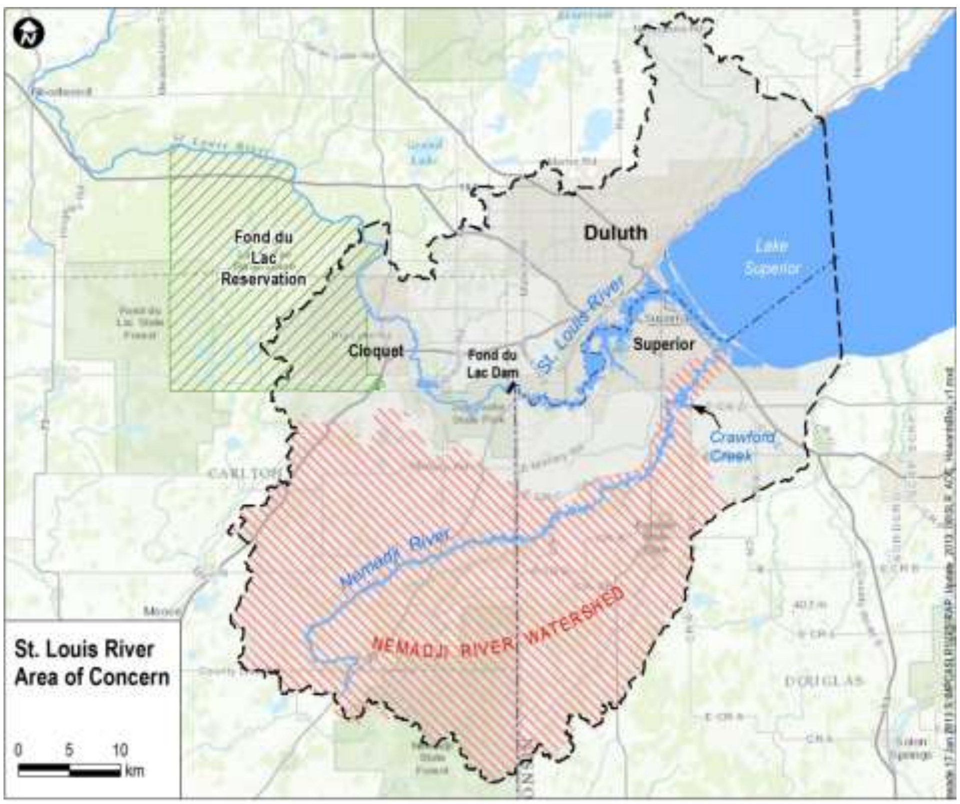
St. Louis River Area of Concern Quality Assurance Program Plan for Minnesota Based Projects

January 2015



Minnesota Pollution Control Agency

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List of Acronyms

AIS	Aquatic Invasive Species
AOC	Area of Concern
ASTM	American Society for Testing and Materials
BUI	Beneficial Use Impairment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	Chain of Custody
DQO	Data Quality Objective
FdL	Fond du Lac Band of Chippewa
GLNPO	Great Lakes National Program Office
GLRI	Great Lakes Restoration Initiative
GLWQA	Great Lakes Water Quality Act
GPS	Geographic Positioning System
MDL	Method Detection Limit
MERLA	Minnesota Environmental Response and Liability Act
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NAD	North American Datum
QA	Quality Assurance
QAM	Quality Assurance Manual
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QC	Quality Control
RAP	Remedial Action Plan (2013)
RCRA	Resource Conservation and Recovery Act
RL	Reporting Limit
RPD	Relative Percent Difference
SE	Sorting Efficiency
SLRAOC	Saint Louis River Area of Concern
SOP	Standard Operating Procedure
SQT	Sediment Quality Target
USACE	United States Army Corps of Engineers
USEPA/EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VIC	Voluntary Investigation & Cleanup (MN non-petroleum brownfields cleanup program)
WDNR	Wisconsin Department of Natural Resources

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Section A: Project Management

A 1: Purpose of the St. Louis River Area of Concern Quality Assurance Program Plan (QAPrP)

The purpose for this QAPrP is to:

1. Provide guidance on data quality requirements for all private and public contractors undertaking work in the St. Louis River Area of Concern (SLRAOC)
2. Ensure all data generated for assessing and removing Beneficial Use Impairments (BUIs) in the SLRAOC meet minimum data quality standards.
3. Provide uniform data quality and consistent labeling for all data in the SLRAOC Data System to enable temporal comparisons within and between sites.

All projects that are designed to address one or more of the BUIs within the SLRAOC must have a project specific Quality Assurance Project Plan (QAPP) or other quality documentation that confirms to United States Environmental Protection Agency's (USEPA) Policy and Program Requirements for the Mandatory Agency-wide Quality System (USEPA, 2000b), that is approved by the quality assurance staff of the entity conducting or funding the project.

This QAPrP documents the minimum framework for data quality requirements necessary to aid program staff, partners and contractors when:

- planning project proposals
- drafting project specific data quality documents and
- evaluating completed project tasks

In addition, any SLRAOC project that generates data for the use of and/or intended to be stored in the SLRAOC Data System should follow this QAPrP.

A 2: Program Organization and Responsibility

In the State of Minnesota, the Minnesota Pollution Control Agency (MPCA) has the primary responsibility for delisting the SLRAOC. However, MPCA has partnered with many Federal, State, Tribal and local governmental and non-governmental organizations to ensure timely completion of various aspects of the remediation and restoration efforts within the SLRAOC.

A 2.1: Program Responsibilities

EPA Great Lakes National Program Office: The Great Lakes National Program Office (GLNPO) coordinates U.S. efforts with Canada under the Great Lakes Water Quality Agreement (GLWQA) to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem, which includes Lakes Superior, Michigan, Huron, Erie, and Ontario. GLNPO brings together federal, state, tribal, local, and industry partners under the strategic framework of the Great Lakes Restoration Initiative (GLRI) to accomplish the objectives of GLRI action plan which in turn fulfills the aims of the GLWQA. GLNPO includes GLRI quality assurance staff that provides leadership and information to the AOC QA coordinators.

GLRI Task Force Federal Agencies: In addition to USEPA, National Oceanic & Atmospheric Administration, Army Corps of Engineers, U. S. Fish & Wildlife Service and U.S. Geological Survey are part of the GLRI Task Force and Regional Working Group and are actively participating in implementation of the SLRAOC Remedial Action Plan (MPCA & WDNR 2013).

MPCA Northeast Watershed Section/Lake Superior Unit: Responsible for SLRAOC related activities within Minnesota, including formal and informal agreements between State and Federal agencies and serves as the primary Minnesota liaison with EPA GLNPO. Coordinates technical consultation with other MPCA Divisions as needed.

MNDNR St. Louis River AOC Program Staff: Responsible for SLRAOC related activities in Minnesota, especially per the expertise and mandates of the Divisions of Ecological and Water Resources and Fish and Wildlife. This team includes MNDNR staff from the Divisions of Ecological and Water Resources and Fish and Wildlife assigned to SLRAOC work, as well as technical consultation with staff from these divisions as needed. Coordinates technical consultation with other MPCA Divisions as needed.

Wisconsin DNR Office of Great Lakes (OGL): The OGL is focused on the restoration and protection priorities identified by the Council of Great Lakes Governors. These priority issues are: water use and transfer of water out of the basin; exotic species introductions through ballast water; contaminated sediment sites; nonpoint source pollution impacts; beach safety; habitat and species restoration; persistent bio-accumulative toxins; sustainable development; and indicators and information. The OGL is responsible for implementation of the SLRAOC Remedial Action Plan in Wisconsin and serves as the primary Wisconsin liaison with EPA GLNPO.

MPCA Environmental Data Quality Assurance Program: Provides QA oversight and coordination and dedicated GLRI QA Coordinator provides leadership for QA related issues within the MPCA and EPA. Responsible for drafting and updating the QAPrP, reviewing and approving all state generated QAPPs and reviewing and commenting on quality documentation for Federal projects within the Minnesota portion of the SLRAOC.

MPCA/MNDNR SLRAOC Team: Responsible for day to day management of habitat restoration projects and other action items related to Beneficial Use Impairments (BUI) removal in accordance with the SLRAOC Remedial Action Plan. This includes communicating and coordinating with other AOC Coordinators from WDNR, Fond du Lac Band of Chippewa (FdL), MNDNR and MPCA Superfund/VIC programs.

MPCA Site Remediation and Redevelopment Program: Identifies and assesses environmental releases of hazardous substances to determine the extent and magnitude of contamination, as well as risks to human health and the environment. The Superfund Program oversees as well as conducts investigation and remediation at contaminated sites where risks to human health or the environment exist. The Brownfield Redevelopment (Voluntary Investigation & Cleanup) Program works primarily with voluntary parties to provide appropriate assurances regarding environmental liability as well as review of efforts to document and cleanup contamination so properties can be returned to productive use. The Resource Conservation and Recovery Act (RCRA) program provides technical support for the Hazardous Waste Enforcement, Permitting and Corrective Action efforts. The Site Remediation & Redevelopment Program is also responsible for contaminated sediment characterization, remediation project management, long-term monitoring and technical support for individual sediment remediation projects within MN side of the SLRAOC.

Academic, EPA-Mid-continental Ecology Division, Nonprofit, Tribal and other Partners: Work with the SLRAOC staff to conduct endpoint specific surveys, develop habitat restoration metrics, and monitor and analyze data for BUI removal.

A 3: The Great Lakes and SLRAOC Background

The Great Lakes (Superior, Michigan, Huron, Erie and Ontario) form the largest surface freshwater system on earth. More than 30 million people live in the Great Lakes basin and prior to the Clean Water Act, there were decades of industrial and residential pollution that degraded the Great Lakes environment (USEPA 2013a). In 1972, the Great Lakes Water Quality Agreement (GLWQA) was signed by United States and Canada and later amended in 1978, 1987, and 2012. The 1987 revision named 43 Areas of Concern (AOC) across the Great Lakes in relation to legacy contamination. Although the GLWQA is not regulatory, it is accountable to the International Joint Commission and the EPA. Both GLWQA and the Great Lakes Binational Toxics Strategy (1997) recognized the need to restore and protect the Great Lakes. The SLRAOC is the largest of the 38 remaining AOCs and includes land and water in Minnesota and Wisconsin. The projects designed and implemented within Minnesota and associated QAPPs & other quality documentation should be developed in compliance with the Remedial Action Plan (RAP).

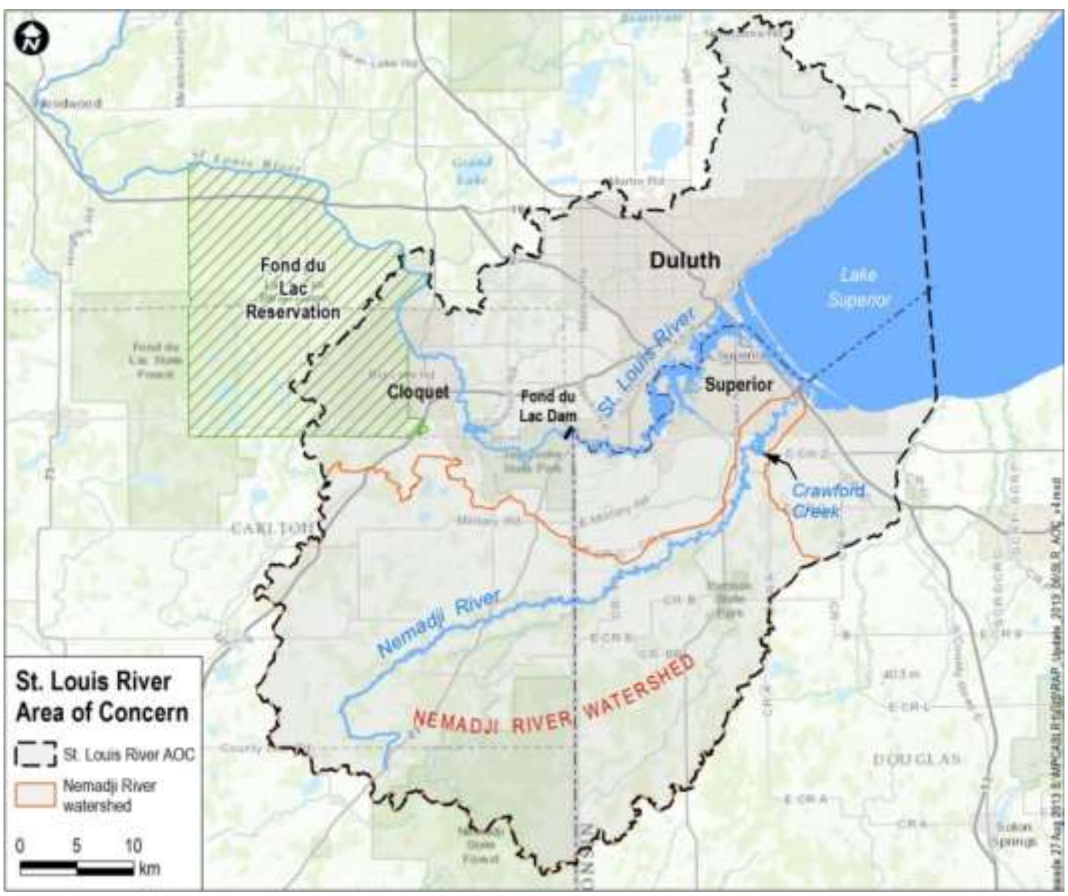

Figure 1: SLRAOC Boundaries

Action items in the SLRAOC are defined by the BUIs assigned to the SLRAOC in 1987. There are nine BUIs in the SLRAOC:

1. Fish Consumption Advisories
2. Degraded Fish and Wildlife Populations
3. Fish Tumors and Deformities
4. Degraded Benthic Communities
5. Dredging Restrictions
6. Nutrient and Sediment Loading
7. Beach Closings and Body Contact Advisories
8. Aesthetics Degradation – *removed in 2014*
9. Fish and Wildlife Habitat Loss

All funding for implementation of the RAP is aimed at removing each of the BUIs in order to delist the SLRAOC. The action items, process and timelines for removing each BUI and eventually delisting the entire SLRAOC is outlined in the SLRAOC RAP. MPCA will follow the delisting principals and the process outlined by the International Joint Commission - United States Policy Committee (USEPA, 2001(b)).

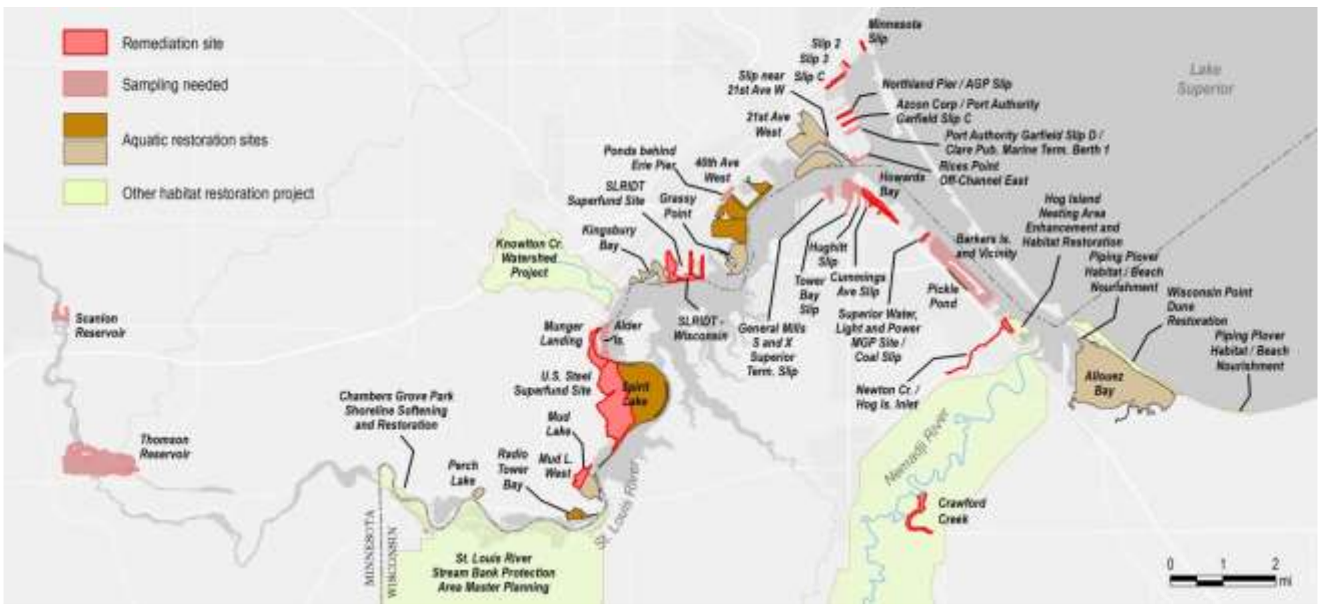

Figure 2: SLRAOC Remediation and Restoration Sites also showing Sediment Characterization Sites.

A 4: Program Descriptions

Through the hard work of partners and stakeholders in the St. Louis River estuary, a bold and aggressive RAP has been adopted. This plan contains a well-defined list of action items, cost estimates, and a timeline for removing BUIs with a goal of delisting the AOC by or before 2025 (MPCA & WDNR, 2013). The Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources are the regulatory agencies designated by the U.S. Environmental Protection Agency to address SLRAOC. Many of the actions will require the collection of data and use of data to make determinations regarding BUI removal and AOC delisting.

The goal of SLRAOC partners is to complete major remediation and restoration actions associated with BUI removal by 2020 and to monitor the success of those activities for BUI removal and delisting purposes until 2025 if necessary. BUI's will be proposed for removal as required management actions are complete and any required monitoring indicates it is appropriate to do so. Once all actions are complete and post-construction monitoring shows targets have been met, final removal of remaining BUIs and request for delisting will be proposed. The quality of the data generated for the purpose of understanding and evaluating the environmental conditions within the SLRAOC must to be sufficient to meet EPA Order - Policy and Program Requirements for the Mandatory Agency-wide Quality System (USEPA, 2000b).

A 4.1: SLRAOC Quality Assurance Process

For consideration in SLRAOC decision-making all projects that generate data are required to be covered under this QAPrP and a project specific QAPP or other quality documentation that is approved by project manager, QA Coordinator and relevant leadership.

Projects that are conducted by Federal agencies will have their own QAPP or other quality documentation process. In order to ensure the quality and the usability of the data generated by such projects, the MPCA requests that the QAPPs or other quality documentation be provided to MPCA staff for review and comment.

A 4.1.1: QAPP and other Quality Documentation Timelines

- All State contractors must submit a QAPP to the contract granting agency within 30 days of receiving the approval of funding.
- The Project Manager and MPCA QA coordinator has 30 days to review and comment on the submitted document.
- The contractor must submit a revised QAPP or other quality documentation within 14 days.
- The QAPPs should be finalized and signed within 14 days of submittal from the contractor.
- Once the project is completed, the contractor must submit the data and any quality control data to the SLRAOC QA coordinator within 30 days.
- The QA coordinator must respond to the contractor and the project manager within 14 days if the data is acceptable or not.
- The contractor must submit to the project manager, the final report and data in the format requested by the State, within 30 days of receiving data approval from the QA coordinator.

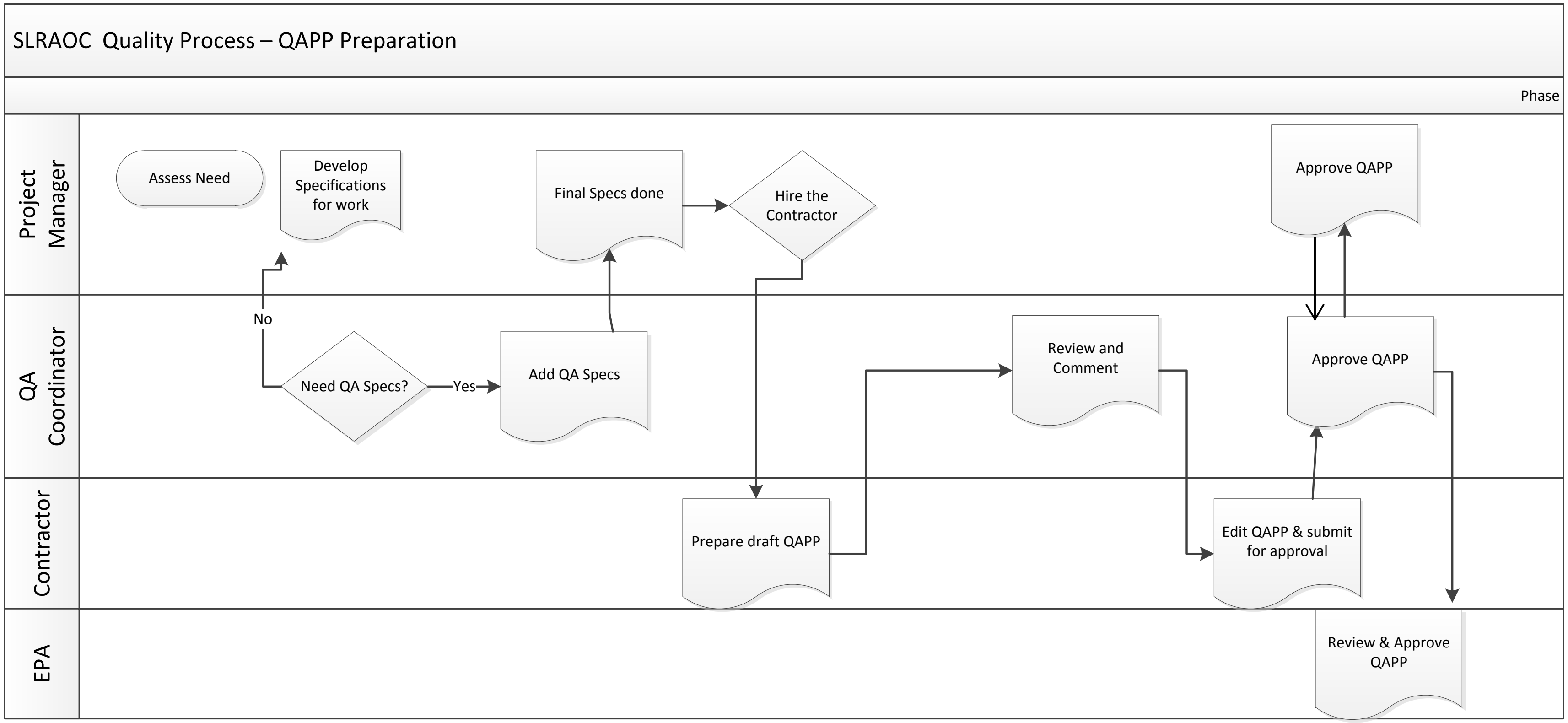

Figure 3: Quality Assurance Process Map for SLRAOC projects based in Minnesota

A 4.2: Contaminated Sediment and Soil Projects

Highly contaminated sediment and soil sites, i.e. sites requiring remediation (red sites) within the Minnesota side of the SLRAOC will be managed by the MPCA Site Remediation and Redevelopment section according to its program guidance. The QAPP for such projects will be reviewed and approved by Minnesota's GLRI QA coordinator for State funded projects. If funded directly by EPA or other Federal entity, the review and approval will be done by the QA staff of the Federal agency. The SLRAOC QA coordinator will provide any State specific comments.

All other remediation and restoration activities on the Minnesota side of the SLRAOC will be managed by the MPCA/MNDNR SLRAOC Team, based on this QAPrP and site specific quality documentation.

A 4.3: Metadata

For all matrices, the following metadata must be obtained:

1. Geographical coordinates measured by GPS to within 5 meter accuracy (see standard reporting format below)
2. Date of sampling/measurement
3. Sampling Agency/Contractor name

In addition, the following metadata must be reported for **Biological** Samples:

1. Sample collection gear or method;
2. Sediment type; and,
3. Depth of sediment for sediment dwelling organism investigations (normal depth for such investigations is 0-15 cm)

A 4.3.1: Station Location Geographic Coordinate Attribute Reporting Standards

The following information provides the necessary requirements for reporting geographic coordinate attributes associated for a given station within the SLRAOC. All stations are required to follow these criteria to ensure proper geographic coordinate reporting throughout the SLRAOC and improve data sharing and accessibility.

Geographic Coordinate System

The selected geographic coordinate system for reporting station location is the Universal Transverse Mercator (UTM) Zone 15 North with linear units in meters. This geographic coordinate system has been selected due to its full coverage of the SLRAOC, independence from individual state plane coordinates, and use of International System of Units (SI). Together with the following horizontal datum, the following geographic projection information can be used in a GIS environment:

EPSG: 26915
Projected Bounds: 176250.0589, 1577463.0797, 823749.9411, 9106037.1690
Scope: Large and medium scale topographic mapping and engineering survey.
Area: North America 96°W to 90°W
Proj4 Definition: +proj=utm +zone=15 +ellps=GRS80 +datum=NAD83 +units=m +no_defs
(Source: http://spatialreference.org/)

Horizontal Datum

The selected horizontal datum for reporting station location is the North American Datum of 1983 (NAD83). The following information provides the specifications for NAD83:

Ellipsoid: GRS80
Semimajor Axis: 6,378,137 m
Semiminor Axis: 6,356,752.3141 m
Inverse Flattening: 298.257222101

Vertical Datum
The selected vertical data for reporting station location is the North American Vertical Datum of 1988 (NAVD88) with linear units in meters. NAVD88 has been selected as it is easy to convert to other vertical datums including the International Great Lakes Datum of 1985 (IGLD 1985).

A 4.4: Data Quality Requirements

A 4.4.1: Chemical Parameters

Any laboratory that performs analysis of samples for the SLRAOC should be certified by Minnesota Department of Health or a comparable entity. University research laboratories that are not certified must provide the Standard Operating Procedures (SOPs) for each analyte they will be testing for and follow established EPA protocols when available.

Table 1 Minnesota Reporting Limits for Analytical Samples

Matrix	Reporting Limit	Standards
Sediment	Less than or equal to Level 1 Sediment Quality Targets^	Table 1 of MN SQT Guidance http://www.pca.state.mn.us/index.php/view-document.html?gid=9163
Surface Water	Less than or equal to MN Lake Superior Surface Water Std.*	MN Rules 7052.0100 https://www.revisor.mn.gov/rules/?id=7052.0100
Pore Water	Less than or equal to MN Lake Superior Surface Water Std.*	MN Rules 7052.0100 https://www.revisor.mn.gov/rules/?id=7052.0100
Soil	Less than or equal to MN Soil Residential Reference Values	http://www.pca.state.mn.us/index.php/view-document.html?gid=3154

^ When feasible the RL should be ½ Level 1 SQT or less.

∗ Must use the Applicable Chronic standard.

The reporting limit (RL) for chemical entities must meet the most current and lowest of the MN standard or guidance for that matrix (Table 1). When a result is between RL and Method Detection Limit (MDL), the value of that result must be reported with appropriate qualifiers. If a given RL cannot be met due to matrix interferences and high dilution rates or other unanticipated circumstances, the issue should be discussed among the project team and decided on a path forward.

A 4.4.2: Biological Parameters

All biological entities studied in the SLRAOC intended to be included in SLRAOC Data System must be identified to the lowest practical level consistent with project-specific protocols, usually genus.

Nomenclature used for observations and verifications will be based on an authoritative taxonomic naming/numbering scheme for plants, animals, fungi, and microbes through the Integrated Taxonomic Information System (IT IS) by referencing data sources from the www.itis.gov website.

A 4.4.3: Ecotoxicological Parameters

All benthic toxicological testing in sediment, intended to be included in SLRAOC Data System must be conducted according to U.S. EPA's *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates: 2nd Edition* (U.S. EPA 2000a) (USEPA Eco-toxicology Guidance).

Table 2 EPA guidance recommended species and parameters for ecotoxilogical studies:

Parameter	**Test Species**	**Duration**
Survival and Growth	*Hyalella Azteca* *Chironomus tentans*	10 days 10 days
Survival, Growth/Emergence and Reproduction	*Hyalella Azteca* *Chironomus tentans*	42 days 50-65 days
Bioaccumulation	*Lumbriculus variegatus*	28 days

The Project Team may modify the above requirements with appropriate justification which will be documented in the project specific QAPP or other quality documentation.

A 5: Intended Data Usage

Overall, the data will be used to determine:

- the condition of a given habitat at a point in time;
- the baseline assessment and/or extent and magnitude of contamination at a site;
- appropriate treatment and/or disposal of contaminated media during site remediation activities;
- if remedial and/or restoration efforts have been successful; and
- BUI Removal and delisting of the SLR AOC

The project proposal and the QAPP or other quality documentation must state how the work proposed can achieve the intended data usage.

A 6: Project/ Task Description

All project proposals, QAPPs or other quality documentation should include a description of each task and which objective(s) the task will accomplish. This section of the QAPP/quality documentation can also be used to state:

1. Hypothesis to be tested

2. Expected Measurements
3. Standards to be used
4. Any required technical audits

Project proposals and QAPPs or other quality documentation, must include a project schedule or timeline. If there are significant deviations from the proposed schedule, a revised schedule should be provided to the project manager, as well as other entities who are involved in the project.

A 7: Data Quality Objectives and Criteria

Data Quality Objective (DQO) process is used in scientific investigations to ensure that the type, quality, and quantity of environmental data used in decision-making are appropriate for the intended application. The DQO process used by Minnesota has seven steps:

1. State the problem that the study is designed to address.
2. Identify the decisions to be made with the data obtained.
3. Identify the types of data inputs needed to make the decision.
4. Define the boundaries (in space and time) of the study.
5. Define the decision rule that will be used to make decisions.
6. Define the acceptable limits on decision errors.
7. Optimize the design for obtaining data in an iterative fashion using information and DQOs identified in Steps 1-6.

Following these seven steps helps ensure that the project plan is carefully thought out and that the data collected will provide sufficient information to support the key decisions that must be made.

A 7.1: Chemical Parameters

A 7.1.1: Overview

The DQOs, as defined in EPA QA/G-4 (USEPA, 2006) for the SLRAOC projects are determined by individual site requirements. The project team is responsible for defining the goals to remove the BUI(s) that impact the project site. Based on these decisions, the team will develop objectives, an action plan and a timeline for each project.

For most chemical analysis, the EPA has established sampling, extraction and analysis protocols for sediment, soil, and water. When available, these EPA protocols/methods must be used for sampling and chemical analysis, unless there is a project specific reason for using a different or modified EPA method. In such situations, the rationale for not using an established method/protocols must be detailed in the project specific QAPP.

The following contaminants are historically found in the SLRAOC, and therefore should be considered for analysis when appropriate (Crane & Hennes, 2007). The PAH list include the entire 17 alkylated PAH list considered by the Agency for Toxic Substances and Disease Registry (ATSDR), an agency of Centers for Disease Control and Prevention (ATSDR 1995). The final analyte list should be determined by the project team:

Table 3 Contaminants commonly considered for analysis

Metals	PAHs	Pesticides	Other Organic Contaminants
Arsenic	Acenaphthene	Chlordane	Dioxins/Furans
Cadmium	Acenaphthylene	Dieldrin	Total PCBs
Chromium III	Anthracene	Sum DDD	
Chromium VI	Benz[a]anthracene	Sum DDE	
Copper	Benzo[a] pyrene	Sum DDT	
Lead	Benzo[e] pyrene	Total DDT	
Mercury	Benzo[b]fluoranthene	Endrin	
Nickel	Benzo[g,h,i]perylene	Heptachlor epoxide	
Zinc	Benzo[j]fluoranthene	Lindane (gamma-BHC)	
	Benzo[k]fluoranthene	Toxaphene	
	Chrysene		
	Dibenz[a,h]anthracene		
	Fluoranthene		
	Fluorene		
	Indeno[1,2,3-c,d] pyrene		
	Phenanthrene		
	Pyrene		

Quality assurance objectives and processes should be developed for field sampling, chain of custody (COC), and laboratory analysis and reporting. The sampling entity (e.g., academic, federal, state or local agency, responsible party, contractor, etc.) is responsible for field sampling and COC forms until the laboratory accepts the samples for analysis.

Specific procedures to be used for sampling, quality control, audits, preventive maintenance and corrective actions should follow the directions of EPA Requirements for QAPPs (USEPA 2001(a)). The purpose of this section is to define quality assurance goals for precision, accuracy and completeness. See MPCA's Laboratory Quality Control and Data Policy guidance (http://www.pca.state.mn.us/index.php/view-document.html?gid=16288) for further information. Establishing these goals will allow the SLRAOC partners to judge the adequacy of the results and whether corrective actions are necessary. Data quality indicators (precision, bias, accuracy, representativeness, comparability, completeness and sensitivity) are specific to each project and should be clearly defined in the project specific QAAP or other quality documentation.

Laboratory reports for chemical analysis must include:

- Date of sampling;
- Date of analysis;
- Signed and completed COC form;
- Narrative of the analysis which notes items outside the laboratory QC limits, if any,
- Analytical results for the collected samples; and,
- QC sample results (e.g., blanks, duplicates, spikes).

In addition to the analytical results, the chemical analysis reports must include the percent recoveries (% R) of surrogates and the percent recoveries (% R) and relative percent differences (RPD) of laboratory control sample/laboratory control sample duplicates and matrix spike/matrix spike duplicates. Data will be reviewed as needed by QA staff from MPCA, USEPA, or GLNPO. When reviewed, the QA staff will report to the project manager any data found not meeting the requirements as defined by the project quality documentation. Decisions on data usability are made by the project team for questionable (or flagged) data.

A 7.1.2 Quality Control & Quality Assurance

Blanks

Field blanks: Field blank results verify the field sampling equipment is free of contamination. The field technician should use field blanks as equipment blanks if sampling equipment will be reused. Once the sampling equipment has been cleaned, an adequate amount of de-ionized water should be used to rinse (pour through) off the equipment to ensure there are no background levels of contaminants. Treat the sample in the same way as all other samples. One field blank per crew per day should be submitted.

Method Blanks: The laboratory must use method blanks to verify the extraction procedures, glassware, and instrument conditions do not exceed background contaminant levels. The method and field blanks are reported with other samples to allow the project manager to determine if the laboratory contamination or analytical error could cause a false positive. The method blanks should be run at a rate of 5% (one per 20 samples).

The acceptance criterion for all Blanks is below Reporting Limit for a given analyte. If the method blanks are above twice the RL, the results for that analyte should be considered estimated.

Duplicate Samples

As is the case for field blanks, duplicate samples are collected as necessary to protect the integrity of the sampling investigation. Duplicates are collected by alternately filling two separate sample containers from the same source for each set of parameters. Duplicate sample analyses provide a check on sampling and analytical reproducibility, or precision. For soil, sediment and water samples, duplicates should be taken at a rate of 10% (one per 10 samples). The percent difference between sample and sample duplicate must be within ≤25% for water samples and ≤50% for solid samples.

For soil and sediment samples the “field duplicate” would consist of obtaining adequate material for two complete analyses from one location, thoroughly mixing the sample and obtaining two aliquots.

Spike Samples

The laboratory must prepare and analyze the matrix spike and matrix spike duplicates (MS/MSD) to gain a measure of reproducibility and accuracy. The RPD goal for duplicates is 25% for water and 50% for soils. Spiked samples should not be collected in the field, however, the field technician must submit adequate volumes of samples to ensure the laboratory has enough sample to allow for spike and spike duplicate analyses. The COC forms must indicate which samples are collected for spike and spike duplicate samples. The MS/MSD should be at 10% rate for environmental samples. Recovery of the spiked material varies by the analyte measured but generally for metals analysis is 80-120% and 50-150% for organic compounds. These limits are established by the laboratory based on historical data.

Laboratory Activities

The quality assurance objectives for accuracy, precision, completeness, representativeness, reporting limits, and comparability are described in a laboratory's Quality Assurance Manual (QAM). The QAM or similar document must include the following

a. The RL for each analyte in accordance with the project specific QAPP. The project manager or principal investigator is responsible for ensuring the laboratory RL meets the DQOs of the project and to communicate any discrepancies with the SLRAOC data quality coordinator.

b. Quality control limits used by the laboratory and the limits used for data validation should be referenced. Note: the control limits must be as good as or better than the data quality indicators.

c. The equations for percent recovery and relative percent difference, and a statement on how this information is used. MPCA recommends a minimum of 90 percent completeness. Note that rejected data or sampling points that do not yield a usable sample count against percent completeness. Completeness is critical to measuring how well the project was managed and completed.

All other requirements of USEPA's QA/R5 must be followed and documented in a project specific QAPPs for chemical parameter investigations in any matrix.

A 7.2 Biological Parameters

A 7.2.1 Overview

Many biological endpoints are used as a measure of habitat health. It is important that we have the ability to compare data from a given site over time and in between sites within the AOC. To achieve this, the SLRAOC partners have adopted several sampling, analysis and reporting standards. Data quality indicators (precision, bias, accuracy, representativeness, comparability, completeness and sensitivity) are project specific and should be clearly defined in the project specific QAAP or other quality documentation.

All biological endpoints should be identified to the genus level. If this is not possible or if the project manager deems it unnecessary to identify to this level, an explanation must be provided in the QAPP or other quality documentation. The SLRAOC partners have identified several sites within the SLRAOC that can be used as reference sites. These reference sites are known to all AOC coordinators and project managers. The project specific QAPP or other quality documentation should identify any reference sites used and the appropriateness of using each of them.

Laboratory reports for biological sampling must include:

- Date of sampling;
- Date of laboratory processing;
- Signed and completed COC form; and,
- Narrative of sampling and laboratory processing which notes items outside the QC limits.

A 7.2.2: Definitions of Quality Assurance Components for Biological Parameters.

Precision

Where possible, laboratory precision is measured through duplicate processing or quality control by separate laboratory staff. Duplicate processing should be conducted at a recommended rate of 10% (one duplicate per ten samples processed), but often individual laboratory protocols require 100% quality control. The result for the duplicate processing is compared to the result of the original processing. The relative percent difference (RPD) in sorting efficiency (SE) between the original sample result and the duplicate processing result is calculated according to the following formula:

$$RPD\ SE = \frac{(Sample\ No._1)*100*2}{(Sample\ No._1 + Sample\ No._2)}$$

Accuracy

Identification accuracy is determined through independent analyses of the same sample. Quality assurance samples are processed at the rate of 10% (one sample per ten samples processed). If accuracy cannot be determined using random samples, complete voucher collection identifications will be an appropriate substitute. Voucher collection accuracy should be completed regardless of individual sample QA protocols. The percent accuracy is determined by comparing the agreement rate in nomenclature. The formula for determining percent recovery is as follows:

$$\%\ Accuracy = \frac{(Sample\ Taxa\ not\ in\ agreement)*100}{(Total\ Sample\ Taxa)}$$

If there is no established QA limit specific to the project, the acceptable error rate should fall below 5%.

Representativeness

Representativeness of the data set is the measure that expresses the degree to which the data accurately represents the population as a whole. The methods for sample collection in the field, sample preservation, transportation to the laboratory, sample preparation, and sample analysis are reviewed to determine if appropriate procedures were followed. If the procedures as described in this QAPrP are followed, the sample results will be considered representative of the site.

The project specific QAPP or other quality documentation should describe how experimental design and sampling methods ensure representativeness of the samples.

Comparability

Comparability is the degree of confidence that one data set can be compared to another data set and whether the data sets can be combined and used for decision-making purposes. The level of comparability between data sets is determined by reviewing sample collection and handling procedures, sample preparation and analytical procedures, holding times, and quality assurance protocols. When a large difference in one of the methods or procedures exists, the comparability of the data is considered low. If all of the procedures stated in this QAPrP are followed and meet established criteria, then data from the same site is considered comparable.

Completeness

Completeness is measured by determining the ratio of valid sample results compared to the total number of sample results for a specific matrix. During data verification, the data completeness is determined by the following equation:

$$\% \text{ Complete} = \frac{(\text{\# of Valid Results}) * 100}{(\text{\# of Sample Results Expected})}$$

Completeness is expected to be 90% or better for a field report to be considered acceptable, unless field descriptions explain adequately the reasons for repeated failure.

A 7.3: Toxicological Studies of Benthic Invertebrates

Toxicological studies of benthic invertebrates combine both chemical and biological parameters. Section 9 of the USEPA Ecotoxicology Guidance (U.S. EPA, 2000a), addresses the QA/QC requirements for toxicological studies and should be followed. Any deviation from the requirements outlined in the USEPA Ecotoxicology Guidance should be justified and detailed in the project specific QAPP or other quality document.

A 7.4: Physical, Hydrodynamic and Geotechnical Parameters

Physical, hydrodynamic and geotechnical data needs are very specific to each project. When performed, physical and geotechnical parameter measurements should follow established American Society of Testing Materials (ASTM) standards or standards established by United States Army Corps of Engineers (USACE) and USEPA. If the project team decides not to follow these standards, a justification should be provided in the project specific QAPP or other quality documentation.

Table 4: Physical, Hydrodynamic and Geotechnical Standards

Geo Technical Attribute	Standard*
Grain Size	ASTM D421 and D422
Water Content	ASTM D2216
Organic Matter	ASTM D2974
Atterberg Limits	ASTM D4318
Specific Gravity	ASTM D854
Standard Elutriate Test Prep	USEPA/USACE,1998(a) & (b)
Sediment Characterization	ASTM D2487
Shear Tests	ASTM D2573
Consolidation Characteristics	ASTM D2435, D2435M
Permeability	ASTM D2434

* Use the latest version available

A 7.5: Dredging, Aquatic Habitat Restoration and Stormwater Management

Dredging of sediment by any entity within the SLRAOC must follow the Minnesota Dredge Manual (MPCA, 2014). The Minnesota Dredge Manual addresses the requirements for stockpiling material for land use applications. However, if dredged material either from the navigational channel, Erie Pier, or the site itself is placed in water at aquatic habitat restoration sites, use *Managing In-Water Placement of Dredge Material for Habitat Restoration sites in the St. Louis River Area of Concern* (Appendix 1). This document provides the guidance for sampling and analyzing the sediment chemistry and benthic toxicity to ensure adequate protection of aquatic habitat.

When considering the benefits and costs associated with restoration of aquatic habitat use the guidance document, A *Biological, Chemical, and Physical Approach to Aquatic Habitat Restoration Decisions in the St. Louis River Area of Concern.* (Appendix 2). This document provides the guidance for data collection and analysis of measurable response variables including sediment chemistry, benthic macroinvertebrate community structure, and aquatic macrophyte assemblage metrics to inform restoration design and removal of beneficial use impacts. This guidance is intended to define existing site conditions, generate quantifiable targets for proposed site conditions, and analyze targets using surface area-weighted concentrations to delineate and sequence Restoration Management Units within a restoration site for construction activities.

Managing stormwater and runoff from land based materials stockpiled during and after construction work is an important part of most restoration projects. The *Minnesota Stormwater Manual* (MPCA, 2013) provides information regarding best management practices (BMPs) and regulatory requirements to comply with State water quality standards.

A 8: Special Training/Certification

All field and laboratory technicians should be trained and competent to perform the work assigned to them, or work directly under an experienced professional. In addition, all employees must have received Occupation Safety & Health Administration (OSHA) required safety training, such as 40-hour Hazardous Waste Operations and Emergency Response Standard (HazWOpER), if working in contaminated media. Laboratory technicians must be trained in analytical techniques and remain competent to perform the assigned duties. Field technicians must be trained in water safety, sampling, sample handling, and sample storage protocols and any other training required in order to perform the assigned work. Training documentation must be provided to MPCA upon request.

A 9: Documents and Records

All SLRAOC projects will have procedures in place to secure project records by the laboratory, the consultant, and others responsible for generating and/or storing project data. The project specific QAPP or other quality documentation will specify where the records are stored and document the retention schedule for the records. Electronic forms of data storage must be recoverable upon request by MPCA or USEPA. Note that all records are to be maintained in addition to the reports, for at least 3 years.

Section B: Data Generation and Acquisition

B 1: Sampling Design

Sampling design should be able to:

1. Meet the objectives of the project;
2. Be scientifically defensible; and
3. Support eventual delisting and consistent with the RAP.

The DQOs for each task of the project must guide the sampling designs documented in the QAPP or other quality documentation and be approved by the appropriate parties involved in the project prior to the commencement of work. The project team for a given site will determine the DQOs which will guide sample density, and the sampling plan(s). The sampling design will normally follow a statistical model and ensuring representativeness and completeness will be considered within the design. The project specific QAPP or other quality documentation should provide details of statistical methods used to derive the sampling plan.

B 2: Sampling Procedures

All sampling procedures must ensure the data generated is defensible and comparable spatially and temporarily. When available, USEPA sanctioned/approved sampling and analytical methods should be used. All sampling methods, equipment, and quality assurance procedures must be detailed in a project specific QAPP or other quality documentation. Sampling procedures will include a description of the sampling method, sample bottle or container, preservatives if required, holding times, and quality assurance samples (e.g., duplicates, splits, blanks).

The field notebooks should clearly identify the sample locations, sample numbers, and sample depths (depth of upper and lower limits in centimeters). Surface samples are generally considered to be 0-15 cm.

For sampling of dredge materials expected to be re-used (i.e., not highly contaminated) follow MPCA's *Managing Dredge Materials* (MPCA 2014). For sediments suspected to be or have the possibility of being highly contaminated use the USEPA's *Technical Manual on Sediments* (USEPA 2013b). If the dredged sediments will be reused on land, they must meet the appropriate SRV. If the dredge material will be reused within the St. Louis River Estuary, they must meet the applicable SQTs.

The entire river segment of the SLRAOC is designated as Infested Waters by MDNR due to the presence of several Aquatic Invasive Species (AIS). Therefore, extreme care must be taken when sampling within the SLRAOC to prevent spreading of AIS from the SLRAOC into other water bodies. Please review the MDNR website regarding steps that must be taken when working in the SLRAOC:
http://www.dnr.state.mn.us/invasives/aquatic/index.html

B 3: Sample Custody

Only trained field personnel should collect samples. The field personnel should keep the samples in their possession, in their view, or in a secured area only accessible to them until such time as they turn custody over to another individual who has signed COC form.

B 3.1: Chain of Custody (COC) Forms

All samples must be accompanied by a COC forms or other documentation that verify the integrity of the samples when the custody changes from one entity to another. The COC will be signed by the sampler with custody maintained by the sampler through securing the samples or keeping visual contact with the samples until they are signed for by the laboratory (or shipped with the COC included in a resealable plastic bag within the cooler).

B 3.2: Handling, Storage and Transportation of Samples

Samples should be transported in a rugged container to maintain sample integrity, and secure the samples from tampering. If necessary, the container should be insulated to maintain temperature control. All samples must be properly labeled in accordance with the COC.

The project specific QAPP or other quality documentation must detail all such requirements including who will be responsible for meeting and maintaining those requirements. Where appropriate, the COC form should note sample handling requirements.

B 4: Analytical Methods

B 4.1: Chemical Analysis

All chemical analysis methods must be identified in the project specific QAPP, if using established USEPA methods. If a given USEPA method is being modified, the nature of the modification and the need for the modification must be clearly stated in the QAPP. The QAPP should identify who is responsible for corrective actions at the laboratory and discuss the documentation and levels of review by management of corrective actions. The QAPP should also specify the turn-around time for the samples needed for the project. Any nonstandard methods being used should be discussed in detail (in an appendix, if the methods are lengthy), and how these nonstandard methods would be validated or reviewed by the laboratory and project manager/principal investigator.

B 4.2: Biological Survey/Sample Analysis

All statistical and other methods used to analyze the data must be discussed in the project specific QAPP or other quality documentation. The qualifications of industry experts (either institutions or individuals) used to verify plant/animal identification should be identified.

All biological survey/sampling and analysis methods should be identified in the project specific QAPP or other quality documentation. The methods selected should be comparable to methods used in previous similar studies at the site and if a different method was used, this fact and reasons for change of sampling method should be clearly stated in the site specific QAPP or other quality document.

B 5: Quality Control

Common field and laboratory QC checks for chemical analysis are identified in Table 3. The frequency of analysis and the control limits are also listed in Table 3. If the results don’t meet the QC acceptance criteria identified in Section A 7.1 (chemical analysis) and A 7.2 (biological parameters), corrective actions taken to remedy the situation should be discussed in reporting.

Table 5: Quality Control Elements for Chemical Analysis

QC Type	Soil	Surface & Pore Water	Sediment
Blanks			
Equipment Rinsate Blanks	X*	X*	X*
Method Blanks	X	X	X
Spikes			
Matrix Spike	X	X	X
Matrix Spike Duplicate	X	X	X
Laboratory Control Sample	X	X	X
Surrogates	X	X	X
Calibration Checks	X	X	X
Duplicates			
Field Duplicates	X	X	X
Laboratory Duplicates	X	X	X

∗ Only if re-using decontaminated equipment

Biological or other matrices will have different requirements for quality assurance within their procedures. Acceptable QC limits will be generated by the entity performing the analysis for the SLRAOC, with concurrence of MPCA and/or MDNR. The limits should be detailed in the project specific QAPP or other quality documentation.

B 6: Instrument/Equipment Testing, Inspection, Calibration and Maintenance

B 6.1: Field Equipment

Preventive maintenance of field equipment should be performed before each sampling or field measurement event. More extensive maintenance should be performed based on hours of use and manufacturer's recommendations. Maintenance and calibration records must be available to the project team upon request.

B 6.2: Laboratory Equipment

The protocols for testing, inspection, maintenance of laboratory equipment, and preventive maintenance will be addressed in the laboratory's QAM or Standard Operating Procedures (SOP). Routine equipment calibration should be detailed in laboratory SOPs attached to the QAPP, and should be available to the MPCA/MDNR. If there are special calibration requirements of the analytical method (i.e., chemical analysis) used, they must be documented in the project specific QAPP. All equipment should be routinely serviced and maintained per the manufacturer's instructions. Records of maintenance should be available to the project team upon request. Corrective Actions taken by the laboratory will be documented and noted on laboratory reports when data is affected for the project.

B 7: Inspection/Acceptance of Supplies and Consumables

All sampling supplies and equipment must be inspected to ensure they are in proper working order and are free of contamination. Before setting off for sampling, the field crew must ensure there are adequate supply of labels, sample containers, water proof pens, decontamination supplies, extra batteries for GPS and other electronic equipment, bug spray and sun screen (if used and will not interfere with sampling or analysis), U.S. Coast Guard approved personal flotation devices, fuel for boats, etc. All items needed by the sampling crew should be listed in the project QAPP or other quality documentation.

The laboratory performing sample analysis must ensure that supplies and consumables are inspected for usability and quality upon receipt. The laboratory must identify a contact that will ensure the supply and quality of all consumables are tracked and replenished as needed.

B 8: Non-direct Measurements and Secondary Data

Historical data may be used to compare temporal differences. However, the methods and equipment used in the historical data must be similar. If methods and equipment used in the two data sets are different from each other, the project manager must explain why it is appropriate to compare the data sets.

Use USEPA's *Guidance on Quality Assurance Project Plans for Secondary Research Data* (USEPA 1999) for using data from other sources as guidance. The quality of the secondary data must meet the DQOs of the project and the data source and date must be clearly stated.

B 9: Data Management

The entity generating the data must maintain and archive as needed all the field, transportation and laboratory information pertaining to the project, according to the data management protocol of the entity. The types of data that would be generated and how the data would be managed must be identified in the project specific QAPP or other quality documentation.

All SLRAOC related data generated by any entity must be submitted to the AOC coordinator in the format requested.

B 10: Data Rejection

Any data which does not meet the established QA/QC criteria defined in the project specific QAPP or other quality documentation will be flagged as estimated or rejected depending on the use of the data. All field data must be evaluated by the technical staff to ensure they are compliant with this QAPrP and the project QAPP or other quality documentation. Data collected judged to be out of compliance are qualified as estimated or rejected, and maybe re-collected if deemed necessary by the project team.

Section C: Assessment and Oversight

C 1: Assessment and Response Actions

The project manager of a given project is responsible for immediately notifying the MPCA and/or MDNR project manager of any data that may be questionable or does not meet the QA/QC criteria established for the project. The MPCA/MDNR staff will determine the best course of action. Assessments to include laboratory or field audits may be performed based upon the identified needs of by the project team.

C 2: Reports to the SLRAOC Leaders

The entity conducting the project must provide progress reports to the MPCA or MDNR project manager on a routine basis. The project specific QAPP or other quality documentation should state who would be submitting the report and to whom and when they will be submitted.

For reports containing chemical analysis the following must be submitted:

- Tabulated sample results
- COC forms
- Batch QC
- Case Narrative
- Data Qualifiers

For reports containing biological surveys/investigations the following items must be submitted:

- Tabulated sample/investigation results
- COC forms
- Case Narrative, including quality assurance information

All reports must be reviewed and approved by the project manager and laboratory's QA/QC officer, and project management staff. Corrective actions performed by the field or laboratory staff that effect the data will be documented in reports to the project team on a regular basis. Follow up data audits or on site audits may be performed based upon these reports and/or corrective actions performed.

D: Data Validation and Usability

D 1: Data Review, Verification, Validation and Methods

The project manager or designated experienced technician must verify data is correct as reported. 100% of the raw data must be verified against the report and ensure transposition errors were not made.

For chemical data the laboratory QA/QC officer must review all reports to verify the data meets all QAPP requirements. A third party data validation may be required for projects conducted under regulatory oversight (e.g., CERCLA, RCRA or MERLA). The MPCA/MDNR project manager(s) will determine the level of data quality required for a given project, based on program requirements. Raw data must be available to the funding source granter, if requested.

When determining taxa for species, any uncertain or questionable identification(s) must be verified by an individual or entity (e.g. herbarium) familiar with types of species found in the SLRAOC. The project specific QAPP or other quality document should identify the experts/entities that will be used in such situations.

D 1.1: Treatment of non-detect data:

The past practice of substituting ½ Reporting Limit for all non-detect chemical data has been questioned in recent years, and other procedures have been recommended for summarizing and analyzing environmental data such as the Kaplan-Meier method (Helsel, 2012). In order to use these statistical methods, it is important that the method of reporting non-detect values is clearly specified in the laboratory data report, and that both the MDL and RL are included. Concentrations below the Reporting Limit should be reported as follows:

- Values between the MDL and RL: report the actual value, flagged as estimated.
- Values below the MDL: report as less than (<) MDL.

It is important to notify the analytical laboratory of the above requirement before contracting with them. If the laboratory cannot provide the required information or the project team believes this is not necessary for the project, the reasons must be detailed in the project specific QAAP or other quality documentation.

The MPCA SLRAOC data quality coordinator will review the submitted data to verify all QC requirements are met and the required information is provided in the laboratory report in accordance with project requirements. If corrective actions are needed the project team and the data quality coordinator will meet to discuss discrepancies and make decisions with SLRAOC partners if necessary on how to deal with data not meeting requirements or sampling not meeting the completeness requirements.

D 2: SLRAOC Data Submittal Requirements

All SLRAOC data must be submitted in the electronic format requested by the SLRAOC Data System curator or appropriate designee. Providing the data in the preferred format ensures that data can be uploaded into the SLRAOC Data System with minimum effort and errors.

The current Data System manager is the MPCA contractor, LimnoTech and the flat file format used by LimnoTech can be obtained from the SLRAOC Coordinators, QA data quality coordinator or SLRAOC project managers. Data formats and file structure will be provided on a project-specific basis. Data inclusion into a SLRAOC Data System will require the data custodian's adherence to a hierarchical labeling scheme provided as templates by the curator. Emphasis will be placed on consistent completion of STATION_ID, SAMPLE_ID, DATE, and geolocations.

Section E: References

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Appendix 1

Managing In-Water Placement of Dredge Material for Habitat Restoration Sites in the St. Louis River Area of Concern

Minnesota Pollution Control Agency

Background

The St. Louis River Area of Concern 2013 Remedial Action Plan (RAP) identifies priority actions necessary to remove nine beneficial use impairments and delist the St. Louis River Area of Concern (SLRAOC). In order to remove beneficial use impairments, several habitat improvement projects have been identified at sites within the St. Louis River Estuary. Restoration activities include optimizing bathymetric contours to increase the extent and quality of submerged and emergent plant communities to increase fish habitat structure and improve macroinvertebrate communities. These restoration plans will include construction of features to minimize wind and wave energy by strategically placing sediment (beneficial use of dredge materials) delivered from the Federal Navigation Channel, Confined Disposal Facility at Erie Pier, and/or the Restoration Site itself to promote aquatic plant colonization for habitat improvement.

Altering the bathymetry (cross section) of a waterbody through in-water placement of dredge materials requires environmental review and permit approval through multiple organizations. These programs include:

- USACE Clean water Act 404(b)1 - Guidelines For Specification Of Disposal Sites For Dredged Or Fill Material
- USACE Nation Wide Permit (NWP 18) for minor discharges
- Environmental Review Worksheet (EAW)/Environmental Assessment (EA)
- MPCA Clean Water Act 401 Water Quality Certification
- MNDNR Public Waters Work Permit
- MNDNR Lake Superior Coastal Program Federal Consistency Certification

Guidance for placing materials in-water for the purpose of improving or creating aquatic habitat is currently regulated using existing federal guidelines to ensure adequate protection of an aquatic resource (USACE 1998a, 1998b). Fundamental to the federal guidelines is the precept that dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination on the aquatic ecosystem.

Current sampling guidance and testing requirements for dredging sediment and beneficial use of dredged material on land follow existing State procedures (MPCA 2014.). This document provides sampling and testing procedures for evaluating the acceptability of in-water placement of fill or dredged material that are obtained from the Federal Navigation Channel, Erie Pier, or other sites within the SLR estuary and moved from one location to another for the purpose of aquatic habitat restoration. The screening values know as Sediment Quality Targets (SQTs) and biological effects data (laboratory toxicity and bioaccumulation testing) are used to evaluate the suitability of using fill or dredged materials for in water placement under the Federal Clean Water Act (CWA).

The process for assessing, handling and placement of dredged material comes from the following documents:

- MPCA. 2014. Managing Dredge Materials in the State of Minnesota, April 2014 (Minnesota Dredge Material Guidance) (http://www.pca.state.mn.us/index.php/view-document.html?gid=12959)
- MPCA. 2007. Guidance for the Use and Application of Sediment Quality Targets for the Protection of Sediment-Dwelling Organisms in Minnesota, Crane and Hennes, 2007 (SQT Guidance Document) (http://www.pca.state.mn.us/index.php/view-document.html?gid=9163

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Sediment Quality

The St. Louis River is a Class 2 water of the state under Minnesota's Water Quality Rule Chapter 7050. Minnesota Rule 7050.0150, Subp. 3. states: *for all Class 2 waters, the aquatic habitat, which includes the waters of the state and stream bed, shall not be degraded in any material manner…* The SLRAOC has several beneficial use impairments (BUIs) that address sediment quality. For aquatic habitat restoration in particular, the BUI addressed is degradation of benthos.

Sediment quality targets (SQTs) are Minnesota sediment quality assessment tools intended to define the concentrations of contaminants in sediment associated with a high or low probability of observing harmful biological effects to benthic invertebrates. SQTs are not promulgated in Minnesota's Water Quality Rule, but they serve as a chemical benchmark to make decisions relative to Minnesota's Rule Chapter 7050. Two types of SQTs have been established by MPCA (Crane and Hennes 2007).

- The Level I SQT is intended to identify contaminant concentrations below which harmful effects on sediment-dwelling organisms (i.e., benthic invertebrates) are unlikely to be observed. (Relatively Low Concern)
- The Level II SQTs are intended to identify contaminant concentrations above which harmful effects on sediment-dwelling organisms are likely to be observed. (Relatively High Concern)

In general, proposed dredge areas where multiple locations with one or more contaminant concentration exceed Level II SQTs are not considered suitable for in-water placement and may require remediation of sediments. Furthermore, proposed dredge areas with no contaminants exceeding Level I SQTs generally have no restrictions on in-water placement. However, sediments in the St. Louis River have been affected by years of contaminant inputs from multiple sources, such that relatively few areas in the lower river may meet the Level I SQT for all contaminants. Consequently, project managers may commonly find themselves operating in an area of uncertainty between clearly acceptable and clearly unacceptable sediment quality, and therefore, additional tools including biological effects testing may be necessary to make decisions on sediment acceptability.

For aquatic habitat restoration purposes, a tiered-approach for evaluating the suitability of using dredged material for habitat restoration projects incorporates use of both SQTs and biological effects data. Figure 1 is a flow chart describing the general tiered approach for decision-making related to sampling and testing of dredged materials to assure successful habitat restoration in accordance with permit requirements under Section 404(b)(1) of the Federal CWA (specification of disposal sites for dredged or fill material). Additional Federal CWA requirements for placement of fill and dredged material at habitat restoration sites require the MPCA to certify that the release of dredged material will meet applicable Minnesota water quality standards and that the planned project is consistent with the Lake Superior Coastal Zone Management Program.

In applying a risk management approach to the costs and benefits of a successful restoration, the partners may choose to generate additional data to help in the decision-making process anywhere along the tiered approach to reduce uncertainty and improve potential ecological risk estimates. Likewise, the partners can determine at any point that the beneficial use of dredge material is not feasible if the costs for reducing uncertainty and improving estimates of risk exceed the value of the sediment volume needed for beneficial use at the restoration site.

Regulated Dredge Material Permit Requirements

This section describes the proposed sampling and analysis requirements for dredged materials in the St. Louis River Estuary for the purpose of in-water placement at an aquatic habitat restoration site.

<u>Evaluating Fill and Dredged Materials</u>

- *A sampling and analysis plan* for characterizing sediments to be dredged for beneficial use must be submitted and approved prior to sampling. A list of recommended analytes is provided in the Quality Assurance Program Plan (QAPrP). The number and specific analytes to test for, however, is site specific for each sampling plan.
    - Real time sampling and analysis during dredging or material handling operations should be considered only if absolutely necessary. In this case, a project specific sampling and analysis plan for dredging or material handling operations is required.
- *Dredge Material Management Units (DMMUs)* for the purpose of this document represent areas being considered as potential sources of dredged material that will be placed as fill for habitat components at restoration sites. Separate DMMUs will be designated for different geographic locations or for areas with distinctly different sediment characteristics within a single geographic location. For sediment quality considerations related to placement of material at the restoration site, see Appendix 2, A Biological, Chemical, and Physical Approach to Aquatic Habitat Restoration Decisions in the St. Louis River Area of Concern. DMMUs may be located in the following areas:
    - Operable areas specified by the US Army Corps of Engineers (USACE) for characterizing shoals within the Federal navigation channel and developing engineering construction plans for dredging of sediments. Some locations within the Federal navigation channel have recurring shoals that are dredged annually; other locations are dredged less frequently depending on the rate of sedimentation and requirements for marine transportation. Within the Duluth Harbor, annual maintenance dredging in the Federal navigation channel to support commercial navigation typically involves removing shoals in the most critical reaches of the Harbor.
    - Dredge materials in the Erie Pier Confined Disposal Facility which are designated for beneficial use
    - Locations within restoration sites where dredging would serve habitat restoration objectives
- Sediment to be dredged within DMMUs must be sampled prior to dredging to determine whether contaminant concentrations in the material are acceptable or elevated to levels of potential

concern. Sampling will be conducted such that the sediments within a volume of a proposed dredge prism are adequately characterized. Analysis must be conducted on samples that are representative of the material to be dredged, and in consideration of the intended use at the project site. The minimum number of samples for chemical analysis for every DMMU between 0 and 50,000 cubic yards described in Table 1. It is unusual for a DMMU to exceed 50,000 cubic yards, but if in the event it does the sampling frequency will double. It is not expected that a DMMU will be much greater than 50,000 cubic yards.

- Except for the sampling frequency noted in Table 1, (more extensive sampling is required for in-water placement), sampling locations and methods should follow the Minnesota Dredge Materials Guidance (MPCA, 2014), specifically noting bullet 6 under “Sampling Methods” (pg 19) which specifies sampling to the proposed dredging depth and analyzing each distinct layer or two-foot vertical core segments if distinct layers are not observed.

Table 1: Minimum number of sediment samples per Dredged Material Management Unit (DMMU).

Dredged Area (DMMUs) Volume (cubic yards)	Number of Discrete Samples for Chemical Analysis	Number of Composite Samples from the Discrete Samples for Bioassays
0 - 50,000	**5**	**1**

- All chemistry samples should be core samples, except as noted below:
  - DMMUs identified within the Federal navigation channel that are dredged routinely (every year or two) may be sampled using surface grab samples The sediments that annually form shoals within the Federal navigation channel have relatively low year to year variability in contaminant concentrations as well as low variability within the vertical sediment profile. Therefore, the collection of surface grab samples for characterizing DMMUs that are dredged every year or two is considered acceptable.
- All samples (grab or core) within a DMMU should be chemically analyzed as discrete samples. If no distinct layers or visual or olfactory evidence of contamination are observed within a core sample, vertical core segments may be homogenized to form discrete samples.
- Laboratory reporting limits for all analytes specified in the sampling plan should follow the QAPrP, Section A 4.4. Analytes for which there are SQTs should have reporting limits below the Level I SQTs. To ensure the desired reporting limits are achieved when interfering analytes are encountered, the analytical chemistry methods selected must permit quantitation of all target analytes. Values below the reporting limits should be handled as specified in the QAPrP, Section D1.1.
- Analytical results should be compared to Level I and Level II SQTs and the midpoint between the Level I and Level II SQTs, as well as to other appropriate screening values (e.g. bioaccumulation values) and St. Louis River ambient or least-impacted site concentrations if available. In addition, mean PEC-quotients (mean PEC-Qs) should be calculated following the guidance in Section 2.5 of the SQT Guidance Document (Crane and Hennes, 2007).
- PAH toxic units should be calculated following the procedure in EPA’s Equilibrium Partitioning Sediment Benchmarks guidance (USEPA 2003)

(http://www.epa.gov/nheerl/download_files/publications/PAHESB.pdf). Area of concern (SLRAOC) or restoration site specific PAH uncertainty factors may be used for estimating toxic units if alkylated PAHs have not been analyzed. Direct measurement of dissolved PAHs in pore water may be used instead of bulk sediment PAH measurements using USEPA 8272/ASTM D7363 methods.

- In accordance with the QAPrP, all analytical results and calculated values should be made available in electronic spreadsheet or database format that includes data on location, depth interval, reporting limits, lab data qualifiers and other relevant information to facilitate MPCA review.
- When necessary, one composite sample per 50,000 cubic yards within a DMMU will be prepared for biological effects testing by combining the 5 discrete samples (grab or core). For each additional 10,000 cubic yards after that one additional discrete sample for biological effect testing will be collected.
- Biological effects testing (i.e., bioassays) will be conducted as necessary using each single composite sample representative of sediments within the DMMU. This testing is necessary if previous testing and analysis is not sufficient to make a determination that the dredged material will not have an adverse impact on the aquatic ecosystem when used beneficially. Chemical analysis will also be performed on the composite samples used for bioassays.
- Elutriate Tests will be conducted as necessary using the single composite sample for each DMMU. The elutriate test procedure and subsequent water quality modeling (if necessary) is required to demonstrate compliance with applicable State Water Quality Standards during dredged material placement operations.

Considerations for biological effects (toxicity and bioaccumulation) testing

If the DMMU chemical test results fall below Level I SQTs, and/or are similar to ambient concentrations or least impaired site concentrations (reference) and do not pose a concern for bioaccumulation, the DMMU sediment is considered suitable to place in the restoration site and biological effects testing is not required.

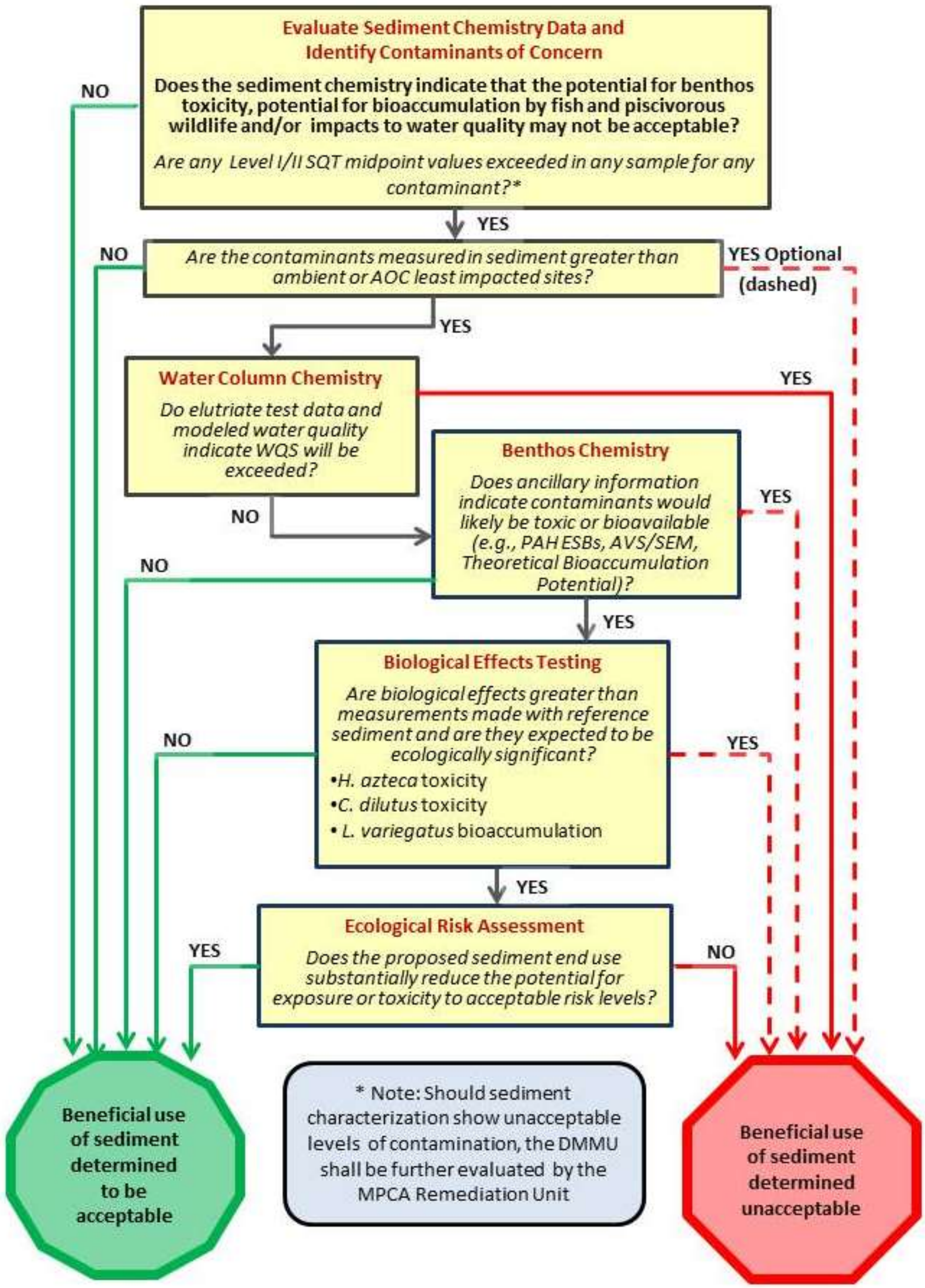
If the DMMU chemical test results are significantly greater than those observed for the SLRAOC least impaired sites, ambient concentrations, and/or are greater than the midpoint of Level I and II SQT values, biological effects testing may be necessary to further assess if the materials are acceptable to place in the restoration site.

- SLRAOC sample locations with a history of low levels of contaminants and no observed biological effects impairments are available in Crane et al., 2005. Reference sediment(s) can be collected and characterized from these locations and other suitable locations that have been identified from more recent data. Reference sediment(s) used for toxicity and bioaccumulation tests should have total organic carbon content (TOC) and grain size distribution that is similar to the DMMU test sediment(s). Sampling and analysis protocols for reference sediments will follow the same procedures outlined above for DMMU test sediments. The sampling density for new data will be determined on a site by site basis. A well-characterized negative laboratory control sediment (e.g., West Bearskin Lake, Ely, MN) should be included in all toxicity tests as a check on the test performance.
- Test acceptability criteria should conform with USEPA 2000 methods. Ammonia concentrations should be monitored and the test sediments manipulated prior to initiating toxicity and bioaccumulation tests per USEPA/USACE 1998a guidelines, if necessary.

Considerations for State Water Quality Certification

Dredging operations and placement of dredged material for habitat restoration projects must meet promulgated State water quality standards and the State must certify to the USACE that the planned activity complies with applicable numeric State water quality standards. For each DMMU, a single composite sample will be tested using the Standard Elutriate Test procedure (USEPA/USACE 1998a, 1998b) for compounds that are defined as constituents of concern. The results of Standard Elutriate Tests and water quality modeling will be interpreted using federal guidelines and applicable Minnesota water quality standards (USEPA/USACE 1998a, 1998b).

Figure 1. General approach for addressing the in-water placement of dredge materials at aquatic habitat restoration sites



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Appendix 2:

A Biological, Chemical and Physical Approach to Aquatic Habitat Restoration Decisions in the St. Louis River Area of Concern

Defining Aquatic Ecosystem Restoration Targets by Evaluating Site Conditions

Minnesota Pollution Control Agency

Photo curtesy of Barb Aker.

Introduction

A strategy to delist the St. Louis River (SLR) estuary as an Area of Concern (AOC) identifies remediating contaminated sediments at sites posing a human health or environmental risk, and restoring aquatic habitats in areas modified by human development (MPCA and WDNR 2013). Remedial action will be pursued at a suite of sites in the estuary by the Minnesota Pollution Control Agency (MPCA) to address legacy contaminant concerns identified as imperative to removing Beneficial Use Impairments (BUI) in the SLR AOC. Contaminants present in sediments within restoration sites will not require site-wide remedial action in order to meet AOC delisting goals. However, areas of sediment quality consideration (ASQC) identified within a restoration site may require supplemental investigation prior to final determination. Restoration design plans must consider potential risk to the aquatic ecosystem during construction phases to address State guidance (Crane and Hennes 2007) and as part of the Clean Water Act 404(b)(1), considering both the ASQC and subsurface conditions following construction.

Chemical, biological, and physical data collected in the SLR estuary adhere to State quality standards (MPCA 2014a), and are archived in a SLR Data System. This information supports initial site screening, informs habitat restoration design plans, and will eventually be used to support BUI removal recommendations. These data and documents are being used in the following decision framework to develop a design-basis for evaluating current restoration site condition and to inform final construction plans and specifications. The decision framework described in the following document is the basis for evaluating aquatic habitat restoration efforts in the SLR and is consistent with the U.S. Environmental Protection Agency (USEPA or EPA) Remedial Effectiveness evaluation guidance (USEPA *in progress*).

Sediment chemistry, biological community composition, and bathymetric data sets comprise the bulk of information available for evaluating site condition and predicting aquatic habitat recovery. Sediment coring data collected in the estuary throughout the 2008-2010 field seasons were summarized in a series sediment chemistry dashboards, with sample point detail provided in a final MPCA report characterizing contaminant concentrations by sediment assessment areas throughout the SLR AOC (Limno Tech 2013). These summaries were used by the MPCA Remediation Division to identify where remedial investigations are warranted, then the MPCA Watershed Division combined coring data, habitat variables, water chemistry, and a suite of benthic macroinvertebrate metrics to further evaluate restoration conditions at prioritized sites (c.f., Limno Tech 2014a, b, c, d). Supplemental chemical and biological evaluations required to further define site condition are outlined by Federal and State compliance documents (c.f., USEPA and USACE 1998a ,b, MPCA 2014b), or as a result of feasibility study recommendations (c.f., Limno Tech 2014e). As site restoration plans enter final designs, these data and guidance documents are fundamental to ensuring restoration activities address BUI removal objectives and are consistent with SLR AOC delisting goals.

Successful BUI removal is based on a premise that biological indicators will respond positively to aquatic habitat improvements completed at a restoration site. In order to evaluate progress and ultimately determine success, habitat improvement targets and appropriate biological response variables must be quantified. Relationships between habitat quality and community structure are well established in a variety of aquatic systems (c.f., Barton and Smith 1984), and modeling efforts to predict aquatic community response are useful for determining the feasibility of alternative design features. Utilizing the data specific to the estuary provides an opportunity to assess ecological gains associated with the costs of a particular construction design, introducing ecological benefits, public values, and economic interests into the decision framework (Stahl et al. 2008). This document introduces a process for developing a design-basis for restoration decisions that identifies habitat structures within a site using standardize data sets (MPCA 2014a, b), and provides quantifiable targets based on existing conditions and feasible construction goals.

Site Decision Process

A Design-Basis for Implementing Construction- Developing a quantitative method for making restoration site decisions integrates a host of information described through sediment characteristic summaries, benthic invertebrate community condition, aquatic macrophyte model output, and bathymetric surveys. The objective of a design-basis approach is to utilize data sets collected according to 2013 Remedial Action Plan (RAP) guidance for describing site conditions. Describing sediment characteristics, habitat, and the aquatic community provides an opportunity to assess current status, and spatially sub-divide a restoration project into management units, providing opportunities to initiate sequential construction projects that are based on existing site condition.

Sediment characterization is fundamental to understanding baseline habitat condition, and coring data has been summarized to determine the potential risks associated with each (Limno Tech 2013). Contaminant concentrations will be used to generate sediment quality targets that will be analyzed using a statistical interpolation technique that weigh the mean value and variance of one sample point with the proximity and concentrations associated with neighboring points (c.f., Limno Tech 2013a, b, c, d). The output utilizes predicted values to spatially map the respective conditions of either contaminants concentrations or benthic invertebrate condition across an entire site (Fig. 1a, b). A similar kriging technique may be used on benthic macroinvertebrate metrics, and as an example of the distance-weighted benthic interpolation (Fig. 1b), a series of contours is created that reflect a ranked value. Where sample density is sufficient, these spatial interpretations of the benthic community predict a gradient of condition across the AOC (Fig 2).

Variability in aquatic vegetation, sediment type and grain size, water current and depth, wave energy, and estuary wind fetch all affect the resulting benthic community structure. For accurate comparison of benthic metrics between the baseline restoration site condition and restored habitat community, these metrics need to be normalized to the confounding natural environmental variables that impact benthic community variability. Statistical regression models are used to generate normalized benthic metrics using existing data and predict the expected community structure following construction.

To develop restoration construction plans, a surface area-weighted benthic value is generated for each management unit based on the surface area of the site polygon. A surface area-weighted mean value for the restoration site is compared to the mean and lower 95% confidence interval for the least-impaired reference sites, identifying a range of conditions across the site. Comparing conditions within a site helps determine which management units are sequenced for construction, and those that more closely resemble habitat goals that may not require restoration. Construction design specifications are then selected by evaluating the engineering feasibility, sediment transport model output, and costs associated with a net improvement per site given the existing benthic community structure. This process provides a quantitative method for comparing existing condition to the least-impaired condition, introducing more design alternatives for efficiently completing construction goals. Regardless of how habitat restoration actions are proposed, designed, or implemented, prior assumptions that the aquatic community will respond positively to habitat improvements will be confirmed through on-going ecological monitoring administered through the State agencies. Approved monitoring protocols provided as templates for future efforts are referenced in the St. Louis River AOC data quality document plan, Section A7 (MPCA 2014a).

Site Data and Assessment Guidance

Areas of Sediment Quality Consideration- Chemical concentrations from sample points are used to map the interpolated extent and magnitude of surficial sediment contamination occurring within a site (Fig 1a). The statistical interpolations that predict concentration levels (described above in *A Design-Basis for Implementing Construction*) are used to label areas of sediment quality consideration (ASQC). Polygons that defined ASQC within a suite of restoration sites (Limno Tech 2013a, b, c, d) utilized the Level II sediment quality target (SQT). By delineating the contaminant footprint, restoration improvements can be prioritized to specific areas within a project site. Construction activities can proceed at locations within the site with little risk of disturbing ASQC. Sequencing implementation is an important logistical consideration, and managing ASQC separately allows on-going investigations (e.g., bioaccumulative contaminants, aquatic macrophyte growth studies, etc.) to make further determinations, potentially minimizing project costs of over protecting (e.g., through unnecessary excavation expense) or under protecting the resource (e.g., exacerbating bioaccumulative potential by improper capping or unintentional exposure).

Potential impacts on the aquatic ecosystem from contaminant concentrations exceeding sediment screening values are assessed using a tiered approach as discussed in more detail in *Ecotoxicological Parameters,* Section A4.4.3 (MPCA 2014a) and Appendix 1 (MPCA 2014a). Adding levels of site-specific assessment establishes confidence among agency partners that environmental conditions are adequate to meet BUI removal goals before restoration is complete. Where sediment contaminants are present at concentrations that could potentially cause toxicity to benthic aquatic life ($\geq$ Level I SQT), existing data on the biological community will be evaluated and compared to unimpaired condition. If the biological community metrics calculated from samples within an ASQC do not represent an impaired community structure, then these areas will be considered unimpaired by the low-level contaminant concentrations in the surrounding sediment. Where sediment contaminants are present at concentrations that likely cause toxicity to benthic aquatic life ($\geq$ Level II SQT), an ecological risk evaluation may require additional lines of evidence. This effort should consider laboratory bioassay results and, where appropriate, biological community status to compare to least impaired condition (USEPA and USACE 1998a, b, USEPA 2000).

Current methods for conducting toxicity tests and assessing potential impacts from bioaccumulative compounds follow those procedures prescribed in Federal and State guidelines (USEPA and USACE 1998a, b, USEPA 2000, MPCA 2014a, b). Methods for measuring the biochemical partitioning of compounds within the pore water of moderately contaminated sediments are currently being developed for the SLRAOC to facilitate BUI removal and AOC delisting (USACE. 2012. Project 369813-I-RAP-St. Louis River Bioavailability, U.S. Army Corps of Engineers, USACE District, Detroit, MI). The methodologies emerging from this work are providing another critical line of evidence in a tiered approach towards evaluating ecological risk and informing restoration design decisions.

Bioaccumulation potential of in-place contaminants is currently evaluated using 28-day Lumbriculus variegates bioassays. Similar testing standards are suggested to demonstrate the reduction in potential for bioaccumulation within restoration sites using USEPA and USACE testing (USEPA/USACE 1998a,b, USEPA 2000) as required for CWA 404(b)(1) evaluations.

A decision tree flow chart provides a generalization of the tiered approach for evaluating ecological condition at restoration sites, and incorporating best management practices to improve sediment quality for benthic macroinvertebrate communities, fish, and wildlife (Fig 3). Best management practices will vary from site to site depending on numerous factors including the risk level and species impacted. They may include, but are limited to, avoiding any disturbance, removing sediments, and/or covering sediments with material to increase habitat value of existing features.

Restoration areas with sediment quality consideration where concentrations exceed Level II SQT should be subject to best management practices that include, but are not limited to:

1. Better defining the extent and magnitude of chemical concentrations through supplemental sampling
2. Performing bioassays (acute/chronic) to ensure acceptable risk of exposure and uptake by appropriate test organisms as recommended by the agency.
3. Finalize decision to remediate, avoid, or cover with appropriate medium to increase the long-term effectiveness of habitat restoration efforts.

Predictive Habitat Model Results- Restoration designs represent habitat improvements across the restoration sites. Probability-based models have been developed for the estuary to predict ecological function under a variety of scenarios (i.e. changes in bathymetry to alter wave energy, wind fetch). Output from the models provide a probability of establishing an aquatic macrophyte assemblage as well as other ecosystem goods and services gained or lost by various restoration scenarios. The Ecological Design (ED) models for 40th and 21st Avenues were developed to predict how constructed habitat features influence environmental factors (e.g., bathymetry, wave energy, wind fetch) that effect aquatic vegetation assemblages (USFWS 2012, 2013). Using similar water depth and wind fetch factors, the EPA-MED developed a model to predict submerged aquatic vegetation (SAV) in the estuary (Angradi *et al.* 2013), and embarked on an AOC-wide evaluation to generate a host of ecological variables and public amenities through an Ecosystem Services Model (ESM). This effort establishes a basis for quantifying and tracking not only variables directly related to BUI removal, but also those human valued ecological services indirectly influenced by remediation, restoration, and eventual delisting.

Alteration in bathymetry is the main design feature constructed through in-water material placement. The ESM, SAV, or ED model will detect the differences between restoration design alternatives in the form of quantifiable output variables (e.g., % acres suitable for SAV, lineal distance of shoreline angling opportunities, etc.). By modeling outcomes and realizing efficiencies gained or lost by implementing all, or part, of a particular restoration plan, a more accurate estimate of the benefits and associated costs are realized.

Aquatic Macrophyte Assemblage- Habitat improvement is referenced extensively in the Lower SLR Habitat Plan (SLRCAC 2002) and the 2013 RAP (MPCA and WDNR 2013). Macrophytes assemblages are the primary feature associated with aquatic habitats, providing refugia for productive fish and invertebrate populations. Macrophyte assemblages have been used to assess wetland community health of near shore habitats across the Great Lakes (Danz *et al.* 2004, Uzarski *et al.* 2005), and targeted in long-term monitoring of sites under remedial investigation and cleanup (BARR 2013). As described above (see *Predictive Habitat Model Results*), aquatic macrophyte data are instrumental in modeling the predicted habitat improvements that result from bathymetric alterations. Aquatic macrophyte data are also applicable to the Loss of Fish and Wildlife Habitat BUI removal recommendations using analytical techniques similar to those for the Degradation of Benthos (see *Benthic Macroinvertebrate Community*). Methods for determining site condition or evaluating restoration success using aquatic macrophyte as indicators include;

- Mean coefficient of conservatism of a plant(s)
- Presence or proportional abundance of invasive species
- Presence or proportional abundance of nutrient- and sediment-tolerant species
- A multi-metric aquatic macrophyte Index of Biotic Integrity (IBI)

Benthic Macroinvertebrate Community - As presented in the 2013 RAP, macroinvertebrate community structure and function are recommended response variables used for analysis when recommending removal of the Degradation of Benthos BUI (No. 4), and widely accepted as indictors of aquatic community health (Rosenberg and Resh 1993). Knowledge of benthic community health prior to construction activities is important for establishing a gradient of condition across the suite of sites prioritized for restoration (Fig 2). The importance of understanding the status of a site and the feasibility of implementing specific design alternatives was previously described (see *A Design-Basis for Implementing Construction*). Comparisons made for BUI removal once construction has been implemented will be based on monitoring and analysis to demonstrate a statistically significant difference between the restoration site community and a community representing a least-impaired condition. When a significant difference does not exist, a restoration site will be unimpaired. Similarly, when post-construction monitoring indicates the suite of restoration sites (representing approximately 1,700 acres, a majority included within 21st and 40th Avenues West, Grassy Point, Spirit Lake, etc.) are unimpaired, the degradation of Benthos BUI will be recommended for removal.

Biological metrics are useful for standardizing biological endpoints associated with complex systems (c.f., Barbour *et al.* 1995). In order to standardize data sources by season, location, and over multiple years, multiple metrics (e.g., indices of biological integrity) are often combined to factor out confounding variation. Ultimately, a multi-metric index will be used by the State agencies when recommending removal of the Degradation of Benthos BUI (c.f., USEPA 2014). Candidate macroinvertebrate metrics include;

- % Individuals represented by 1) Intolerant species, 2) Ephemeroptera, and 3) both Ephemeroptera and Trichoptera, are all metrics that increase with improved habitat condition
- % Individuals represented by; 4) Very Tolerant species, and 5) Collector-Gatherers are metrics that are inversely summarized due to an increase in degraded habitat conditions.

Discussion

St. Louis River estuary data are available as raw form, report summaries, and guidance manuals for evaluating the chemical, biological, and physical information associated with each restoration site. Integrating these main data sources into a transparent and defensible design-basis allows quantifiable targets to be observed and monitored. Key elements to the design-basis are provided in Table 1.

Table 1. Key elements of a design-basis to quantitatively evaluate site condition and inform restoration plans. The design-basis integrates existing site information through a tiered-approach (MPCA 2014b) and helps to sequentially implement construction activities.

Characterize Sediment Chemistry
Use sediment chemistry dashboard summaries and characterization reports to identify sample points potentially impaired by contaminant concentrations. • When screening values exceed Level I SQT, confirm risk estimates by summarizing benthic macroinvertebrate community data. • When screening values exceed Level II SQT, further evaluate benthic community condition and/or determine if supplemental action is required to initiate laboratory toxicity tests and bioaccumulation assays.
Define areas of sediment quality consideration (ASQC)
Conduct distance-weighted analysis (Kriging) to delineate contaminant footprints based on spatial distribution of chemical concentrations. • Define the spatial extent of the ASQC using Level I and/or II SQT screening values. • Calculate the benefit and associated costs of removal, capping, and no action options for ASQC.
Define restoration management units
Management units within a restoration site are determined based on the spatial distribution of benthic macroinvertebrates, aquatic macrophyte modeling, and associated sediment risk assessment. • Develop normalized indicator metric(s) for least-impaired reference condition. • Conduct spatial analysis (Kriging) of normalized indicator metric(s) to calculate a surface area-weighted delineation for each management unit. • Calculate a surface area-weighted average benthic metric for the restoration site and compare the 95% CI (lower) for the least-impaired condition. Determine if habitat improvements are required. • Define minimum number of management units within the site requiring restoration of shallow water habitat to meet BUI removal criteria.
Define preliminary design features
• Design preliminary bathymetric surface alterations for each management unit within the site to reach habitat objectives. Objectives are based on predicted aquatic macrophyte assemblage results (submerged, floating leaf and emergent) based on an Ecological Design and Submerged Aquatic Vegetation model. Assess Ecosystem Services Model output as needed to further inform site design decisions.
Confirm aquatic habitat restoration objectives are meet with proposed design
• Conduct hydrodynamic/sediment transport modeling to confirm sediment stability for optimal habitat surfaces and constructability. • Run probabilistic aquatic macrophyte model and generate quantifiable spatial coverage of resulting vegetative assemblage structure. • Determine if the benthic community metrics fall within the range considered normal for least-impaired condition.

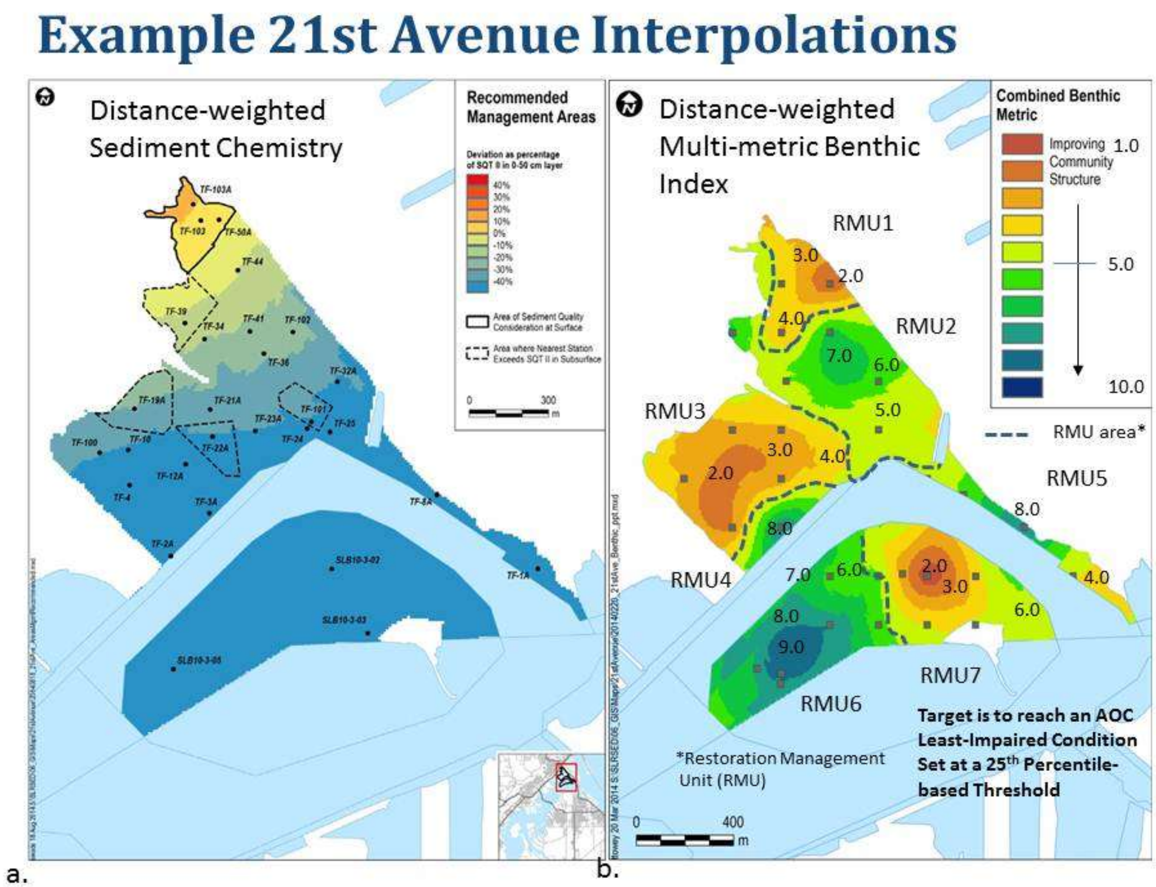

Figure 1. Examples of a distance-weighted interpolation of sediment chemistry (a.) and invertebrate multi-metric condition (b.) within the St. Louis River Area of Concern at the 21st Ave project site. Areas of sediment quality considerations are delineated kriging that uses a maximum deviation for a Level II Sediment Quality Target screening value (fig. a). An example of how the benthic community is used to delineate a site into management units using an area-weighted value to each restoration management unit (b.). Construction sequencing can then target areas based on current condition, resulting in aquatic community that is similar to a least-impaired condition within the estuary.

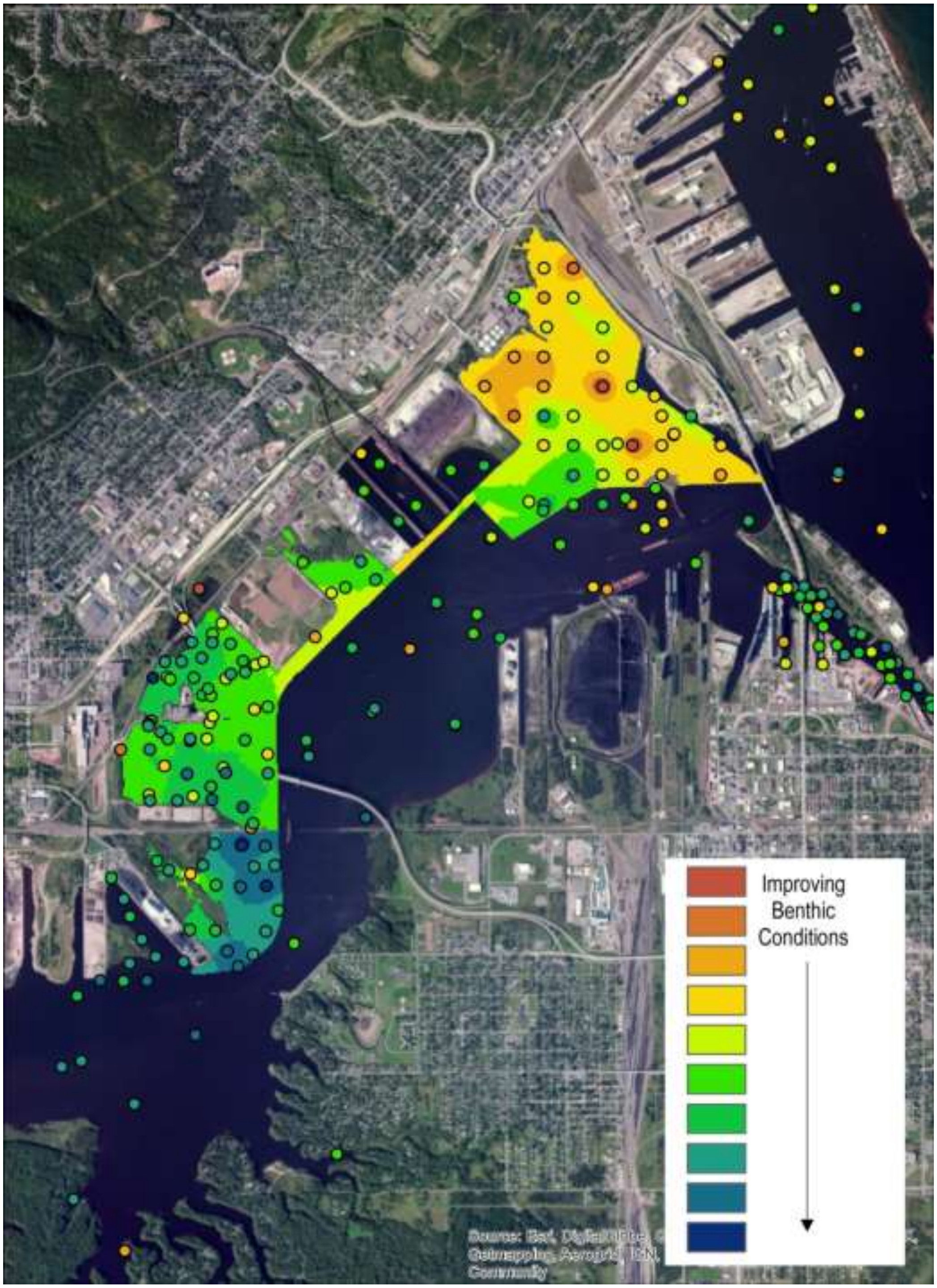

Figure 2. An example of benthic community health based on a MPCA benthic macroinvertebrate combined metric interpolated for habitats within St. Louis Bay of the Duluth/Superior Harbor. Contours are based on a distance-weighted kriging technique using the maximum variance from a multi-metric index of improving community conditions within the Grassy Point, 40th Avenue West, and 21st Avenue project sites.

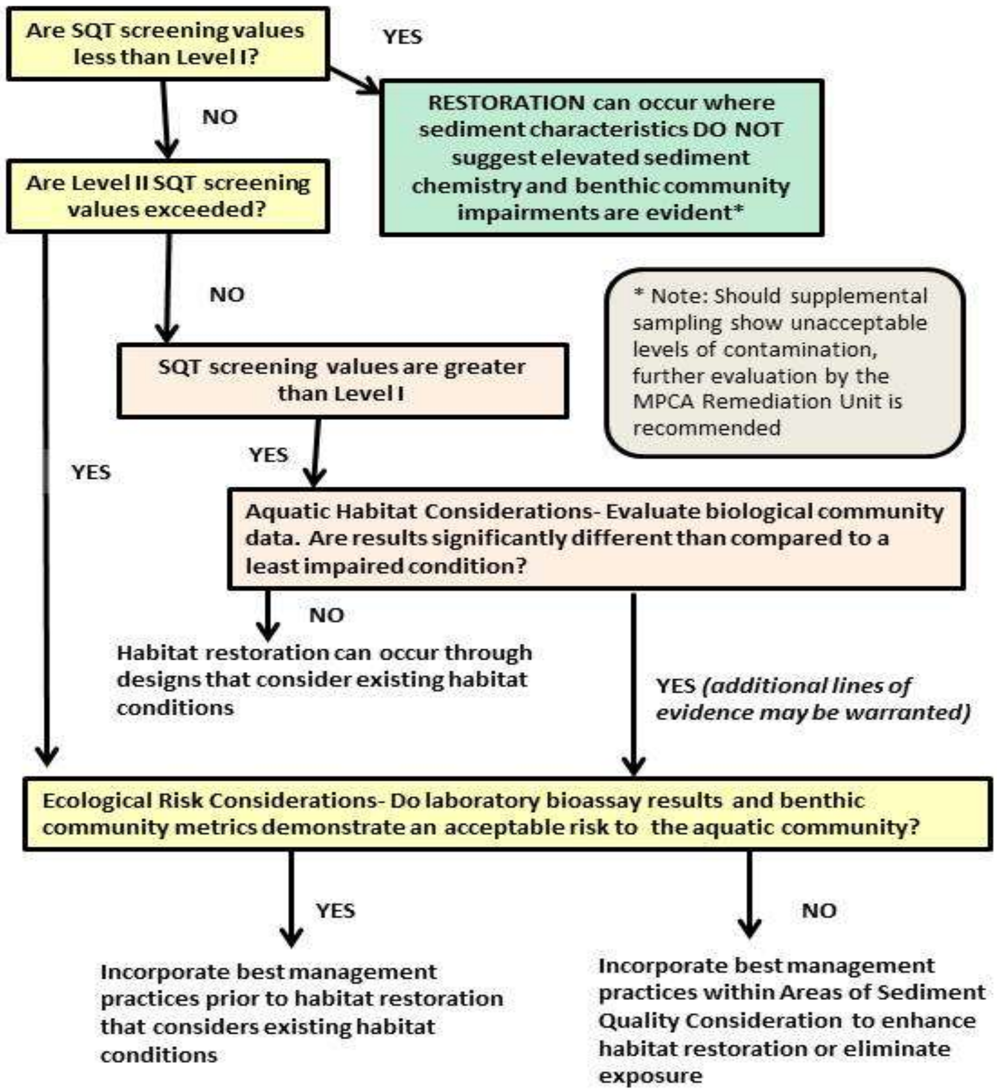

Figure 3. General approach for addressing best management practices at areas of sediment quality consideration in restoration sites

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Addendum 1

Minnesota Pollution Control Agency

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February 26, 2015

Mr. Louis Blume
Quality Assurance Program Manager
Great Lakes National Program Office
USEPA Region 5
77 W. Jackson Blvd
Mail Code: G-17J
Chicago, IL 60604-3507

RE: Response to Comments

Dear Mr. Blume:

The Minnesota Pollution Control Agency (MPCA) has received and reviewed the Revised Quality Assurance Project Plan Technical and Quality Review, provided by your office, dated February 4, 2015. Your comments are valued and helpful.

The MPCA has prepared this letter to respond to the comments you have provided. As we have previously discussed with you, we will not be revising the St. Louis River Area of Concern (SLRAOC) Quality Assurance Program Plan (QAPrP) at this time. However, we will make this letter Addendum 1 to the QAPrP.

Sincerely,

Todd J. Biewen

Todd J. Biewen
Assistant Division Director
Remediation Division

TJB/LC:ld

cc: Nelson French
Luke Charpentier
Deepa deAlwis

Mr. Louis Blume
Page 1 Attachment
February 26, 2015

The MPCA Comments

Date Received: February 13, 2015 Date Responded: February 20, 2015

Project Information

GLNPO Project Officer:	Rajen Patel
Review of Quality Assurance Project Plan (QAPP) for:	St. Louis River Area of Concern Quality Assurance Program Plan for Minnesota Based Projects
Grant Number:	GL00E01190-0

Date QAPP Submitted for Review:	January 23, 2015	Date Review Requested:	February 6, 2015
Date Review Completed:	February 4, 2015	Reviewed By:	CSC = Joan Aron, PhD; Justin Telech; and Molly Middlebrook Amos

Comments

1. **Section A2:** Please specify the need for project-specific organization charts in project-specific QAPPs. The former Figure 1, which included an organization chart for QA tasks for the SLR AOC, was deleted.
   MPCA Response: MPCA agrees with the comment. All site specific QAPPs or other Quality Documentation must include an organization chart for individuals, firms and/or agencies involved in the project.

2. **Section A3:** Figure 1 (formerly Figure 2) includes an overview of the SLR AOC. Project-specific QAPPs should include more detailed map(s) as necessary. Please specify this project-specific need in the QAPrP.
   MPCA Response: MPCA agrees with the comment. All site specific QAPPs or other Quality Documentation will have detailed project specific maps that identify sampling locations and other relevant information.

3. **Section A4, 4.4.1:** In addition to describing how results between the RL and MDL should be reported, please state whether RLs should be sample-specific for sediment chemistry analyses.
   MPCA Response: The MPCA expects all reasonable effort will be made to obtain required RLs as they are based on human health or ecological standards/guidance. Furthermore, this change is unnecessary as the issue of the difficulty meeting RLs referenced in Table 1, that can occur in some situations is addressed by the sentence that follows the RL an MDL reporting: *If a given RL cannot be met due to matrix interferences and high dilution rates or other unanticipated circumstances, the issue should be discussed among the project team to decide on a path forward.*

4. **Section A8:** It is suggested that the QAPrP identify how training/certification is documented and where records are maintained. If this is project specific, please indicate so.

MPCA Response: The MPCA agrees with this comment. Records of all training for each employee must be maintained by the entities conducting the work and such records must be provided to MPCA upon request.

5. **Section B1:** The following statement was included in the revised QAPrP: "The project specific QAPP or other quality documentation should provide details of statistical analysis that will be performed." It is suggested that the QAPrP include detail on what is expected in a project-specific QAPP with regards to statistical analyses. One recommendation for project-specific QAPPs should be that they state the objectives for statistical analysis of the data and the anticipated statistical power of hypothesis testing that might be used for decision making based on project data.
MPCA Response: MPCA agrees with the comment. Project specific QAPPs or other quality documentation should state the objectives for statistical analysis of the data and the anticipated statistical power of hypothesis testing that might be used for decision making based on project data.

6. **Section B2:** It is suggested that the QAPrP specify the need for project-specific QAPPs to identify individuals responsible for corrective action during sample collection.
MPCA Response: MPCA agrees with the comment. In the event that the sampling plan cannot be followed for any reason, the individual(s) authorized to make changes to the sampling plan should be identified in the project specific QAPP or other quality documentation.

7. **Section B2:** Please consider including, where appropriate, that sampling procedures should be consistent with the RAP. For many BUIs, the RAP identifies specific sampling procedures. These procedures should be followed or a rationale provided if alternative procedures are used.
MPCA Response: This is not the case for SLRAOC RAP, but there are removal targets and strategies. The following is recommended: *In all cases, sampling plans must be consistent with BUI removal targets and strategies and would allow the AOC managers to determine pre-remediation/restoration status and if the remediation/restoration efforts had been successful.*

8. **Section B5:** It is suggested that the QAPrP specify the minimum frequency for QC samples in Table 2.
MPCA Response: This information is included in Section A 7.1.2. However the same information will be added to Table 2 in the next revision.

9. **Section C1:** The following was included in the revised QAPrP: "Assessments to include laboratory or field audits may be performed based upon the identified needs of by the project team." It is suggested that the QAPrP follow this statement with, "If the project team identifies the need for a laboratory and/or field audit the following details should be included..." It is suggested that these details include the required number and frequency of assessments, with approximate date and names of responsible personnel, and the individuals responsible for corrective actions.
MPCA Response: MPCA agrees with the comment.

10. **Section D3:** It is suggested that the QAPrP specify the need for project-specific QAPPs to describe the processes for reconciling with DQOs and reporting limitations on use of data.
MPCA Response: MPCA agrees with the comment. **Section D3: Reconciliation with User Requirements** - Project Specific QAPP or other quality documentation should document how the results will be assessed and how any data that does not meet QC or RL requirements will be handled and documents as well as who would make data usability decisions.