CONTINUOUS DISSOLVED OXYGEN MONITORING
QUALITY ASSURANCE PROJECT PLAN

Revision 2.2

Effective Date: December 31, 2023

Organization:	Metropolitan Water Reclamation District of Greater Chicago Department of Monitoring and Research
Address:	100 East Erie Street Chicago, Illinois 60611-2803
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GROUP A: PROJECT MANAGEMENT

A1: Approval Sheet:

Date 12/20/23

Edward Podczerwinski
Director of Monitoring and Research

Date 12/12/23

Dustin Gallagher
Senior Aquatic Biologist
Monitoring and Research

Date 12/20/23

Ashley Jesernik
Quality Assurance Coordinator
Monitoring and Research

A2: TABLE OF CONTENTS

A3: Distribution List

A copy of this Quality Assurance Project Plan (QAPP) will be distributed to each person signing the approval sheet and each person involved with project tasking identified in Section A4. A copy of this QAPP shall be available on request to any person participating in the project from any of the personnel listed in Section A4. Persons not employed by the Metropolitan Water Reclamation District of Greater Chicago (District) may obtain a copy of this QAPP from the District website under the “Education and Water Quality” section.

As this document will be updated periodically, the reader is advised to check with the Network Coordinator for the latest revision if the version is more than one year old. Revision 2.2 has been prepared following the United States Environmental Protection Agency (EPA) guidance document EPA QA/R-5 titled “EPA Requirements for Quality Assurance Project Plans,” March 2001.

A4: Project/Task Organization

The responsible persons for project management are:

<u>Project Director</u>:
Edward Podczerwinski
Director of Monitoring and Research

<u>Project Manager</u>:
Dustin Gallagher
Senior Aquatic Biologist

<u>Quality Assurance Officer</u>:
Ashley Jesernik
Quality Assurance Coordinator

<u>Network Coordinator</u>:
Thomas Minarik
Principal Environmental Scientist

<u>Field Operations Manager</u>:
Erica Spiess
Aquatic Biologist

<u>Figure 1</u> is the organization chart for the project. Primary lines of communication are shown as dashed lines. However, within the District, communication between any of the project participants may occur and is in fact encouraged as questions or issues arise.

Overall, project planning, including the selection of monitoring locations, is performed jointly by the Project Director, the Project Manager, and the Network Coordinator. The Project Director is responsible for project staffing, funding, and the proper execution of the entire project. The Network Coordinator oversees the execution of routine project activities, resolves major deviations from procedures, and assists in the final review of project reports and the QAPP.

The Project Manager coordinates day-to-day project activities, resolves minor deviations from procedures and ordinary quality control problems; supervises the data review, statistical analysis, management of the project database, and preparation of project reports; and prepares and updates the QAPP.

The Field Operations Manager is responsible for the execution of field activities. A field team deploys the monitors, makes field measurements, and transports the retrieved monitors to the Aquatic Ecology (AE) Section. These activities are primarily done by boat, but certain monitoring stations require a land-based team. Two days each week are scheduled to retrieve and deploy the monitors at various monitoring stations.

The AE Section maintains and calibrates the water quality monitors, downloads collected data from the monitors, and assists in the cross-sectional dissolved oxygen (DO) profiling performed at each monitoring location each spring, summer, and fall. The Project Manager oversees the fabrication, installation, and maintenance of the protective housing needed for field deployment of the water quality monitors. The Field Operations Manager oversees field deployment and retrieval of the water quality monitors. An aquatic biologist (biologist) reviews monitoring data for abnormalities and directs the laboratory's quality control program.

The Quality Assurance (QA) Officer is responsible for oversight of quality control for the project and reviewing the QAPP.

A5: Problem Definition/Background

The Chicago Area Waterway System (CAWS) was designed in the 19th century to convey Chicago's sewage and stormwater away from Lake Michigan, Chicago's primary source of drinking water. This was accomplished by the construction of the Chicago Sanitary and Ship Canal (CSSC) and the reversal of the flow in the Chicago River and South Branch Chicago River (SBCR). Instead of flowing into Lake Michigan, the Chicago River and SBCR now flow into the CSSC. The CSSC collects the area's treated sewage effluents and stormwater runoff and carries it into the Des Plaines River (DPR) at the canal juncture south of Lockport. Major waterways in the CAWS include the North Shore Channel (NSC), the Chicago River, the North and South Branches of the Chicago River, the CSSC, Calumet River, Grand Calumet River (GCR), Little Calumet River (LCR), and the Calumet-Sag Channel (CSC).

The DPR System originates in Wisconsin and flows southward and eventually turns to the southwest and joins with the CSSC below the Lockport Lock and Dam. Salt Creek is a tributary of the DPR that originates in northwest Cook County and flows southeast through

DuPage County into the Des Plaines River. The District service area, including the CAWS and DPR System, is shown in Figure 2.

The data from this project will be used in conjunction with other District projects to determine overall water quality of the waterway system. These other projects include the Ambient Water Quality Monitoring project, which analyzes inorganic and organic parameters at 30 monitoring locations, and a biological survey project that assesses biological health by monitoring the diversity of biological species and their abundance at various locations in the waterway system.

The continuous DO monitoring data from the CAWS are also provided to the Illinois Environmental Protection Agency (IEPA) on a quarterly basis, as required by the District's National Pollutant Discharge Elimination System permits for the Terrence J. O'Brien (O'Brien) and Calumet Water Reclamation Plants (WRPs).

A6: Project/Task Description

Currently, DO, specific conductivity, and water temperature are monitored at 20 locations in ten waterways in the District service area. The monitored waterways include the following rivers, man-made channels, and canals:

Chicago Waterway System

- Chicago River
- NSC
- NBCR
- SBCR
- South Fork South Branch Chicago River (Bubbly Creek)
- CSSC

Calumet Waterway System

- LCR
- CSC

Des Plaines Waterway System

- DPR
- Salt Creek

The CDOM program was initiated at 20 locations during the summer of 1998. These monitoring locations were concentrated on the NSC, the NBCR, the Chicago River, the SBCR, Bubbly Creek, the CSSC, and the CSC. The monitoring location on the DPR at Jefferson Street, Joliet, and the location on the Chicago River at the Chicago River Lock and Michigan Avenue were added in 2000. An additional 11 monitoring locations were added in 2001. These included additional locations on the CSC and locations on the Grand Calumet River (GCR), the LCR, and the Calumet River. An additional Bubbly Creek monitoring location at 36th Street was added in 2002. During 2004, a monitoring location was added at Foster Avenue on the NSC. During 2005, an additional 11 monitoring locations were added. These locations monitor Salt Creek and additional reaches of the DPR, GCR, LCR, and NBCR. During 2011, the CDOM program was reassessed and reduced to a total of 18 stations, 13 in the deep draft and five in wadeable locations. In 2014, the deep-draft location at Cicero Avenue on the CSC was reactivated. Ogden Avenue on the DPR was reactivated in 2016, and a new location at Church Street on the NSC was activated. In 2018, Central Park on the NBCR and J. F. Kennedy Boulevard on Salt Creek were deactivated. In 2019, Clark Street on the Chicago River was deactivated, and Michigan Avenue on the Chicago River was reactivated. In 2020, Busse Woods Main Dam on Salt Creek was deactivated.

Descriptions of all monitoring locations, both active and inactive, are provided in Tables 1, 2, and 3. Table 1 lists all monitoring locations and service history. Table 2 shows the latitude and longitude of each monitoring location. Table 3 gives the Illinois Pollution Control Board (IPCB) waterway classification and IPCB DO water quality standard at each monitoring location. Figure 2 is a map showing the active monitoring locations.

In 2020, telemetry equipment was installed at a portion of the monitoring locations to promote real-time reporting of water quality information, and additional telemetry locations were added in 2023. Water quality monitors that are deployed to telemetry locations are connected to dataloggers via a data cable, and the equipment is powered by a battery that is charged via solar panel. Hourly data are automatically uploaded to the AQUARIUS Time-Series database from a secure file transfer protocol site that receives data from the telemetry equipment via cellular transmission.

The locations of the monitoring stations are reviewed at least annually. Monitoring location changes may occur over time for logistical or safety reasons, or to respond to different monitoring objectives that may arise.

A7: Quality Objectives and Criteria for Measurement Data

Measurement data must be accurate enough to determine compliance with the applicable IPCB DO water quality standards. The DO standards are stated to tenths of a milligram per liter (mg/L). Therefore, measurements of DO should be accurate to ± 0.1 mg/L.

The IPCB water quality standards for temperature specify the maximum allowable water temperature and maximum allowable temperature rises resulting from, for example, the discharge of heated effluents. These standards are stated in degrees Fahrenheit (°F) or to tenths of degrees Celsius (°C) following conversion of the standard from Fahrenheit to Celsius. While these standards are presently not a primary concern of this project, temperature measurements to ± 0.1°C are necessary to ensure the accuracy of the recorded DO measurements, as these measurements are affected by temperature.

A8: Special Training/Certification

The tasking of the project has been assigned to the personnel with appropriate job classifications. The project personnel are trained on the job to perform their assigned technical activities. No additional special training or certifications are required for the project.

A9: Documents and Records

Project Data and Reports

The Network Coordinator maintains the following project records and reports:

1. Monitoring data are stored in a cloud-based AQUARIUS Time-Series database.

2. Field observations performed during monitor retrieval and deployment are stored electronically as portable document format (PDF) documents and in the AQUARIUS Time-Series database.

3. Laboratory calibration and maintenance records are stored electronically in Excel® spreadsheets.

4. Seasonal cross-sectional DO surveys at each monitoring station are stored electronically in an Excel® spreadsheet.

Other Reports and Communications

1. The Network Coordinator shall retain copies of all correspondence related to the transmittal of project data to the IEPA and retain electronic copies of data transmittals.

2. The Project Manager and Network Coordinator shall retain copies of annual Monitoring and Research (M&R) Department reports pertaining to continuous DO monitoring.

3. The Network Coordinator and QA Officer shall retain copies of all annual updates and revisions of this QAPP.

4. The Network Coordinator shall retain copies of all procedures.

5. The Network Coordinator and Project Manager shall retain copies of all laboratory analytical reports and correspondence with other laboratories.

6. The Project Manager and Network Coordinator shall retain copies of all management reports pertinent to continuous DO monitoring.

7. The Project Manager and Network Coordinator shall retain copies of all communications pertinent to continuous DO monitoring to and from outside agencies and other interested parties.

All hard copies of the records and reports listed above will be retained for a minimum of ten years at the Cecil Lue-Hing Research and Development Complex located at the Stickney WRP.

GROUP B: DATA GENERATION AND ACQUISITION

B1: Sampling Process Design (Experimental Design)

Selection of Monitoring Locations

There have been forty-nine locations selected for DO monitoring in the District service area waterways (Table 1) since the inception of this project. Of these, 20 are currently actively monitored. The criteria used to select these locations were:

1. A history of low DO levels.

2. Location above and below the confluence of major waterways.

3. Proximity to an artificial aeration station.

2. Location above and below the major WRPs.

3. Location below pumping stations, such as the North Branch and Racine Avenue, and below discretionary Lake Michigan diversion locations.

4. Proximity to ambient biological and or water quality monitoring locations.

To examine the suitability of a sampling location, cross-sectional DO profiles are made at each site to verify the uniformity of DO concentrations. Uniform cross-sectional DO at a monitoring location is necessary to ensure that representative DO measurements can be obtained from a single DO monitor. Cross-sectional DO profiles are routinely repeated three times each year (spring, summer, and fall) at each monitoring location to verify that cross-sectional uniformity of DO concentrations exists.

Monitoring locations may be added to or removed from the monitoring network based upon periodic assessments of monitoring needs and available resources. Table 1 shows the monitoring history of monitoring locations used for this project.

Measurement Frequency

The DO concentration at any point in a waterway is subject to many influences. Measurements taken at infrequent intervals, such as weekly or even daily, may be insufficient to adequately characterize fluctuations that may occur during wet-weather events or diurnal fluctuations that may occur in wadeable waterways. Previous monitoring has shown that hourly measurements will record these changes and allow for a more comprehensive understanding of DO behavior in the District service area waterways. After CDOM has been conducted for a suitable amount of time at a given station, it may not be necessary to continue such intensive monitoring until conditions change in that waterway due to operational upgrades, completion of reservoirs, or changes in lake diversion amounts, for instance.

Parameters Measured and Information Monitored

When DO measurements are taken, it is important to record water temperature since the DO saturation concentration will increase as temperature decreases. Currently, specific conductivity is also measured at continuous monitoring locations. Available information related to lake water diversions, precipitation, and recorded combined sewer overflows (CSOs) into the waterways is also used to interpret the collected DO data.

B2: Sampling Methods

The water quality monitors used for this project are programmed to record DO, specific conductivity, and temperature measurements at hourly intervals. The alkaline batteries used by the monitors (C cells) generally allow field deployment for a period of at least four weeks. At locations where telemetry equipment is installed, monitors can be deployed for extended periods of time because an external battery powers the monitors and dataloggers and that battery is charged by solar energy. If the external battery or equipment fails, the sonde will continue to log hourly measurements using alkaline batteries. The monitors are exchanged in prescheduled batches, on Tuesdays and Wednesdays. Rarely, usually because of inclement weather, monitors are in the field for extended periods during which they will continue to collect measurement data until the batteries are exhausted.

The monitors are secured in eight-inch stainless steel or polyvinyl chloride pipes to protect them from marine vessels, debris, and vandalism. The monitors are typically deployed inside a 12- to 15-foot pipe vertically mounted on the side of a suitable bridge abutment, dolphin, or seawall. The monitors are generally positioned two to three feet below the water surface. These pipes have numerous two-inch openings in the pipe wall to allow water to flow freely through the housing and around the monitor, thereby ensuring representative water quality measurements.

B3: Sample Handling and Custody

The newly prepared and calibrated monitors are transported to the monitoring stations in coolers that contain enough tap water to saturate the air inside the cooler with humidity. The monitors that are retrieved from the waterway are placed in the same coolers for transport back to the laboratory. When the monitors arrive in the AE Section Laboratory, they are suspended vertically in a water-filled tank referred to as the “receiving tank.”

When a monitor is deployed at a sampling location, a calibrated hand-held DO meter is used to measure DO and temperature in situ just prior to deployment at the same depth and location. The results are recorded on the field data sheet that is provided in the standard operating procedure (SOP).

B4: Analytical Methods

Each water quality monitor utilizes a DO probe, conductivity probe, and a thermistor to measure water temperature. The DO probes utilize optical DO sensors. The optical DO sensor measures the lifetime of the luminescence, which is inversely proportional to the amount of DO present. The DO probe calibration is performed with a single-point adjustment to 100 percent DO saturation following manufacturers' and EPA guidelines. The conductivity sensor measures the voltage drop between the electrodes and converts it to specific conductance. Temperature is measured with a thermistor that changes in proportion to resistance with temperature variation.

For this project, the water in the monitor storage tank is used as the reference sample for monitor performance evaluations. The DO of the storage tank water is determined using a calibrated handheld DO meter. The use of monitors to obtain in situ DO measurements eliminates errors associated with sample handling and storage when grab samples are collected for wet chemistry DO analysis.

Independent DO readings are taken with a handheld, calibrated DO meter at each monitoring location when freshly calibrated monitors are deployed for corroborating DO analysis in the laboratory.

B5: Quality Control

Daily performance checks of the DO probes are made while the monitors are maintained in a ready state in the laboratory prior to field deployment.

Monitors are recalibrated whenever the monitor DO is not within ± 0.2 mg/L of the DO concentration of the storage tank water as determined by a calibrated handheld DO meter.

The automatic collection of DO and temperature data does not lend itself to the use of quality control measures that would normally be employed in the laboratory analysis of samples. Therefore, great care is exercised in the calibration of monitors and verification that each monitor has maintained its calibration after deployment.

To verify that data collected by each monitor is accurate, the following quality control measures are employed:

1. Verification of the accuracy of each monitor after retrieval against a 100 percent DO saturation check.

2. Checking the last field DO measurement made by each monitor against a calibrated handheld portable DO meter reading taken in the waterway next to the deployed monitor.

If acceptance criteria for these measurement verifications are not met, the data collected by that monitor may be rejected. Sections B10 and D1 detail these verification procedures.

B6: Instrument Testing, Inspection, and Maintenance

In addition to the monitors that are deployed at all times at the active monitoring sites, several monitors are kept in controlled storage in the laboratory after being prepared for deployment the following week. Other monitors that are not deployed, or are not being prepared for deployment, are available to replace those monitors that require servicing that cannot be performed in the laboratory.

The monitors are maintained as required by the manufacturers' manuals and the laboratory SOPs (Vick, 2018; Manta, 2015). Inventoried parts and supplies include batteries, O-rings, wiper assemblies, calibration standards for the conductivity sensors, and temperature/conductivity sensors.

When the monitors are returned to the laboratory, the field data is downloaded (see Section B10), and the monitors are cleaned of surface debris. Data from telemetry locations is transmitted to the AQUARIUS Time-Series database via cellular transmission, a secure file transfer protocol site, and AQUARIUS Connect, but data logged by the monitors is also uploaded to fill any gaps in telemetry data. The monitor probes are cleaned and inspected for damage.

The thermistor in each monitor is checked annually against a certified thermometer traceable to a National Institute of Standards and Technology standard. When the error of the thermistor exceeds 0.5°C, the temperature/conductivity sensor is changed. If the temperature measurement is still beyond the acceptance range, the monitor is returned to the manufacturer for service.

The voltage of the on-location batteries used to power the data loggers and monitors at telemetry locations is checked via the review of AQUARIUS Time-Series voltage data on the Monday of the week that monitor exchanges are scheduled, to determine if batteries will need to be replaced. Batteries for the telemetry equipment are sent along with the water quality monitors, for locations that have steady decreases in voltage and little to no recharge within a 72-hour period. Before a telemetry battery is exchanged, the solar panel is inspected for damage or debris. Faulty batteries are replaced when the monitors are exchanged, or independent of sonde exchanges if needed.

B7: Instrument Calibration and Frequency

Monitors awaiting field deployment are stored in the AE Section Laboratory in water-filled stainless steel holding tanks. While suspended vertically in these tanks, each DO sensor is checked at least once daily, Monday through Friday, against a calibrated meter DO measurement of the water in the holding tank. A monitor is recalibrated to 100 percent DO saturation whenever the sensor DO is more than $\pm$ 0.3 mg/L from the DO measured by a handheld calibrated meter.

Monitors that are scheduled for deployment are checked twice on the day before deployment. On the day of scheduled deployment, the DO sensor is calibrated to 100 percent DO saturation.

B8: Inspection/Acceptance of Supplies and Consumables

Supplies and consumables shall be inspected by the field operations manager or her/his designee in the AE Section and accepted only if they satisfy all specifications for the intended use.

B9: Non-Direct Measurements

Non-direct measurements are not required for this project.

B10: Data Management

Every four weeks the 20 deployed water quality monitors are exchanged with cleaned and newly calibrated monitors. The retrieved monitors are brought back to the AE Laboratory and placed in the receiving tank. The following morning, each monitor is checked for accuracy by verification to a 100 percent DO saturation check. While still in the receiving tank, the DO, temperature, and conductivity data collected during the deployed period are downloaded from each monitor and then uploaded to the AQUARIUS Time-Series database by a technician. The uploaded data automatically fills in any missing hourly data that was not successfully transmitted or captured at the monitoring sites that have telemetry. After the data is uploaded into the database, the DO measurements are corrected for initial error and instrument drift using the observed errors from the 100 percent DO saturation calibration taken on the morning of deployment and the 100 percent DO saturation check taken the morning after retrieval (Wagner, 2006). Sensor drift is assumed to be linear over the deployment period, and the DO correction is calculated for each hourly measurement and updated in AQUARIUS where there is a raw data set and a corrected data set for each deployment.

A biologist reviews graphs of the hourly DO, percent DO saturation, temperature, and specific conductance data, on a per-deployment basis, in the AQUARIUS Time-Series database (Appendix I). The biologist checks for inconsistent measurements and highlights them for later review by a second biologist and then designates the approval status of the data as “In Review.” A second biologist will then review the data and change the approval status to “Approved” if there is agreement with the first biologist.

Rainfall data from the United States Geological Service (USGS) gages at O’Hare International Airport and Bedford Park are available for viewing in the AQUARIUS Time-Series database and can be overlaid with CDOM data to assist with the DO data review. For a specific CDOM location, if more refined rainfall data is needed, other USGS rainfall gages will be used. Additionally, the Maintenance and Operations (M&O) Department reports CSO activity and backflows to Lake Michigan at mwrd.org, which will also be used, if necessary, following the data review procedures

The M&O Department personnel compile the daily flow information for Lake Michigan discretionary diversion. The discretionary diversion data is transmitted to the AE Section on a monthly basis. A biologist reviews the daily discretionary diversion flows at the Wilmette Pumping Station, Chicago River Controlling Works, and O’Brien Lock when reviewing the CDOM data at the monitoring stations on the NSC (above the O’Brien WRP outfall), SBCR, and the LCR, respectively.

After this, a biologist reviews and verifies the field DO data following the guidance provided in the IEPA's Standard Operating Procedure for Continuous Monitoring of Water Quality (IEPA, 2014). The criteria used to review and validate the DO data are stated in Section D1. The biologist also considers the rain and flow information as well as best professional judgment when verifying the DO data. All DO data that fail the review criteria or are considered to be erroneous are marked as "Raw" data in the database and are not published.

GROUP C: ASSESSMENT AND OVERSIGHT

C1: Assessment and Response Actions

Routine assessments are not used in this project.

C2: Reports to Management

The Project Manager and all those on the approval list will receive from the Network Coordinator all investigative and corrective action reports concerning quality control problems and other non-conformance issues from field personnel and participating laboratories.

Project related systems audits or special data quality assessments are not undertaken.

GROUP D: DATA VALIDATION AND USABILITY

D1: Data Review, Verification, and Validation

A biologist reviews and verifies the field DO data. The field data from any water quality monitor may be rejected following review of these quality control checks:

1. Accuracy of Retrieved Monitors

   The monitor in the laboratory receiving holding tank is given a post-calibration check to 100 percent DO saturation. A difference of more than 0.4 mg/L is used as a rejection criterion for the batch of field collected data. This check is done to evaluate inaccuracies due to calibration drift.

2. Comparison of Monitor DO Measurement with Meter Measurement

   A DO meter reading is taken in close proximity to the protective enclosure during the exchange of monitors using a calibrated handheld DO meter. The DO measured from the meter is compared with the last DO measurement of the retrieved monitor. The relative percent difference is calculated, and if it is greater than 20 percent and the absolute magnitude is greater than 0.3 mg/L, this will alert the biologist to a possible problem and may result in the rejection of the entire batch of field data. If evidence suggests that there were conditions in the waterway at the time of the meter measurement that can explain a difference greater than 20 percent, the reviewers may accept the data. This check is done to evaluate total inaccuracies attributed to fouling drift and calibration drift.

3. Inspection of Possible Erroneous Data

   Additional review of the field data is necessary to verify continuous monitoring data. Situations can arise where portions of a batch of data may need to be rejected if, for example, the equipment malfunctioned in the middle of a deployment, there was a technician error (such as deploying a sonde that was not activated), the monitor experienced a period of time out of the water due to a draw down or vandalism (which can be indicated by a sudden drop in specific conductance), or the monitor recorded momentary spikes in the data that are not naturally occurring. The reason for rejection is recorded in a separate spreadsheet.

The reviewers will use best professional judgement, the rain data, diversion data, and CSO data to help make these decisions. An electronic file is kept to record all deployment dates and justifications for lost data which is reviewed and approved by the project manager.

D2: Verification and Validation Methods

The Project Manager and the QA Officer shall be informed of all situations where data integrity has been found to be compromised by errors, including storage of incorrect data or the corruption of stored data. All responsible persons identified in Section A4 and all known data users shall be informed of data problems when they are discovered and the corrective action taken. The QA Officer shall prepare the disclosure report for distribution.

D3: Reconciliation with User Requirements

The QAPP shall govern the operation of the project at all times. Each responsible person listed in Section A4 shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise.

This QAPP shall be reviewed annually to ensure that the project will achieve all intended purposes. All the responsible persons listed in Section A4 shall participate in the review of the QAPP. The annual review shall address every aspect of the program including:

1. The accuracy of the information contained in the QAPP and incorporation of changes made since its completion.
2. The adequacy and location of monitoring stations.
3. The adequacy of measurement frequency at each location.
4. Sampling procedures.
5. Analytical procedures.
6. The appropriateness of parameters monitored.
7. Changes in data quality objectives and minimum measurement criteria.
8. Whether the data obtained met minimum measurement criteria.
9. Corrective actions taken during the previous year for field and laboratory operations.
10. The adequacy of quality control procedures.
11. All interim reports and annual project report.
12. Review of other user requirements and recommendations.

The project will be modified as directed by the Project Director. The Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made.

It is expected that from time to time ongoing and perhaps unexpected changes will need to be made to the project. Significant changes or deviations in the operation of the project shall not be made without authorization by the Project Director. The need for a change in project operation should be conveyed to the Network Coordinator. Data users and other interested persons may also suggest changes to the project to the Network Coordinator.

The Network Coordinator shall evaluate the need for the change, consult with the Project Manager and others as appropriate, and make a recommendation to the Project Director for approval. The Network Coordinator shall inform the appropriate project personnel of approved changes in project operation in a timely manner.

Following approval, a memorandum documenting each authorized change shall be prepared by the Network Coordinator and distributed to all the responsible persons listed in Section A4. Approved changes shall be considered an amendment to the QAPP and shall be incorporated into the QAPP when it is updated.

Following the annual QAPP review, the Project Manager will prepare an updated version of the QAPP with the assistance of the QA Officer.

REFERENCES

Illinois Environmental Protection Agency, Bureau of Water. Document Control number 202. Standard Operating Procedure for Continuous Monitoring of Water Quality. Revision No. 1. June 26, 2014.

Manta 2, Sub 2, and Sub 3, Water Quality Multiprobe Manual, Eureka Water Probes, February, 2015.

Vick, J.A., Laboratory Servicing Procedures for Continuous Dissolved Oxygen Monitors, Environmental Monitoring and Research Division Laboratory, MWRDGC, May 8, 2018.

Wagner, R.J., R.W. Boulger Jr., C.J. Oblinger, and B.A. Smith. 2006. Guidelines and Standard Operating Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting. Techniques and Methods 1-D3. United States Geological Survey. Reston, VA.

FIGURE 1: CONTINUOUS DISSOLVED OXYGEN MONITORING
PROJECT ORGANIZATION CHART

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|---Project Director
|     (Planning, decision making, staffing, and
|            ultimate execution of project)
|
O----Project Manager
|    | (Project planning, execution, and reporting,
|    |  troubleshooting database issues, QAPP preparation,
|    |  and supervising data review)
|    |
O----O---QA Officer
|    |   |      (Project QA/QC, review of QAPP)
|    |   |
O----O---O--Network Coordinator
     |         |  (Coordination of project activities, review
     |         |                  of M&R Department reports, review of monitoring data,
     |         |                  review of QAPP, providing data to IEPA)
     |         |
     O-----O---Field Operations Manager
     |         |    (Execution of field activities by field team)
     |         |
     |         |      Field Team
     |         |       (Monitor deployment, field measurements, and
     |         |        transport of monitors)
     |         |
     O-----O---Environmental Research Technicians (ERTs) and Biologists
                    (Calibrate DO sensors, clean and
                     maintain water quality monitors, download data from monitors,
                     conduct cross-sectional DO surveys, review monitoring
                     data, prepare of statistical summaries, and collect of
                     auxiliary information.)
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FIGURE 2: CURRENTLY ACTIVE CONTINUOUS DISSOLVED OXYGEN MONITORING STATIONS

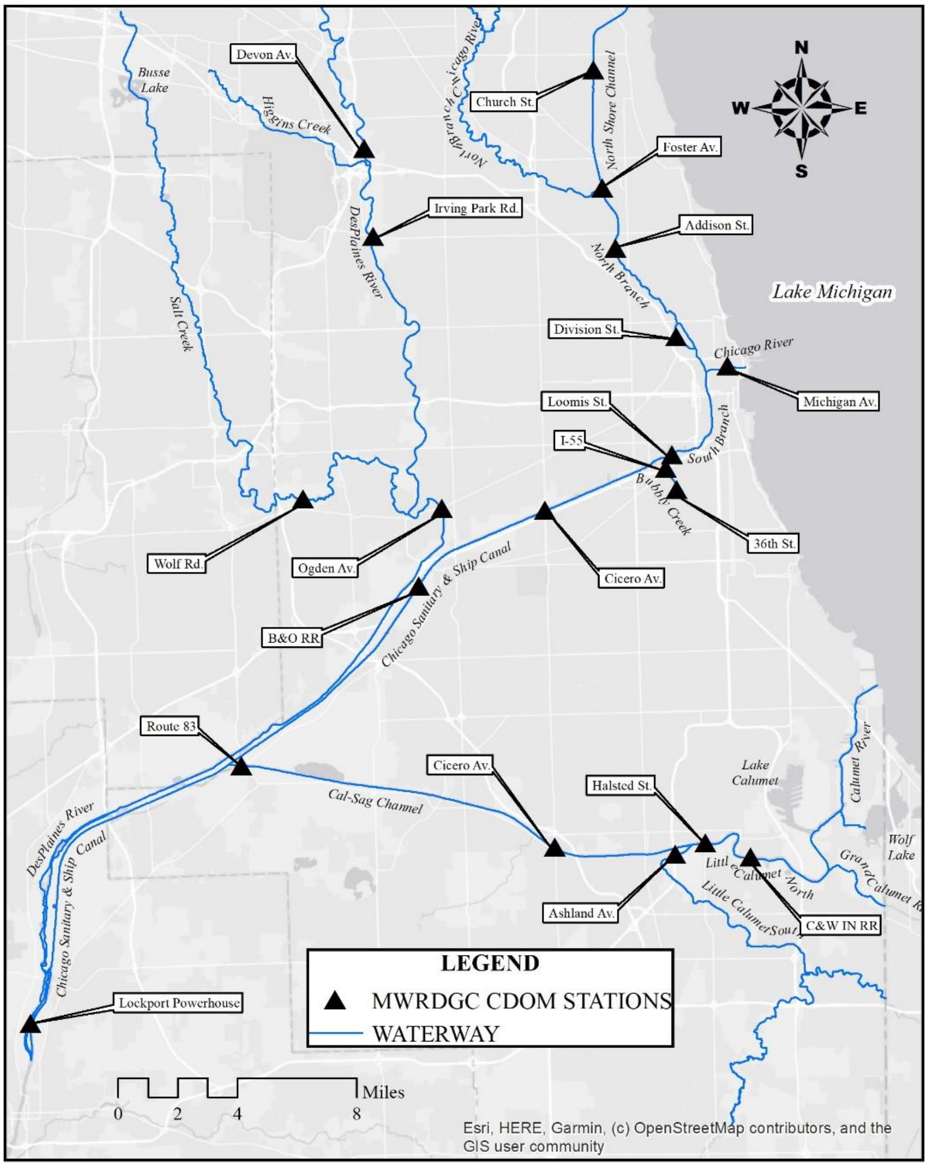

TABLE 1: SAMPLING HISTORY AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	Time Period DO Measured Hourly at Location	Status
1	Linden St., North Shore Channel	August 1998 – March 2004	Inactive
2	Simpson St., North Shore Channel	August 1998 – March 2004	Inactive
72	Church St., North Shore Channel	November 2016 - Present	Active
3	Main St., North Shore Channel	August 1998 – Dec. 2010	Inactive
4	Devon Ave., North Shore Channel	August 1998 – January 2001	Inactive
57	Foster Ave., North Shore Channel	August 2004 – Present	Active
66	Central Park Ave., North Branch Chicago River	July 2005 – April 2013	Inactive
5	Lawrence Ave., North Branch Chicago River	August 1998 – January 2001	Inactive
6	Addison St., North Branch Chicago River	August 1998 – Present	Active
7	Fullerton Ave., North Branch Chicago River	August 1998 – Dec. 2010	Inactive
8	Division St., North Branch Chicago River	August 1998 – March 2004, June 2013 – Present	Active
9	Kinzie St., North Branch Chicago River	August 1998 – June 2013	Inactive
21	Chicago River Controlling Works, Chicago River	March 2000 – March 2004	Inactive
22	Michigan Ave., Chicago River	March 2000 – March 2004, May 2019 – Present	Active
10	Clark St., Chicago River	August 1998 – Dec. 2010, May 2012 – June 2019	Inactive
11	Jackson Blvd., South Branch Chicago River	August 1998 – March 2004	Inactive
12	Loomis St., South Branch Chicago River	August 1998 – January 2001, April 2003 – Present	Active
49	36th St., Bubbly Creek	June 2002 – Present	Active
13	I-55, Bubbly Creek	August 1998 – January 2001 April 2002 – Present	Active
14	Cicero Ave., Chicago Sanitary & Ship Canal	August 1998 – Present	Active
15	B&O Central RR, Chicago Sanitary & Ship Canal	August 1998 – Present	Active
16	Route 83, Chicago Sanitary & Ship Canal	August 1998 – Dec. 2010	Inactive
17	River Mile 302.6, Chicago Sanitary & Ship Canal	August 1998 – March 2004	Inactive
18	Romeoville Rd., Chicago Sanitary & Ship Canal	August 1998 – March 2004	Inactive
19	Lockport Powerhouse, Chgo. Sanitary & Ship Canal	August 1998 – Present	Active
58	Devon Ave., Des Plaines River	October 2005 – Dec. 2010, May 2011 – Present	Active
62	Irving Park Rd., Des Plaines River	July 2005 – May 2011, September 2020	Active
63	Ogden Ave., Des Plaines River	July 2005 – Dec. 2010, March 2016 – Present	Active
64	Material Service Rd., Des Plaines River	October 2005 – Dec. 2010	Inactive
23	Jefferson St., Des Plaines River	March 2000 – Dec. 2010	Inactive
31	130th St., Calumet River	July 2001 – March 2004	Inactive
67	Hohman Ave., Grand Calumet River	July 2005 – April 2008	Inactive
32	Torrence Ave., Grand Calumet River	July 2001 – Dec. 2010	Inactive
33	Conrail RR, Little Calumet River	July 2001 – March 2004	Inactive
34	C&W Indiana RR, Little Calumet River	July 2001 – Present	Active
35	Halsted St., Little Calumet River	July 2001 – Present	Active
65	Wentworth Ave., Little Calumet River	July 2005 – Dec. 2010	Inactive
36	Ashland Ave., Little Calumet River	July 2001 – Present	Active

TABLE 1 (Continued): SAMPLING HISTORY AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	Time Period DO Measured Hourly at Location	Status
37	Division St., Calumet-Sag Channel	July 2001 – March 2004	Inactive
38	Kedzie Ave., Calumet-Sag Channel	July 2001 – March 2004	Inactive
39	Cicero Ave., Calumet-Sag Channel	July 2001 – Dec. 2010, March 2014 – Present	Active
40	River Mile 311.7, Calumet-Sag Channel	July 2001 – November 2004	Inactive
41	Southwest Hwy., Calumet-Sag Channel	July 2001 – March 2004	Inactive
42	104th Ave., Calumet-Sag Channel	July 2001 – October 2010	Inactive
20	Route 83, Calumet-Sag Channel	August 1998 – Present	Active
68	Busse Woods Main Dam, Salt Creek	October 2005 – September 2020	Inactive
59	J. F. Kennedy Blvd., Salt Creek	July 2005 – February 2018	Inactive
60	Thorndale Ave., Salt Creek	July 2005 – March 2009	Inactive
61	Wolf Rd., Salt Creek	July 2005 – Present	Active

TABLE 2: LATITUDE AND LONGITUDE OF MONITORING LOCATIONS

Loc. ID	Continuous DO Monitoring Location	Latitude	Longitude
1	Linden St., North Shore Channel	42° 04.390'	87° 41.140'
2	Simpson St., North Shore Channel	42° 03.350'	87° 42.400'
3	Main St., North Shore Channel	42° 02.010'	87° 42.570'
72	Church St., North Shore Channel	42° 02.890'	87° 42.583'
4	Devon Ave., North Shore Channel	41° 59.820'	87° 42.610'
57	Foster Ave., North Shore Channel	41° 58.5660'	87° 42.2860'
66	Central Park Ave., North Branch Chicago River	41° 58.3790'	87° 42.0882'
5	Lawrence Ave., North Branch Chicago River	41° 58.100'	87° 42.020'
6	Addison St., North Branch Chicago River	41° 56.790'	87° 41.720'
7	Fullerton Ave., North Branch Chicago River	41° 55.520'	87° 40.450'
8	Division St., North Branch Chicago River	41° 54.210'	87° 39.430'
9	Kinzie St., North Branch Chicago River	41° 53.440'	87° 38.330'
21	Chicago River Lock, Chicago River	41° 53.280'	87° 36.580'
22	Michigan Ave., Chicago River	41° 53.340'	87° 37.370'
10	Clark St., Chicago River	41° 53.241'	87° 37.893'
11	Jackson Blvd., South Branch Chicago River	41° 53.911'	87° 38.135'
12	Loomis St., South Branch Chicago River	41° 50.747'	87° 39.662'
49	36th St., South Fork South Branch Chicago River	41° 49.071'	87° 39.437'
13	I-55, South Fork South Branch Chicago River	41° 50.648'	87° 39.878'
14	Cicero Ave., Chicago Sanitary & Ship Canal	41° 49.169'	87° 44.616'
15	B&O RR Bridge, Chicago Sanitary & Ship Canal	41° 46.990'	87° 49.540'
16	Route 83, Chicago Sanitary & Ship Canal	41° 42.420'	87° 55.750'
17	River Mile 302.6, Chicago Sanitary & Ship Canal	41° 41.240'	87° 58.470'
18	Romeoville Rd., Chicago Sanitary & Ship Canal	41° 38.450'	88° 03.549'
19	Lockport Powerhouse, Chicago Sanitary & Ship Canal	41° 34.277'	88° 04.711'
58	Devon Ave., Des Plaines River	41° 59.7633'	87° 51.5629'
62	Irving Park Rd., Des Plaines River	41° 57.1905'	87° 51.2461'
63	Ogden Ave., Des Plaines River	41° 49.2501'	87° 48.6311'
64	Material Service Rd., Des Plaines River	41° 35.7913'	88° 04.1275'
23	Jefferson St., Des Plaines River	41° 31.489'	88° 05.155'
31	130th St., Calumet River	41° 39.619'	87° 34.195'
67	Hohman Ave., Grand Calumet River	41° 37.4546'	87° 31.0777'
32	Torrence Ave., Grand Calumet River	41° 38.652'	87° 33.542'
33	Conrail RR, Little Calumet River	41° 38.345'	87° 33.955'
34	C&W Indiana Harbor Belt RR, Little Calumet River	41° 39.026'	87° 36.695'
35	Halsted St., Little Calumet River	41° 39.431'	87° 38.450'
65	Wentworth Ave., Little Calumet River	41° 35.1058'	87° 31.7625'
36	Ashland Ave., Little Calumet River	41° 39.110'	87° 39.625'
37	Division St., Calumet-Sag Channel	41° 39.160'	87° 40.250'
38	Kedzie Ave., Calumet-Sag Channel	41° 39.120'	87° 41.920'
39	Cicero Ave., Calumet-Sag Channel	41° 39.345'	87° 44.313'
40	River Mile 311.7, Calumet-Sag Channel	41° 40.626'	87° 47.532'

TABLE 2 (Continued): LATITUDE AND LONGITUDE OF MONITORING LOCATIONS

Loc. ID	Continuous DO Monitoring Location	Latitude	Longitude
41	Southwest Hwy., Calumet-Sag Channel	41° 40.812'	87° 48.642'
42	104th Ave., Calumet-Sag Channel	41° 41.352'	87° 53.052'
20	Route 83, Calumet-Sag Channel	41° 41.810'	87° 56.480'
68	Busse Woods Main Dam, Salt Creek	42° 01.0089'	88° 00.0289'
59	J. F. Kennedy Blvd., Salt Creek	42° 00.3152'	87° 59.7498'
60	Thorndale Ave., Salt Creek	41° 59.0307'	87° 59.4212'
61	Wolf Rd., Salt Creek	41° 49.5759'	87° 54.0781'

TABLE 3: ILLINOIS POLLUTION CONTROL BOARD USE CLASSIFICATION AND DISSOLVED OXYGEN STANDARD AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	IPCB Classification	DO Standard
1	Linden St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
2	Simpson St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
72	Church St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
3	Main St., North Shore Channel	CAWS ALU A	3.5-5.0[1]
4	Devon Ave., North Shore Channel	CAWS ALU A	3.5-5.0[1]
57	Foster Ave., North Shore Channel	CAWS ALU A	3.5-5.0[1]
66	Central Park Ave., North Branch Chicago River	General Use	3.5-6.0[2]
5	Lawrence Ave., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
6	Addison St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
7	Fullerton Ave., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
8	Division St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
9	Kinzie St., North Branch Chicago River	CAWS ALU A	3.5-5.0[1]
21	Chicago River Lock, Chicago River	General Use	3.5-6.0[2]
22	Michigan Ave., Chicago River	General Use	3.5-6.0[2]
10	Clark St., Chicago River	General Use	3.5-6.0[2]
11	Jackson Blvd., South Branch Chicago River	CAWS ALU A	3.5-5.0[1]
12	Loomis St., South Branch Chicago River	CAWS ALU A	3.5-5.0[1]
49	36th St., South Fork South Branch Chicago River	Indigenous ALU	4.0
13	I-55, South Fork South Branch Chicago River	Indigenous ALU	4.0
14	Cicero Ave., Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
15	B&O RR, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
16	Route 83, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
17	River Mile 302.6, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
18	Romeoville Rd., Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
19	Lockport Powerhouse, Chicago Sanitary & Ship Canal	CAWS ALU B	3.5-4.0[3]
58	Devon Ave., Des Plaines River	General Use	3.5-6.0[2]
62	Irving Park Rd., Des Plaines River	General Use	3.5-6.0[2]
63	Ogden Ave., Des Plaines River	General Use	3.5-6.0[2]
64	Material Service Rd., Des Plaines River	General Use	3.5-6.0[2]
23	Jefferson St., Des Plaines River	CAWS ALU B	3.5-4.0[3]
31	130th St., Calumet River	CAWS ALU A	3.5-5.0[1]
67	Hohman Ave., Grand Calumet River	CAWS ALU A	3.5-5.0[1]
32	Torrence Ave., Grand Calumet River	CAWS ALU A	3.5-5.0[1]
33	Conrail RR, Little Calumet River	CAWS ALU A	3.5-5.0[1]
34	C&W Indiana Harbor Belt RR, Little Calumet River	CAWS ALU A	3.5-5.0[1]
35	Halsted St., Little Calumet River	CAWS ALU A	3.5-5.0[1]
65	Wentworth Ave., Little Calumet River	General Use	3.5-6.0[2]
36	Ashland Ave., Little Calumet River	General Use	3.5-6.0[2]
37	Division St., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
38	Kedzie Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
39	Cicero Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]

TABLE 3 (Continued): ILLINOIS POLLUTION CONTROL BOARD USE CLASSIFICATION AND DISSOLVED OXYGEN STANDARD AT EACH MONITORING LOCATION

Loc. ID	Continuous DO Monitoring Location	IPCB Classification	DO Standard
40	River Mile 311.7, Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
41	Southwest Hwy., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
42	104th Ave., Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
20	Route 83, Calumet-Sag Channel	CAWS ALU A	3.5-5.0[1]
68	Busse Woods Main Dam, Salt Creek	General Use	3.5-6.0[2]
59	J. F. Kennedy Blvd., Salt Creek	General Use	3.5-6.0[2]
60	Thorndale Ave., Salt Creek	General Use	3.5-6.0[2]
61	Wolf Rd., Salt Creek	General Use	3.5-6.0[2]

[1]The Chicago Area Waterway System Aquatic Life Use A (CAWS ALU A) waters require that during the period of March through July, DO shall not be less than 5.0 mg/L at any time, and that during the period of August through February, DO shall not be less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 3.5 mg/L at any time.

[2]The General Use Standard requires that during the period of March through July, DO shall not be less than 5.0 mg/L at any time, or less than 6.0 mg/L as a daily mean averaged over seven days, and that during the period of August through February, DO shall not be less than 3.5 mg/L at any time, or less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 5.5 mg/l as a daily mean averaged over 30 days.

[3]The Chicago Area Waterway System Aquatic Life Use B (CAWS ALU B) waters require that DO shall not be less than 4.0 mg/L as a daily minimum averaged over seven days, or less than 3.5 mg/L at any time.

CONTINUOUS DISSOLVED OXYGEN MONITORING
QUALITY ASSURANCE PROJECT PLAN

APPENDIX I

EXAMPLE OF AN HOURLY DATA REVIEW PLOT

TABLE AI-1: DISSOLVED OXYGEN VALUES IN THE CHICAGO SANITARY AND SHIP CANAL DURING THE PERIOD OF NOVEMBER 23, 2022, THROUGH JANUARY 25, 2023