator lead will review composite data and advise the lab before processing begins

5.9.4.2 Field Quality Control Requirements

Specific quality control measures are listed in Table 5.48 for field measurements and observations.

Table 5.48 Field Quality Control: Whole Fish Tissue Samples for Ecological Analysis.

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels.	Obtain replacement supplies
Set up fishing equipment	An experienced fisheries biologist sets up the equipment. If results are poor, a different method may be necessary.	Note on field data sheet
Field Processing	The fisheries biologist will identify specimens in the field using a standardized list of common and scientific names. A re-check will be performed during processing.	Attempt to catch more fish of the species of interest.
Holding time	Frozen samples must be shipped on dry ice within 2 weeks of collection	Qualify samples
Sample Storage (field)	Keep frozen and check integrity of sample packaging.	Qualify sample as suspect for all analyses

5.9.5 Data Review

Checks made of the data in the process of review, verification, and validation are summarized in Table 5.49 and Table 5.50. The NCCA Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.49 Data validation quality control: eco-fish.

Activity or Procedure	Requirements and Corrective Action
Summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review data from reference toxicity samples	Determine impact and possible limitations on overall usability of data

Table 5.50 Data validation quality control: eco-fish tissue indicator.

Check Description	Frequency	Acceptance Criteria	Corrective Action
Taxonomic "reasonableness" checks	All data sheets	Generally known to occur in coastal waters or geographic area	Second or third identification by expert in that taxon
Composite validity check	All composites	Each composite sample must have 5 fish of the same species	Indicator lead will review composite data and advise the lab before processing begins
75% rule	All composites	Length of smallest fish in the composite must be at least 75% of the length of the longest fish.	Indicator lead will review composite data and advise the lab before processing begins

5.10 Human Health Fish Tissue (HTIS) (Great Lakes Nearshore and Lake Michigan Enhancement Sites Only)

5.10.1 Introduction

Fish are time-integrating indicators of persistent pollutants, and contaminant bioaccumulation in fish tissue has important human and ecological health implications. The NCCA Great Lakes human health fish tissue collection will provide information on the prevalence of selected chemicals (mercury, polychlorinated biphenyls (PCBs), and per- and polyfluoroalkyl substances (PFAS) and fatty acidsin fish commonly consumed by humans from the Great Lakes.

The human health fish tissue indicator procedures are based on EPA's *National Study of Chemical Residues in Lake Fish Tissue* (USEPA 2000a) and EPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1 (Third Edition)* (USEPA 2000b).

5.10.2 Sampling Design and Methods

Field crews collect human health fish tissue composites at all 225 of the Great Lakes nearshore sites (i.e., sites whose prefix begins with NGL20), all 38 Great Lakes island sites (sites whose prefix begins with ISA20), and all 12 Great Lakes National Park sites (sites whose prefix begins with NPA20). This will result in human health fish tissue being targeted at 45 sites per lake, plus the 38 island sites and 12 park sites in Lake Michigan. Human health fish tissue samples should consist of a composite of fish (i.e., five individuals of one target or alternate species) from each site. Field crews should make every effort to consistently obtain five fish for the human health fish composite sample; however, a sample of fewer than five fish is acceptable. Conversely, for the exceptions where field crews collect five fish that are small, they should collect up to five additional fish (for an overall composite of up to 10 fish) to provide adequate tissue for analysis.

As with the ecological fish tissue samples, crews collect human health fish tissue samples using any reasonable method that represents the most efficient or best use of the available time on station (e.g., hook and line, gill net, or otter trawl) to obtain the recommended target species (Table 5.51). Five fish will be collected per composite at each site, all of which must be large enough to provide sufficient tissue for analysis. Fish in each composite must all be of the same species, satisfy legal requirements of harvestable size (or be of consumable size if there are no harvest limits), and be of similar size so that the smallest individual in the composite is no less than 75% of the total length of the largest individual. If the recommended primary or secondary target species are unavailable, the on-site fisheries biologist will select an alternative species (i.e., a species that is commonly consumed in the study area, with specimens of harvestable or consumable size, and in sufficient numbers to yield a composite).

Table 5.51 Recommended target species: whole fish tissue collection

PRIMARY HUMAN HEALTH FISH TISSUE TARGET SPECIES		
FAMILY	SCIENTIFIC NAME	COMMON NAME
Centrarchidae	*Ambloplites rupestris*	Rock bass
	Micropterus dolomieu	Smallmouth bass
	Micropterus salmoides	Largemouth bass
	Pomoxis annularis	White crappie
	Pomoxis nigromaculatus	Black crappie
Cyprinidae	*Cyprinus carpio*	Common carp
Esocidae	*Esox lucius*	Northern pike
	Esox masquinongy	Muskellunge
	Esox niger	Chain pickerel
Ictaluridae	*Ictalurus punctatus*	Channel catfish
Gadidae	*Lota lota*	Burbot
Moronidae	*Morone americana*	White perch
	Morone chrysops	White bass
Percidae	*Perca flavescens*	Yellow perch
	Sander canadensis	Sauger
	Sander vitreus	Walleye
Salmonidae	*Coregonus clupeaformis*	Lake whitefish
	Oncorhynchus gorbuscha	Pink salmon
	Oncorhynchus kisutch	Coho salmon
	Oncorhynchus tshawytscha	Chinook salmon
	Oncorhynchus mykiss	Rainbow trout
	Salmo salar	Atlantic salmon
	Salmo trutta	Brown trout
	Salvelinus namaycush	Lake trout
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum
SECONDARY HUMAN HEALTH FISH TISSUE TARGET SPECIES		
FAMILY	SCIENTIFIC NAME	COMMON NAME
Catostomidae	*Carpiodes cyprinus*	Quillback
	Catostomus catostomus	Longnose sucker
	Catostomus commersonii	White sucker
	Hypentelium nigracans	Northern hogsucker
	Ictiobus cyprinellus	Bigmouth buffalo
	Ictiobus niger	Black buffalo
Centrarchidae	*Lepomis cyanellus*	Green Sunfish
	Lepomis gibbosus	Pumpkinseed
	Lepomis gulosus	Warmouth
	Lepomis macrochirus	Bluegill
	Lepomis megalotis	Longear Sunfish
Ictaluridae	*Ameiurus melas*	Black bullhead
	Ameiurus natalis	Yellow bullhead
	Ameiurus nebulosus	Brown bullhead
Salmonidae	*Coregonus artedi*	Cisco/ lake herring
	Coregonus hoyi	Bloater
	Prosopium cylindraceum	Round whitefish
	Salvelinus fontinalis	Brook trout

5.10.3 Sampling and Analytical Methodologies

Detailed methods and handling for samples are found in the NCCA 2020 FOM.

5.10.4 Pertinent Laboratory QA/QC Procedures

Detailed methods and handling for samples are in the EPA OST Manuals/QAPP.

5.10.5 Pertinent Field QA/QC Procedures

5.10.5.1 Quality Assurance Objectives

The relevant quality objectives for Great Lakes human health fish tissue sample collection activities are primarily related to sample handling issues. Types of field sampling data needed for the fish tissue indicator are listed in Table 5.52. Methods and procedures described in this QAPP and the FOM are intended to reduce the magnitude of the sources of uncertainty (and their frequency of occurrence) by applying:

- standardized sample collection and handling procedures, and
- use of trained scientists to perform the sample collection and handling activities.

Table 5.52 Field data types: Great Lakes human health whole fish tissue samples for fillet analysis

Variable or Measurement	Measurement Endpoint or Unit
Fish specimen	Species-level taxonomic identification
Fish length	Millimeters (mm), total length
Composite classification	Sample identification number
Specimen count classification	Specimen number

5.10.5.2 Quality Control Procedures: Field Operations

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities. Specific quality control measures are listed in **Table 5.53** for field measurements and observations.

Table 5.53 Field quality control: Great Lakes human health whole fish tissue samples for fillet analysis

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact human health fish coolers, solvent-rinsed foil, food-grade polyethylene tubing, and labels	Obtain replacement supplies

Quality Control Activity	Description and Requirements	Corrective Action
Field Processing	The crew will identify specimens to species in the field	Labs verify. If not same species, different species eliminated from sample
Sample Collection	The crew will retain 5 specimens (if available) of the same species to form the composite sample.	Labs verify. If not same species EPA makes compositing decisions. If fewer than 5 specimens, EPA determines composite suitability.
Sample Collection	The length of the smallest fish must be at least 75% of the length of the longest fish.	If fish out of length range requirement, EPA OST Fish Tissue Coordinator contacted for instructions

5.10.6 Data Management, Review and Validation

Checks made of the data in the process of review, verification, and validation are summarized in

Table 5.54. For the whole fish tissue fillet data, the OST Fish Tissue Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other EPA OST staff members. All raw data (including all standardized forms and logbooks) are retained in an organized fashion for seven years or until written authorization for disposition has been received from the NCCA Project Manager.

Table 5.54 Data validation quality control: Great Lakes human health whole fish tissue samples for fillet analysis

Check Description	Frequency	Acceptance Criteria	Corrective Action
Composite validity check	All composites	Each routine composite sample must have 5 fish of the same species	For non-routine composite samples, EPA OST Fish Tissue Coordinator contacted for instructions before processing begins
75% rule	All composites	Length of smallest fish in the composite must be at least 75% of the length of the longest fish.	For non-routine composite samples, EPA OST Fish Tissue Coordinator contacted for instructions before processing begins

5.11 Fish Tissue Plugs

5.11.1 Introduction

Fish are time-integrating indicators of persistent pollutants, and contaminant bioaccumulation in fish tissue has important human and ecological health implications. The NCCA 2020 tissue plug will provide information on the national distribution of mercury in fish species from all coastal waters.

5.11.2 Sample Design and Methods

Detailed methods and handling for samples are found in the NCCA 2020 Field Operations manual. The laboratory method for fish tissue is performance based. Example standard operating procedures are provided in Appendix C of the LOM.

5.11.3 Pertinent Laboratory QA/QC Procedures

5.11.3.1 Laboratory Performance Requirements

Specific laboratory performance requirements are listed in Table 5.55**.**

Table 5.55 Measurement data quality objectives for mercury in fish tissue plugs.

Variable or Measurement	MDL	Quantitation Limit
Mercury	0.47 ng/g	5.0 ng/g

5.11.3.2 Laboratory Quality Control Requirements

Specific laboratory quality control requirements are listed in Table 5.56.

Table 5.56 Quality Control for mercury in fish tissue plugs.

Activity	Evaluation/Acceptance Criteria	Corrective Action
Demonstrate competency for analyzing fish samples to meet the performance measures	Demonstration of past experience with fish tissue samples in applying the laboratory SOP in achieving the method detection limit	EPA will not approve any laboratory for NCCA sample processing if the laboratory cannot demonstrate competency. In other words, EPA will select another laboratory that can demonstrate competency for its NCCA samples.
Check condition of sample when it arrives.	Sample issues, such as punctures or rips in wrapping; missing label; temperature; adherence to holding time requirements; sufficient volume for test. All samples should arrive at the laboratory frozen.	Assign an appropriate condition code.

Store sample appropriately. While stored at the laboratory, the sample must be kept at a maximum temperature of -20° C.	Check the temperature of the freezer per laboratory's standard operating procedures.	Record temperature of sample upon arrival at the laboratory. If at any other time, samples are warmer than required, note temperature and duration in comment field.
Analyze sample within holding time	The test must be completed within the holding time (i.e., 1 year). If the original test fails, then the retest also must be conducted within the holding time.	Perform test but note reason for performing test outside holding time. EPA expects that the laboratory will exercise every effort to perform tests before the holding time expires.
Maintain quality control specifications from selected method/SOP (that meets the measurement data quality objectives)	Data meet all QC specifications in the selected method/SOP.	If data do not meet all QC requirements, rerun sample or qualify data. If the lab believes the data are to be qualified without rerunning sample, the lab must consult with the EPA Survey QA Lead before proceeding.
Maintain the required MDL/RL and denote the dilution factor	Evaluate for each sample. Samples should not be diluted more than necessary. Labs must report the dilution factor and adjusted MDL/RL	If MDL could not be achieved, then provide dilution factor or QC code and explanation in the comment field.
Use consistent units for QC samples and field samples	Verify that all units are provided in wet weight units and consistently	If it is not possible to provide the results in the same units as most other analyses, then assign a QC code and describe the reason for different units in the comments field of the database.
Maintain completeness	Completeness objective is 95% for all parameters.	Contact the EPA Survey QA Lead immediately if issues affect laboratory's ability to meet completeness objective.

5.11.3.3 **Data Reporting**

Table 5.57 Data Reporting Criteria: Fish Tissue Plugs

Measurement	Units	Expressed to the Nearest
Metals	fish tissue wet weight	0.01

5.11.4 Pertinent Field QA/QC Procedures

Field data quality is addressed, in part, by application and consistent performance of valid procedures documented in the standard operating procedures detailed in the NCCA 2020 FOM. That quality is enhanced by the training and experience of project staff and documentation of sampling activities.

Crews will collect fish plugs for mercury. Field crews will verify that all sample containers are uncontaminated and intact, and that all sample labels are legible and intact.

Before leaving the field, the crews will:

- Check the label to ensure that all written information is complete and legible.
- Place a strip of clear packing tape over the label, covering the label completely.
- Enter a flag code and provide comments on the Sample Collection Form in the App if there are any problems in collecting the sample or if conditions occur that may affect sample integrity.
- Store the sample frozen.
- Recheck all forms and labels for completeness and legibility.

5.11.4.1 Field Performance Requirements

Specific field performance requirements are listed in Table 5.58**.**

Table 5.58 Method quality objectives for field measurement for the fish tissue plug indicator.

Quality Control Activity	Description and Requirements	Corrective Action
Minimum Acceptable Fish Length	Fish plugs should not be collected from fish smaller than 190 mm in length.	If unable to collect plug sample from fish longer than 190 mm, do not collect plug and flag sample.
75% rule	Length of smaller of the two fish from which plug samples were collected must be no less than 190 mm and at least 75% of the length of the longest fish.	Collect fish plug and flag sample as not meeting 75% rule.

5.11.4.2 Field Quality Control Requirements

Specific quality control measures are listed in Table 5.59 for field measurements and observations.

Table 5.59 Field Quality Control: Fish Tissue Plug.

Quality Control Activity	Description and Requirements	Corrective Action
Check integrity of sample containers and labels	Clean, intact containers and labels.	Obtain replacement supplies
Set up fishing equipment	An experienced fisheries biologist sets up the equipment. If results are poor, a different method may be necessary.	Note on field data sheet
Field Processing	The fisheries biologist will identify specimens in the field using a standardized list of common and scientific names. A re-check will be performed during processing.	Attempt to catch more fish of the species of interest.

Holding time	Frozen samples must be shipped on dry ice within 2 weeks of collection.	Qualify samples
Sample Storage (field)	Keep frozen and check integrity of sample packaging.	Qualify sample as suspect for all analyses

5.11.5 Data Review

Checks made of the data in the process of review, verification, and validation are summarized in Table 5.60. The Project QA Coordinator is ultimately responsible for ensuring the validity of the data, although performance of the specific checks may be delegated to other staff members.

Table 5.60 Data validation quality control: Fish Tissue Plugs.

Activity or Procedure	Requirements and Corrective Action
Range checks, summary statistics, and/or exploratory data analysis (e.g., box and whisker plots)	Correct reporting errors or qualify as suspect or invalid.
Review holding times	Qualify value for additional review
Review data from QA samples (laboratory PE samples, and interlaboratory comparison samples)	Determine impact and possible limitations on overall usability of data

5.12 Microplastics in Sediment

The laboratory SOP for Microplastics in Sediment will be under the Quality Assurance protocol by the Office of Research and Development (ORD) laboratory processing the sample. Detailed sample collection and handling procedures are found in the NCCA 2020 Field Operations Manual. Example SOPs are provided in **Appendix D: Microplastics in Sediment** in the LOM.

5.13 Total Alkalinity

5.13.1 Introduction

Total alkalinity (TA) is a characteristic of seawater that, in combination with other measurements, can be used to calculate total pH (i.e., coastal acidification) and the availability of carbonate ions used by marine organisms to produce structural materials such as corals and shells. TA is also used to calculate the fate of carbon that enters coastal waters in various forms and is useful as a direct indicator of seawater buffering capacity. TA is defined differently from the alkalinity measurements typically used in freshwater monitoring. In addition, the above seawater calculations are sensitive to tiny errors in TA

determination, so monitoring programs aim for extreme care in the collection, handling, and analysis of TA samples.

The laboratory SOP for Total Alkalinity will be under the Quality Assurance protocol by the Office of Research and Developmemt (ORD) laboratory processing the sample. Detailed sample collection and handling procedures are found in the NCCA 2020 Field Operations Manual. Example SOPs are provided in **Appendix E: Total Alkalinity** in the LOM.

5.14 δN15 Isotope in Benthic Organic Matter

The laboratory SOP Delta N15 Isotope in Benthic Organic Matter will be under the Quality Assurance protocol by the Office of Research and Development (ORD) laboratory processing the sample. Detailed sample collection and handling procedures are found in the NCCA 2020 Field Operations Manual. Example SOPs are provided in **Appendix F: Research Indicator- Δ N15 Isotope in Benthic Organic Matter** in the LOM.

6 Field and Biological Quality Evaluation & Assistance

6.1 National Coastal Condition Assessment Field Quality Evaluation and Assistance Visit Plan

EPA, contractor and other qualified staff will conduct evaluation and assistance visits with each field crew early in the sampling and data collection process, if possible, and corrective actions will be conducted in real time. These visits provide both a quality check for the uniform evaluation of the data collection methods and an opportunity to conduct procedural reviews, as required, minimizing data loss due to improper technique or interpretation of field procedures and guidance. Through uniform training of field crews and review cycles conducted early in the data collection process, sampling variability associated with specific implementation or interpretation of the protocols will be significantly reduced. The visit also provides the field crews with an opportunity to clarify procedures and offer suggestions for future improvements based on their sampling experience preceding the visit. The field evaluations, while performed by a number of different supporting collaborator agencies and participants, will be based on the uniform training, plans, and checklists. The field evaluations will be based on the evaluation plan and field evaluation checklist. EPA has scheduled this review and assistance task for each unique field crew collecting and contributing data under this program. If unforeseen events prevent the EPA from evaluating every crew, the NCCA Quality Assurance Coordinator (QAC) will rely on the data review and validation process to identify unacceptable data that will not be included in the final database. If inconsistencies cannot be resolved, the QAC may contact the Field Crew Leader for clarification..

One or more designated EPA, contractor or other staff who are qualified (i.e. have completed training) in the procedures of the NCCA 2020 field sampling operations will visit trained state, contractor, federal agency and EPA field sampling crews during sampling operations on site. If membership of a field crew changes, and at least two of the members have not been evaluated previously, the field crew must be evaluated again during sampling operations as soon as possible to ensure that all members of the field crew understand and can perform the procedures. If a deviation is needed from the process described here, the staff member conducting the assistance visit (AV) must contact the Assistance Visit Coordinator who will contact the NCCA Project Lead and the NCCA Project QA Coordinator to determine an acceptable course of action.

The purpose of this on-site visit will be to identify and correct deficiencies during field sampling operations. The process will involve preparation activities, field day activities and post field day activities as described in the following sections. Additionally, conference calls with crews may be held approximately every two weeks to discuss issues as they come up throughout the sampling season.

6.1.1 Preparation Activities

- Each Field Crew Evaluator will schedule an assistance visit with their designated crews in consultation with the Contractor Field Logistics Coordinator, Regional NCCA Coordinator, and respective Field Sampling Crew Leader. Ideally, each Field Crew will be evaluated within the first two weeks of beginning sampling operations, so that procedures can be corrected or additional training provided, if needed.
- Each Evaluator is responsible for providing their own field gear sufficient to accompany the Field Sampling Crews during a complete sampling cycle. Schedule of the Field visits will be made by the Evaluator in consultation with the respective Field Crew Leader. **Evaluators should be prepared to spend additional time in the field if needed (see below).**
- Each Field Crew Evaluator will ensure that field crews are aware of their visit plans and all capacity and safety equipment will be provided for the Field Crew Evaluator.
- Each Field Crew Evaluator will need to bring the items listed in Table 6.1.

Table 6.1 Equipment and Supplies – Field Evaluation and Assistance Visits

Type	Item	Quantity
Assistance Visit Checklist	Appendix D (see FOM)	1
Documentation	NCCA 2020 Field Operations Manuals NCCA 2020 Quality Assurance Project Plan Clipboard Pencils (#2, for data forms)/Pen (or computer for electronic versions) Field notebook (optional)	1 1 1 1 1
Gear	Field gear (e.g., protective clothing, sunscreen, insect repellent, hat, water, food, backpack, cell phone)	As needed

6.1.2 Field Day Activities

- The Field Crew Evaluator will review the Field Evaluation & Assistance Visit Checklist with each crew during the field sampling day and establish and plan and schedule for their evaluation activities for the day.
- The Field Crew Evaluator will view the performance of a field crew through one complete set of sampling activities as detailed on the checklist.
- Scheduling might necessitate starting the evaluation midway on the list of tasks at a site, instead of at the beginning. In that case, the Field Crew Evaluator will follow the crew to the next site to complete the evaluation of the first activities on the list.

- If the field crew misses or incorrectly performs a procedure, the Field Crew Evaluator will note this on the checklist and *immediately point this out so the mistake can be corrected on the spot*. The role of the Field Crew Evaluator is to provide additional training and guidance so that the procedures are being performed consistent with the FOM, all data are recorded correctly, and paperwork, if applicable, is properly completed at the site.
- When the sampling operation has been completed, the Field Crew Evaluator will review the results of the evaluation with the field crew before leaving the site (if practicable), noting positive practices and problems (i.e., weaknesses [might affect data quality]; deficiencies [would adversely affect data quality]). The Field Crew Evaluator will ensure that the field crew understands the findings and will be able to perform the procedures properly in the future.
- The Field Crew Evaluator will review the list and record responses or concerns from the field crew, if any; on the checklist (this may happen throughout the field day).
- The Field Crew Leader will sign the checklist after this review.

6.1.3 Post Field Day Activities

- The Field Crew Evaluator will review the checklist that evening and provide a summary of findings, including lessons learned and concerns.
- If the Field Crew Evaluator finds major deficiencies in the field crew operations (e.g., less than two members, equipment, or performance problems) the Field Crew Evaluator must contact the EPA NCCA Project QA Coordinator. The EPA NCCA Project QA Coordinator will work with the EPA NCCA Program Manager to determine the appropriate course of action. Data records from sampling sites previously visited by this Field Crew will be checked to determine whether any sampling sites must be redone.
- The Field Crew Evaluator will retain a copy of the checklist and submit to the EPA Logistics Coordinator either via Fed-Ex or electronically.
- The EPA Logistics Coordinator and the NCCA Project QA Coordinator or authorized designee (member of the NCCA 2020 quality team) will review the returned Field Evaluation and Assistance Visit Checklist, note any issues, and check off the completion of the evaluation for each field crew.

6.1.4 Summary

Table 6.2 summarizes the plan, checklist, and corrective action procedures.

Table 6.2 Summary of Field Evaluation and Assistance Visit Information

Field Evaluation Plan	The Field Crew Evaluator: • Arranges the field evaluation visit in consultation with the Project QA Coordinator, Regional NCCA Coordinator, and respective Field Sampling Crew Leader, ideally within the first two weeks of sampling • Observes the performance of a crew through one complete set of sampling activities

	• Takes note of errors the field crew makes on the checklist and immediately point these out to correct the mistake • Reviews the results of the evaluation with the field crew before leaving the site, noting positive practices, lessons learned, and concern
Field Evaluation Checklist	The Field Crew Evaluator: • Observes all pre-sampling activities and verifies that equipment is properly calibrated and in good working order, and protocols are followed • Checks the sample containers to verify that they are the correct type and size, and checks the labels to be sure they are correctly and completely filled out • Confirms that the field crew has followed NCCA protocols for locating the X -site • Observes the index site sampling, confirming that all protocols are followed • Observes the littoral sampling and habitat characterization, confirming that all protocols are followed • Records responses or concerns, if any, on the Field Evaluation and Assistance Checklist
Corrective Action Procedures	• If the Field Crew Evaluator's findings indicate that the Field Crew is not performing the procedures correctly, safely, or thoroughly, the Evaluator must continue working with this Field Crew until certain of the crew's ability to conduct the sampling properly so that data quality is not adversely affected • If the Field Crew Evaluator finds major deficiencies in the Field Crew operations the Evaluator must contact the EPA NCCA Project QA Coordinator

6.2 National coastal condition assessment laboratory quality evaluation and assistance visit plan

As part of the NCCA 2020, field samples will be collected at each assessment site. These samples will be sent to laboratories cooperating in the assessment. To ensure quality, each Project Cooperator laboratory analyzing samples from the NCCA 2020 will receive an evaluation from an NCCA Lab Evaluator. All Project Cooperator laboratories will follow these guidelines.

No national program of accreditation for laboratory processing for many of our indicators currently exists. For this reason, a rigorous program of laboratory evaluation has been developed to support the NCCA 2020.

Given the large number of laboratories participating in the NCCA 2020, it is not feasible to perform an assistance visit[11] (AV) on each of these laboratories. An AV would include an on-site visit to the laboratory lasting at least a day. As a result, the EPA Headquarters Project Management Team will conduct remote review of laboratory certifications and accreditations of all laboratories. Additionally, EPA will include an inter-laboratory comparison between some laboratories (mainly for biological indicators). If issues arise from the remote review or inter-laboratory comparison that cannot be resolved remotely, the EPA Quality Team and/or contractors will perform an on-site visit to the

[11] *The evaluation of the labs is being considered an Assistance Visit rather than an audit because the evaluation is designed to provide guidance to the labs rather than as "inspection" as in a traditional audit.*

laboratory. This process is in keeping with EPA's *Policy to Assure Competency of Laboratories, Field Sampling, and Other Organizations Generating Environmental Measurement Data under Agency-Funded Acquisitions.*

6.2.1 Remote Evaluation/Technical Assessment

A remote evaluation procedure has been developed for performing assessment of all laboratories participating in the NCCA 2020.

The Laboratory Review Coordinator, the NCCA Project QA Coordinator and other members of the NCCA QA Team will conduct laboratory evaluation prior to data analysis to ensure that the laboratories are qualified and that techniques are implemented consistently across the multiple laboratories generating data for the program. The EPA National Aquatic Resource Surveys team has developed laboratory evaluation plans to ensure uniform interpretation and guidance in the procedural reviews.

The NCCA Quality Team is using a procedure that requests the laboratory to provide documentation of its policies and procedures. For the NCCA 2020 project, the Quality Team is requesting that each participating laboratory provide the following documentation:

- The laboratory's Quality Manual, Quality Management Plan or similar document.
- Standard Operating Procedures (SOPs) for each analysis to be performed.
- Long term Method Detection Limits (MDLs) for each instrument used and Demonstration of Capability for each analysis to be performed.
- A list of the laboratory's accreditations and certifications, if any.
- Results from Proficiency Tests for each analyte to be analyzed under the NCCA 2020 project.

If a laboratory has clearly documented procedures for sample receiving, storage, preservation, preparation, analysis, and data reporting; has successfully analyzed Proficiency Test samples (if required by EPA, EPA will provide the PT samples); has a Quality Manual that thoroughly addresses laboratory quality including standard and sample preparation, record keeping and QA non-conformance; participates in a nationally recognized or state certification program; and has demonstrated ability to perform the testing for which program/project the audit is intended, then the length of an on-site visit will be minimum, if not waived entirely. The QA Team will make a final decision on the need for an actual on-site visit after the review and evaluation of the documentation requested.

If a laboratory meets or exceeds all of the major requirements and is deficient in an area that can be corrected remotely by the lab, suggestions will be offered and the laboratory will be given an opportunity to correct the issue. The QA Team will then verify the correction of the deficiency remotely. The on-site visit by EPA and/or a contractor should only be necessary if the laboratory fails to meet the major requirements and is in need of help or fails to produce the requested documentation.

In addition, all labs must sign a Lab Signature Form (see NCCA 2020 LOM) indicating that they will abide by the following:

- Utilize procedures identified in the NCCA 2020 Lab Operations Manual (or equivalent). If using equivalent procedures, please provide procedures manual to demonstrate ability to meet the required MQOs.
- Read and abide by the NCCA 2020 Quality Assurance Project Plan (QAPP) and related Standard Operating Procedures (SOPs).
- Have an organized IT system in place for recording sample tracking and analysis data.
- Provide data using the template provided in the Lab Operations Manual.
- Provide data results in a timely manner. This will vary with the type of analysis and the number of samples to be processed. Sample data must be received no later than May 1, 2016 or as otherwise negotiated with EPA.
- Participate in a lab technical assessment or audit if requested by EPA NCCA Quality Team staff (this may be a conference call or on-site audit).

If a lab is participating in biology analyses, they must, in addition, abide by the following:

- Use taxonomic standards outlined in the NCCA 2020 Lab Manual.
- Participate in taxonomic reconciliation exercises during the field and data analysis season, which include conference calls and other lab reviews (see more below on Inter-laboratory comparison).

6.2.2 Water Chemistry Laboratories

The water chemistry laboratory approval process which is outlined on in the previous paragraphs of this section is deemed appropriate because many laboratories participate in one or more national laboratory accreditation programs such as the National Environmental Laboratory Accreditation Program (NELAP), International Organization for Standardization (ISO-17025) as well as various state certification programs which include strict requirements around documentation and procedures as well as site visits by the accrediting authority. It is built off of the process s used by the NLA 2012 and NRSA 2013/14. The laboratories participating in NCCA 2020 meet these qualifications and as such have demonstrated their ability to function independently. This process is one that has been utilized in Region 3 for many years and is designed around the national accrediting programs listed above.

6.2.3 Inter-laboratory Comparison

The NCCA QA plan includes an inter-laboratory investigation for the laboratories performing analysis on benthic invertebrates for the NCCA 2020. This process is defined as an inter-laboratory comparison since the same protocols and method will be used by both laboratories as described in this manual. The QA plan also includes an independent taxonomist (EPA Contractor) to re-identify 10% of the samples from each laboratory. No site visit is envisioned for these laboratories unless the data submitted and reviewed by EPA does not meet the requirements of the inter-laboratory comparison described.

6.2.4 Assistance Visits

Assistance Visits will be used to:

- Confirm the NCCA 2020 Laboratory Operations Manual (LOM) methods are being properly implemented by cooperator laboratories.
- Assist with questions from laboratory personnel.
- Suggest corrections if any errors are made in implementing the lab methods.

Evaluation of the laboratories will take the form of administration of checklists which have been developed from the LOM to ensure that laboratories are following the methods and protocols outlined therein. The checklist will be administered on-site by a qualified EPA scientist or contractor.

Below are examples of the Document Request form used for both the Biological laboratories and the Chemical laboratories.

6.2.5 NCCA 2020 Document Request Form Chemistry Laboratories

EPA and its state and tribal partners will conduct a survey of the nation's coastal waters. This National Coastal Condition Assessment (NCCA), is designed to provide statistically valid regional and national estimates of the condition of coastal waters. Consistent sampling and analytical procedures ensure that the results can be compared across the country. As part of the NCCA 2020, the Quality Assurance Team will conduct a technical assessment to verify quality control practices in your laboratory and its ability to perform chemistry analyses under this project. Our review will assess your laboratory's ability to receive, store, prepare, analyze, and report sample data generated under EPA's NCCA 2020.

The first step of this assessment process will involve the review of your laboratory's certification and/or documentation. Subsequent actions may include (if needed): reconciliation exercises and/or a site visit. All laboratories will need to complete the following forms:

If your lab has been previously approved within the last 5 years for the specific parameters:

- A signature on the attached Laboratory Signature Form indicates that your laboratory will follow the quality assurance protocols required for chemistry laboratories conducting analyses for the NCCA 2020. A signature on the QAPP and the LOM Signature Form indicates that you will follow both the QAPP and the LOM.

If you have not been approved within the last 5 years for the specific parameters in order for us to determine your ability to participate as a laboratory in the NCCA, we are requesting that you submit the following documents (if available) for review:

- Documentation of a successful quality assurance audit from a prior National Aquatic Resource Survey (NARS) that occurred within the last 5 years (if you need assistance with this please contact the individual listed below).

- Documentation showing participation in a previous NARS for Water Chemistry for the same parameters/methods.

Additionally, we request that all laboratories provide the following information in support of your capabilities, (these materials are required if neither of the two items above are provided):

- A copy of your Laboratory's accreditations and certifications if applicable (i.e. NELAC, ISO, state certifications, North American Benthological Society (NABS), etc.).
- An updated copy of your Laboratory's QAPP.
- Standard Operating Procedures (SOPs) for your laboratory for each analysis to be performed (if not covered in NCCA 2020 LOM).
- Documentation attesting to experience running all analytes for the NCCA 2020, including chlorophyll a.

This documentation may be submitted electronically via e-mail to forde.kendra@epa.gov. Questions concerning this request can be submitted forde.kendra@epa.gov (202-566-0417) or sullivan.hugh@epa.gov.

6.2.6 NCCA 2020 Document Request Form Biology Labs

EPA and its state and tribal partners will conduct a survey of the nation's coastal waters . This National Coastal Condition Assessment (NCCA), is designed to provide statistically valid regional and national estimates of the condition of coastal waters. Consistent sampling and analytical procedures ensure that the results can be compared across the country. As part of the NCCA 2020, the Quality Assurance Team will conduct a technical assessment to verify quality control practices in your laboratory and its ability to perform biology analyses under this project. Our review will assess your laboratory's ability to receive, store, prepare, analyze, and report sample data generated under EPA's NCCA 2020.

The first step of this assessment process will involve the review of your laboratory's certification and/or documentation. Subsequent actions may include (if needed): reconciliation exercises and/or a site visit. All laboratories will need to complete the following forms:

- If your laboratory has been previously approved within the last 5 years for the specific parameters: A signature on the attached Laboratory Signature Form indicates that your laboratory will follow the quality assurance protocols required for biology laboratories conducting analyses for the NCCA 2020. A signature on the QAPP and the LOM Signature Form indicates you will follow both the QAPP and the LOM.

If you have not been approved within the last 5 years for the specific parameters, in order for us to determine your ability to participate as a laboratory in the NCCA, we are requesting that you submit the following documents (if available) for review:

- Documentation of a successful quality assurance audit from a prior National Aquatic Resource Survey (NARS) that occurred within the last 5 years (if you need assistance with this please contact the individual listed below).
- Documentation showing participation in previous NARS for this particular indicator.

Additionally, we request that all laboratories provide the following information in support of your capabilities, (these materials are required if neither of the two items above are provided):

- A copy of your Laboratory's accreditations and certifications if applicable (i.e. NELAC, ISO, state certifications, NABS, etc.).
- Documentation of NABS (or other) certification for the taxonomists performing analyses (if applicable).
- An updated copy of your Laboratory's QAPP.
- Standard Operating Procedures (SOPs) for your lab for each analysis to be performed (if not covered in NCCA 2020 LOM).

This documentation may be submitted electronically via e-mail to forde.kendra@epa.gov. Questions concerning this request can be submitted forde.kendra@epa.gov (202-566-0417) or sullivan.hugh@epa.gov.

7 Data Analysis Plan

The goal of the NCCA is to address three key questions about the quality of the Nation's coastal waters:

- What percent of the Nation's coastal waters are in good, fair, and poor condition for key indicators of chemical water quality, ecological condition, and suitability for recreation?
- How are conditions changing over time?
- What is the relative importance of key stressors (e.g., nutrients and pathogens) in impacting the biota?

The Data Analysis Plan describes the approach used to process the data generated during the field survey to answer these three questions. Results from the analysis will be included in the final report and used in future analysis.

7.1 Data Interpretation Background

The intent of data analyses is to describe the occurrence and distribution of selected indicators throughout the estuaries and coastal waters of the United States within the context of regionally relevant expectations. The analyses will culminate by categorizing and reporting the condition of coastal waters as being good, fair, or poor condition. Statistical analysis techniques appropriate for using data collected using probabilistic survey designs, will serve as the primary method for interpreting survey results. However, other data analyses will be used for further assessment investigations as described below.

Because of the large-scale and multijurisdictional nature of this effort, the key issues for data interpretation are: the scale of assessment, selecting the effective indicators across the range of systems included in the survey, and determining thresholds for judging condition. An NCCA Data Analysis work group will be created to address these points and to help strengthen NCCA assessments.

7.1.1 Scale of Assessment

EPA selected the sampling locations for the NCCA survey using a probability based design, and developed rules for selection to meet certain distribution criteria, while ensuring that the design yielded a set of coastal areas that would provide for statistically valid conclusions about the condition of the population of coastal areas across the nation.

7.1.2 Selecting Indicators

Indicators for the 2020 survey will basically remain the same as those used in the previous National Coastal Condition Assessment[12], with a few modifications. The indicators for NCCA 2020 include nutrients in water, light attenuation, sediment chemistry, sediment toxicity, benthic communities, whole body fish tissue, fish tissue plugs for mercury analysis, microcystins, and enterococci. Supplemental and research indicators also include algal toxins, fish tissue filets (Great Lakes only), phytoplankton (Great Lakes only), and under water vide (Great Lakes only). Of these, fish tissue plugs, microcystins and algal toxins are new indicators.

7.2 Datasets to be used for the Report

The Dataset used for the 2020 assessment consists of data collected during NCCA 2020, the NCCA 2010, and data from historic National Coastal Condition Reports (NCCRs) for tracking changes in water quality data. Other data may be added as appropriate.

7.3 Indicators for the Coastal Assessment

7.3.1 Water Chemistry and Chlorophyll

A wide array of water chemistry parameters will be measured. Water chemistry analysis is critical for interpreting the biological indicators. Chlorophyll-a, Secchi depth, light attenuation and nutrient measurements will be used to create a water quality index and identify stressors.

7.3.2 Benthic Invertebrates

To distinguish degraded benthic habitats from undegraded benthic habitats, EMAP and NCA have developed regional (Southeast, Northeast, and Gulf coasts) benthic indices of environmental condition (Engle et al., 1994; Weisberg et al., 1997; Engle and Summers, 1999; Van Dolah et al., 1999; Hale and Heltshe, 2008). A new Multi-metric approach (M-AMBI) is also being developed and peer reviewed for potential use in the NCCA 2020 report.

7.3.3 Sediment Chemistry/Characteristics

The NCCA is collecting sediment samples, measuring the concentrations of chemical constituents and percent TOC in the sediments, and evaluating sediment toxicity as described in the QAPP, field operations manual and laboratory operations manual. The results of these evaluations will be used to identify the percent of coastal waters with sediment contamination. The sediment quality index is based on measurements of three component indicators of sediment condition: sediment toxicity, sediment contaminants, and sediment TOC. This information will also be used in identifying stressors to ecological/biological condition.

[12] For more information visit the NCCA website at: https://www.epa.gov/national-aquatic-resource-surveys/ncca

7.3.4 Enterococci Data Analysis

The presence of certain levels of enterococci is associated with pathogenic bacterial contamination of the resource. A single enterococci water sample will be collected at each site, then filtered, processed, and analyzed using qPCR. Bacterial occurrence and distribution will be reported. Data interpretation will be enhanced by comparison to USEPA thresholds[13]. In 2012, EPA released new recreational water quality criteria recommendations for protecting human health in all coastal and non-coastal waters designated for primary contact recreation use. NCCA will use the enterococci statistical threshold values for marine and freshwaters to assess the percent of coastal waters above and below human health levels of concern.

7.3.5 Fish Chemistry

For the NCCA, both juvenile and adult target fish species will be collected from all monitoring stations where fish were available, and whole-body contaminant burdens will be determined. The target species typically included demersal (bottom dwelling) and pelagic (water column-dwelling) species that are representative of each of the geographic regions. The EPA recommended values for fish advisories will serve as the threshold against which to evaluate risk.

7.3.6 Algal toxins

The presence of algal toxins can be an indicator of human and/or ecological risk. Microcystin and other algal toxins will be collected at each site. Occurrence and distribution will be reported. Where thresholds are available (such as World Health Organization or other applicable thresholds) concentrations will be reported against those values.

7.4 NCCR Index Development Approach

EPA intends to calculate the indices used in previous NCCR reports. Information on this approach, the indices and related thresholds can be found in the National Coastal Condition Report III (EPA 2008.)

7.5 Calculation of Population Estimates

Once the individual indicator values are calculated for each sampling location, population estimates will be generated using the procedures outlined by EMAP and found on the Aquatic Resource Monitoring website (https://archive.epa.gov/nheerl/arm/web/html/index.html). The population estimates will include estimates of uncertainty for each indicator. The output of these analyses are the specific results that will appear in the coastal assessment report.

7.6 Other Change Analyses

Biological and stressor/chemical data from the NCCA and previous reports will be analyzed to see what

[13] For more information visit EPA's website at https://www.epa.gov/wqc/2012-recreational-water-quality-criteria-documents

changes have occurred over time.

7.7 Index Precision and Interpretation

NCCA indicators will be repeated at 10% of the sites during the summer index sampling period. These repeat samples allow an assessment of the within-season repeatability of these indicators and metrics. The NCCA will calculate the precision of select site condition indicators using a basic measure of repeatability – the RMSrep or the Root Mean Square of repeat visits.

The RMSrep is a measure of the absolute (unscaled) precision of the whole measurement and analytical process as well as short-term temporal variability within the summer sampling period. The RMSrep for a metric is an estimate of its average standard deviation if it were measured repeatedly at all sites, and then standard deviations for each site were averaged. For Log transformed data, the antilog of the RMSrep represents a proportional standard deviation. For example, if theRMSrep of the unscaled total phosphorus data is 0.179, the antilog is 1.51. Therefore, the RMSrep of 0.179 for Log10(PTL+1) means that the error bound on a measurement at a site is +/- 1.51. Because the data are Log10 transformed, the measured value times 1.51 gives the upper ("+") error bound and divided by 1.51 gives the lower ("-") error bound. So, the +/- 1 StdDev error bounds on a PTL measurement of 10 ug/L during the index period is (10 ÷ 1.51) to (10 ×1.51) or 6.6 to 15.1.

Another way of scaling the precision of metrics is to examine their components of variance. The NCCA calculates signal to noise ratios for each indicator to determine whether the amount of variance is acceptable for it to be used in the data analysis described above. The ratio of variance among sites to measurement (or temporal) variation within individual sites has been termed a "Signal-to-noise" ratio. The S/N ratio assesses the ability of the metric to discern differences among sites in this survey context. If the among-site variance in condition in the region, large estuary, Great Lake or nation is high, then the S/N is high and the metric is ble to adequately discern differences in site condition. The NCCA uses a variance-partitioning explained in Kaufmann et al. (1999) and Faustini and Kaufmann (2007), in which the authors referred to RMSrep as RMSE and evaluated S/N in stream physical habitat variables. In those publications, the authors generally interpreted precision to be high relative to regional variation if S/N >10, low if S/N <2.0, and moderate if in-between. When S/N is over about 10, the effect of measurement error on most interpretations is nearly insignificant within the national context; when S/N is between 6 and 10, measurement effects are minor. When S/N ratios are between 2 and 5, the effects of imprecision should be acknowledged, examined and evaluated. Ratios between 2 and 4 are usually adequate to make good-fair-poor classifications in the NCCA, but there is some distortion of cumulative distribution functions () and a significant limitation to ability of a multiple linear regression to explain the amount of among-site variance using single visit data.

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