ILLINOIS WATERWAY MONITORING PROJECT
QUALITY ASSURANCE PROJECT PLAN

Revision 1.2

Effective Date: July 21, 2010

Organization: Metropolitan Water Reclamation District of Greater Chicago
Monitoring and Research Department

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GROUP A: PROJECT MANAGEMENT

A1: Approval Sheet:

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Date 7-12-10

Louis Kollias
Director, Monitoring and Research

CA O'Connor
Date 6/28/10

Catherine O'Connor
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Date 6/28/10

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Assistant Director, Monitoring and Research,
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Deputy Director of Monitoring and Research,
Administrative/Industrial Waste Division

Date 6/29/10

John McNamara
Quality Assurance Coordinator,
Monitoring and Research

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

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 Director of Research and Development.

As this document will be updated annually, the reader is advised to check with the Project Manager for the latest revision if his copy is more than one year old. Revision 1.2 has been prepared following the United States Environmental Protection Agency (USEPA) guidance document EPA QA/R-5 titled "EPA Requirements for Quality Assurance Project Plans," November 1999.

A4: Project/Task Organization

The responsible persons for project management are:

<u>Project Director</u>:
Louis Kollias
Director of Monitoring and Research

<u>Project Manager</u>:
Catherine O’Connor
Assistant Director of Monitoring and Research,
Environmental Monitoring and Research Division

<u>Project Coordinator</u>:
Jennifer Wasik
Supervising Aquatic Biologist

<u>Field Operations Manager</u>:
Sharon Sopcak-Phelan
Pollution Control Officer 3

<u>Stickney Analytical Laboratory Manager</u>:
Ellice Durham
Supervising Environmental Chemist

<u>Industrial Waste Analytical Laboratory Manager</u>:
Robert Polis
Supervising Environmental Chemist

Analytical Microbiology Laboratory Manager:
Rick Gore
Associate Environmental Microbiologist

Environmental Monitoring Manager:
Thomas Minarik, Jr.
Senior Aquatic Biologist

Quality Assurance Officer:
John McNamara
Quality Assurance Coordinator

Figure 1 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.

The Project Director is responsible for the execution of the entire project. The Project Manager has many responsibilities including planning the scope of the project, execution, and preparing project reports. The Project Coordinator coordinates project activities, reviews project data and prepares project reports. The Quality Assurance (QA) Officer is responsible for oversight of quality control for the project and preparing and updating the QAPP.

The Field Operations Manager is responsible for the execution of field activities. He is the supervisor of the Pollution Control Officer 1 (PCO1) who directs Industrial Waste Division personnel assigned to the project for sample collection and sample transport. The Field Operations Manager works closely with the Project Coordinator to ensure that all field activities and sample handling activities are aligned properly with the analytical functions of the laboratories involved in the project.

The sampling team is comprised of Industrial Waste Division (IWD) personnel and staff from the Aquatic Ecology and Water Quality Section. The sampling team collects and preserves samples, and makes field measurements. A transporter from the IWD delivers the samples to the Cecil Lue-Hing R&D Complex the day after sample collection and distributes samples to the participating laboratories. Participant laboratories include the Stickney Analytical Laboratory (SAL), the Industrial Waste Analytical Laboratory, the Aquatic Ecology and Water Quality Section, and the Analytical Microbiology Laboratory.

A5: Problem Definition/Background

The waterways within the jurisdiction of the District are comprised of several natural and modified rivers and streams, and several canals. Most of the District's waterways have been interconnected and these interconnected waterways are collectively referred to as the "Chicago Waterway System." The treated effluents from the District's three largest water reclamation plants (WRPs), as well as most other discharges within the District service area, are conveyed from the District's service area by the Chicago Sanitary and Ship Canal. The Chicago Sanitary and Ship Canal discharges into the Des Plaines River approximately one mile downstream of the Lockport Lock and Dam. The Lockport Lock and Dam controls the release of water from the Chicago Waterway System.

The Illinois Pollution Control Board (IPCB) has designated most water bodies within the State as either general use or secondary contact waters. The secondary contact designation is used for those water bodies that cannot reasonably maintain the water quality required for water bodies designated as general use.

The IPCB has established water quality standards for general use water and public water supply. Standards have also been established by the IPCB for secondary contact water. Generally, less stringent water quality standards are applied to secondary contact water.

All effluents discharged by District WRPs meet or exceed the requirements in their National Pollutant Discharge Elimination System (NPDES) permits. However, because of the enormous volume of treated effluent released into the Chicago Waterway System, and the limited water available for dilution of these effluents, the waterways that receive the treated effluents from the District's three largest WRPs are designated as secondary contact. It is of great concern to the District that effluent discharged from its WRPs may adversely impact water quality both within its service area and also downstream from its service area.

This project has been undertaken by the District to monitor the waterways that carry the flow from the Chicago Sanitary and Ship Canal downstream to Peoria. Monitoring encompasses collection of water and sediment samples and the in-stream measurement of several location sensitive parameters including water temperature, pH and dissolved oxygen. The collected samples are analyzed for chemical and biological parameters. Except for 1998, a historical database of project data exists back to project inception in 1984.

The data from this project may enable the District to evaluate in limited ways the impact of District treated sewage discharges on the downstream waterways. Such evaluations have proven difficult since water quality is continually affected by point and non-point discharges, as well as multiple physical, chemical and biological processes occurring within the waterways.

As the monitored waterways are outside the District's service area, it is not an immediate objective of this project to assess the water quality of the monitored waterways against applicable IPCB water quality standards. It is likely, however, that these assessments will be made from time to time, and that other users of the project data will also make such assessments.

As monitoring for this project is ongoing, the QAPP addresses how the monitoring is currently conducted. An objective of this project is to efficiently utilize available resources. Another objective is to produce water quality data that will meet or exceed the measurement quality objectives for all intended and likely uses of the data.

A6: Project/Task Description

Monitoring is conducted at 49 sampling stations located along 133 river miles from the Lockport Lock and Dam on the Chicago Sanitary and Ship Canal, and continuing in the lower Des Plaines River and on into the Illinois River as far as the Peoria Lock and Dam. The monitored waterways will be referred to in this document as the "Illinois Waterway." Figure 2 is a map of the Illinois Waterway from the Lockport Lock and Dam to the Marseilles Lock and Dam showing sampling Stations 1 through 21. Figure 3 is a map of Illinois Waterway from the Marseilles Lock and Dam to the Peoria Lock and Dam showing sampling Stations 22 through 49. Table 1 lists the 49 monitoring stations with station number, river mileage, navigation pool, and latitude and longitude.

Three one-week sample collection trips are made each year to collect all samples and make all in-stream measurements. The sample collection trips are made by boat in May, August and October.

Water samples for laboratory analysis are collected at all 49 sampling stations during each sample collection trip. Water samples are collected only on the downstream trip to Peoria. Collection of water samples on the upstream trip from Peoria was discontinued in August 2009. Whenever a water sample is collected, in-stream measurements are made of the water temperature, pH, dissolved oxygen, conductivity, and turbidity using an electronic, multi-parameter water quality monitor (Monitor). Water samples for chlorophyll analysis are collected at 22 stations. Sediment samples are collected during the October sample collection trip at 14 selected sampling stations.

Following collection, the field preserved samples are transported to the Cecil Lue-Hing R&D Complex for distribution to the participating laboratories for analysis. The water samples are analyzed for suspended solids, biochemical oxygen demand, ammonia, nitrite, nitrate, Kjeldahl nitrogen, phosphorus, cyanide, phenols, total metals, hardness, and fecal coliform. Sediment samples are analyzed for total solids, total volatile solids, ammonia, Kjeldahl nitrogen, total phosphorus, cyanide, phenols and total metals. Analyzed metals for both water and sediment samples include arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, silver and zinc. Water samples are also analyzed for calcium and magnesium to obtain total hardness by calculation. Most project data are maintained in the District's laboratory management information system (LIMS) database and on Excel® spreadsheets.

A7: Quality Objectives and Criteria for Measurement Data

Many of the analytes measured for this project are present in analytically low concentrations throughout the Illinois Waterway. Analyte concentrations will vary as discharged effluents, stormwater and agricultural runoff are introduced into the waterways. All analytes are subject to chemical, biological and physical processes that will alter their presence in a waterway. It is the intent of this project to employ methods of measurement that will detect and quantify all analytes of interest wherever possible.

Although there may be several potential uses of the data, minimum measurement criteria will be established at the lowest analyte concentration required for foreseeable uses of the data.

A likely use of the water sample project data is to assess water quality against IPCB water quality standards. At this time, except for the IPCB water quality standards, there are no other specified minimum measurement criteria for waterways monitoring data. However, not all of the monitored parameters are subject to a IPCB water quality standard.

Since most sampling stations on the Illinois Waterway are located on general use waters, this project will use the general use water quality standards as the minimum measurement criteria. These minimum measurement criteria will apply for all water samples irrespective of the waterway designation in order to maintain uniform measurement objectives for the project.

The monitored parameters and the established minimum measurement criteria for water samples are shown in Columns 1 and 2 of Table 2. Analytes not subject to an IPCB water quality standard will not have specified minimum measurement criteria. The minimum measurement criteria will be adjusted accordingly when IPCB water quality standards are changed, or as predicated by other planned uses of the data.

Column 3 of Table 2 gives the minimum measurement objectives for the project. The minimum measurement objectives will be set at approximately one-fifth of the minimum measurement criteria shown in Column 2 to ensure that analytes will be measured with reasonable accuracy at the minimum measurement criteria concentrations, and measured to reasonable levels below the minimum measurement criteria.

The parameters analyzed for sediment samples are shown in Column 1 of Table 3. No minimum measurement criteria have been associated with analysis of sediment samples as shown in Column 2 of Table 3.

The minimum measurement objective for any analyte will be achieved when the analytical procedure selected for sample analysis can be shown to have a method detection limit (MDL) at or below the minimum measurement objective.

Analyte MDLs shall be determined by the USEPA method given in 40 CFR Part 136, Appendix B using reagent water standards. The MDL is defined as the minimum constituent concentration that can be distinguished from a sample with no analyte at a 99 percent confidence level. Since the MDL procedure is based upon precision obtained for a standard equal to or slightly greater than the MDL, it also is a measure of method sensitivity at concentrations near the MDL.

For analytes without minimum measurement criteria, the minimum measurement objectives will be understood to be the MDL level that is readily achievable using analytical methods generally employed in environmental laboratories. For parameters where MDLs are not applicable, such as pH, temperature, and dissolved oxygen, the minimum measurement objectives shown in Column 3 of Table 2 are the sensitivity to be obtained by the measurement system.

Sensitivity shall be defined as the minimum difference in a measurement or concentration that can be distinguished by the measurement system.

A8: Special Training/Certification

1. Sample collection personnel shall be trained in proper sample collection methods by their supervising PCO1, or qualified laboratory personnel responsible for sample analysis.

2. Microbiological analysis shall be performed by analysts who have been certified as competent by the Illinois Department of Public Health (IDPH).

3. Chemical analyses shall be performed by trained analysts who have successfully completed a demonstration of capability as set forth in the laboratory's quality assurance plan (QAP).

A9: Documents and Records

1. The Project Manager, Project Coordinator, and QA Officer shall retain copies of all annual updates and revisions of this QAPP.

2. The Project Manager, Project Coordinator, and QA Officer shall retain copies of all sampling procedures and analytical procedures used for collection and analysis of project samples.

3. The Project Manager and Project Coordinator shall retain copies of all laboratory analytical reports and correspondence with the laboratories.

4. The Project Manager and Project Coordinator shall retain copies of all management reports.

5. The Project Manager and Project Coordinator shall retain copies of all communications to and from outside agencies and other interested parties.

6. All the records and reports listed above will be retained for at least five years at the Cecil Lue-Hing R&D Complex located at the Stickney WRP.

GROUP B: DATA GENERATION AND ACQUISITION

B1: Sampling Process Design (Experimental Design)

Sample Matrices

For this project, water and sediment samples are collected along the Illinois Waterway. Water samples are analyzed to determine water quality while sediment samples are analyzed to determine the occurrence, concentration and accumulation of chemical constituents in the sediment.

Selection of Sampling Locations

The 49 sampling locations identified in Table 1 were selected using the following criteria:

1. Upstream and downstream of the major tributaries.

2. Above and below navigational dams.

Water sampling and monitoring are performed at all 49 sampling stations.

Water samples for chlorophyll are collected at Stations 2, 3, 5, 7, 10, 11, 15, 18, 20, 22, 25, 27, 28, 31, 34, 36, 38, 41, 42, 44, 45, and 48.

Because of limited resources, sediment samples are collected at only 14 of the 49 sampling stations. Sediment sampling is performed above each navigational dam and at least one station in each navigational pool. The stations selected for sediment sampling include Stations 1, 2, 5, 8, 12, 18, 23, 28, 32, 35, 38, 41, 44, and 48.

Sampling stations may be added or removed from the monitoring network based upon periodic assessments of monitoring needs and resources available.

Sampling Frequency

The Illinois Waterway is sampled by boat three times a year for water quality and once per year for sediment quality. Water samples for bacterial and chemical analyses are collected from all 49 sampling stations in May, August, and October on the downstream trip to Peoria. Sediment samples are collected on the October sample collection trip. No water or sediment sampling is performed during the upstream trip from Peoria.

Selection of Parameters for Monitoring

Parameters selected for chemical and bacteriological analysis are those that best characterize water and sediment quality. The parameters analyzed for water samples have been identified on Table 2. The parameters analyzed in sediment samples have been identified in Table 3.

Periodically, the parameters monitored are reviewed. A parameter may be dropped from monitoring if the parameter is found to be non-essential for the goals of the project or if the parameter is judged too resource intensive to analyze. If parameters are needed for a monitoring purpose, they will be added to the project.

Selection of Sampling Methods

Generally the waterways monitored are long, shallow and relatively narrow channels with plug-flow characteristics. The constant water movement tends to keep waterways cross-sectionally well mixed. With adequate cross-sectional uniformity, a grab sample will be representative of channel flow. For this project water samples are collected at each sampling location by taking a single water grab sample at the center of the waterway three feet below the water surface with a submersible drainage pump.

Sediment in waterways will exhibit great variability because of the complex nature of its generation, transport and deposition. Sediment may be subject to resuspension and deposition as well as constant transformation from ongoing biological and chemical processes. Sediment samples are collected at the 14 selected sampling stations with a Ponar grab at the same time that the water samples are taken but only on the downstream run to Peoria.

The Ponar grab sampler was selected because it is designed to collect surficial sediment samples from rivers, lakes and reservoirs. It consists of two hinged scoops that close together to enclose a sample of sediment. The top of each scoop section is fitted with a screen to prevent sample loss during closure. This sampler can be used for most substrates including mud, sand, gravel, or small rocks with mud.

B2: Sampling Methods

As the Illinois Waterway sample collection trips are scheduled well in advance, the samples are prelogged into the District's LIMS. The supervising PCO1 generates sample labels for sample containers before each sample collection trip. The labels contain information including sample location, sample type, and unique sample ID with barcode. Each sample container has a unique sample ID comprised of the sample number and aliquot designation.

All sample containers are prepared, with chemical preservatives as necessary, before each sample collection trip. Sample containers for fecal coliform analysis are prepared by the Analytical Microbiology Laboratory. All other sample containers are prepared by the Aquatic

Ecology and Water Quality Section. Specific information regarding sample containers and chemical field preservation is found in Tables 4 and 5.

All samples are collected from a District pollution control boat. The sampling team is comprised of IWD personnel and Aquatic Ecology and Water Quality Section personnel. IWD personnel include two Boat Operators and a Pollution Control Technician (PCT). Aquatic Ecology and Water Quality Section personnel include a Laboratory Technician I or II. A second Laboratory Technician is assigned to assist with the sediment sampling during the downstream run to Peoria in October.

One week is required for each of the three annual sample collection trips. Sample collection begins on Monday of the first week at the Lockport Lock and Dam and continues downstream to the last sampling location above the Peoria Lock and Dam. Four days are required to complete this sampling run. After completion of the Lockport to Peoria run, the M&R personnel return by vehicle on Friday to the Cecil Lue-Hing R&D Complex in Stickney. The boat returns to Stickney during the week following sample collection.

The PCT collects all water samples using a submersible pump. The Laboratory Technician measures water temperature, pH, dissolved oxygen, conductivity, and turbidity with a YSI 6600 monitor. Separate water samples for laboratory analysis of chlorophyll are collected by the PCT. The water samples and in-stream measurements are made at the same position in the waterway; i.e., center of stream at a three-foot depth. Two Laboratory Technicians collect the sediment samples at the selected stations during the downstream October sample collection trip. Sediment samples are taken at center of stream using a Ponar grab sampler. An IWD transporter delivers the collected samples to the Cecil Lue-Hing R&D Complex the day after sample collection.

The individual sample containers are filled in accordance with the sampling procedures described in Appendix I. The preprinted adhesive sample labels with unique LIMS identification numbers are placed on each container immediately before filling. The sampling team completes the sample collection sheet (Appendix II) in the field as each sample is collected.

B3: Sample Handling and Custody

All sample containers are chilled in an ice-filled cooler immediately after collection and kept in ice during transport to the laboratories. The samples are delivered to the Cecil Lue-Hing R&D Complex the day after sample collection.

The Stickney Analytical Laboratory physically receives the samples from the IWD transporter. An Environmental Chemist, or a Laboratory Technician working under the direction of a chemist, "receives" the samples into the District LIMS using a barcode scanner to scan the "general chemistry" sample container. Each sample is inspected against the laboratory's sample-receiving checklist for proper container, proper labeling, sufficient volume and general appearance. Any missing samples are noted on the sample receiving checklist. Sample arrival temperatures are measured and recorded using an infrared thermometer calibrated against a National

Institute of Standards and Technology (NIST) traceable certified thermometer. Samples that require thermal preservation are kept under refrigeration at 4 degrees Celsius after completion of sample login.

Copies of the sample collection sheets are retained by the Stickney Analytical Laboratory. The original sample collection sheets are returned to the supervising PCO1 for review. The PCO1 enters the collection date and time for each sample into the LIMS. Copies of the Stickney Analytical Laboratory sample receiving checklists are sent to the supervising PCO1.

Maximum allowable holding times before analysis, as stated in applicable laboratory method standard operating procedures (SOPs) are adhered to. Parameters of particular concern because of short maximum allowable holding times include fecal coliform analysis (6 hours), biochemical oxygen demand (48 hours), and nitrite (48 hours).

Fecal coliform samples are picked up by a contractor in route during sampling trips. It is essential that this contractor is local to the Peoria area to ensure analysis is performed within the 6-hour holding time.

B4: Analytical Methods

The analytical methods used for this project are shown in Table 6. Column 1 of Table 6 gives the analytes to be measured, column 2 shows the method used by the laboratory, and Column 3 the reference method. Except for chlorophyll, all analytical methods used by the District laboratories are USEPA approved methods listed in 40 CFR Part 136. There is no USEPA approved method for analysis of chlorophyll; however, the method used is Standard Methods 10200 H 2. Except for the field measured parameters, the analytical methods are those generally employed in District laboratories for environmental and WRP samples.

Table 7 shows for each analyzed parameter, sample preservation maintained in the laboratory (Column 2) and maximum holding time permitted by the method (Column 3). Holding times are calculated from the time of sample collection. Refrigeration of samples that require thermal preservation is maintained at 4 degrees Celsius, but temperatures in the range of 0.1 to 6 degrees Celsius are considered acceptable. Preservation and maximum allowable holding times are in accord with those given in 40 CFR Part 136.

The laboratory where each analysis is performed is identified in Column 2 of Table 8. Column 3 of Table 8 identifies the laboratory method SOP. The analytical method SOPs are incorporated into this QAPP by reference in Column 3 of Table 8. SOPs for analytical methods are available from the Quality Assurance Coordinator or the responsible laboratory manager identified in Section A4.

Table 9 compares the minimum measurement objective against the MDL achieved by the designated District laboratory. The laboratory MDL is shown in Column 2 of Table 9, and Column 3 contains the minimum measurement objective. All analytes meet the minimum measurement objectives.

All data collected for this project are reported to the analyte MDL as this is the reportable level established in the District's NPDES permits. Test results less than the MDL will be reported as either zero or as less than the numerical value of the MDL.

B5: Quality Control

The individuals responsible for verification that proper procedures are followed in matters concerning sampling methods, sample preservation and sample custody to the delivery of samples to the Stickney Analytical Laboratory are the supervising PCO1 and the Field Operations Manager. For any quality control or other nonconformance issue the supervising PCO1 and the Field Operations Manager will submit an investigation and corrective action report to the Project Coordinator with copies to the other persons listed on the approval page of this QAPP.

It shall be understood that all measurements, regardless of the sample concentration, must have known and satisfactory accuracy and precision. Because various analytical procedures are utilized for sample analysis, specific criteria for accuracy and precision will not be provided in this document. Rather, satisfactory accuracy and precision shall be considered to be that which is consistent with the USEPA approved methods used to analyze the samples. All measurements must be derived in an environment of an adequate quality control program including statistical process control wherever applicable. The laboratory QAP and laboratory SOPs should be referred to for specific information relating to quality control.

The individuals responsible for verification that analytical methods and other laboratory procedures are being properly executed are the laboratory managers. The laboratory managers are also responsible for the reliability of project analytical data. For any quality control or other nonconformance issue that may have affected the reliability of project data, the responsible laboratory manager will submit an investigation and corrective action report to the Project Coordinator with copies to the other persons listed on the approval page of this QAPP.

B6: Instrument/Equipment Testing, Inspection, and Maintenance

All instrumentation and equipment used in the laboratory are maintained as required by the manufacturer's manuals and the laboratory SOPs.

Each laboratory is responsible for maintaining an adequate supply of spare parts to perform normal maintenance procedures. The three regional WRPs at which the participating laboratories are located maintain storerooms where frequently used supplies and consumables are inventoried. Major laboratory instrumentation is covered by maintenance/service contracts with qualified service representatives who are required to respond within 48 hours of notification. Each laboratory also has an account to purchase any needed parts or consumables not inventoried in the WRP storeroom, or in an emergency or other unforeseen situation.

A YSI 6600 monitor is used for in-stream measurements of water temperature, pH, dissolved oxygen, conductivity, and turbidity. The temperature calibration is verified at least quarterly against a NIST traceable thermometer. The Aquatic Ecology and Water Quality Section is responsible for stocking spare parts for these monitors, performing routine maintenance and securing service from qualified service representatives as needed.

B7: Instrument Calibration and Frequency

All instrumentation used for testing shall be calibrated each day of use as directed by manufacturers' manuals and laboratory SOPs. General guidelines and requirements regarding calibration of laboratory equipment are contained in the laboratory QAPs. Laboratories that participate in an accreditation program also will comply with the requirements for calibration maintained by the accreditation program.

All instrumentation is uniquely identified by serial number or other means. Wherever possible, NIST traceable standards are used for calibration of instruments. Calibration records are kept each time laboratory instrumentation and equipment is calibrated, and the calibration records and quality control samples are unmistakably identified for each batch of test results.

B8: Inspection/Acceptance of Supplies and Consumables

Supplies and consumables shall be inspected by the laboratories and accepted in accordance with all laboratory procedures and specifications contained in laboratory QAPs or SOPs. The laboratory section supervisors are responsible for verifying that supplies and consumables meet the specifications contained in the method SOPs.

B9: Non-direct Measurements

Non-direct measurements are not required for this project.

B10: Data Management

The District maintains several networked servers. The network may be accessed by personal computers and workstations from any District facility. Computer software used for this project include a fully networked LIMS and Excel® software. The Thermo Electron Sample Manager for Windows® 2003 Release 1 (LIMS) uses Oracle's® relational database to store laboratory data. The LIMS is heavily customized to incorporate procedures employed at District laboratories. The District LIMS supports numerous features including: barcode usage, prelogging of samples by either the sample submitter or laboratory personnel, label generation, sample login, sample receiving of prelogged samples, sample batching, instrument interfacing, manual data entry, automated calculations, control limit checking for each sample batch, control chart maintenance, NPDES limit checking, industrial wastewater limit checking, facilitated data handling and data reporting. The LIMS is utilized by all laboratories participating in this project.

All analytical data from the Stickney Analytical Laboratory and the Industrial Waste Analytical Laboratory have resided in the District LIMS since 1996. Historical data back to 1984 are stored in an Oracle® database. Whenever data are manually entered into a computer database file from hardcopy reports, each number is verified by the person entering the data to ensure the accuracy of manual entry.

Field measurement data are stored in the YSI monitor. Upon return from the sample collection trip, a Laboratory Technician under the direction of the Project Coordinator downloads the data to an Excel® file and prints a hard copy report. This Laboratory Technician will be referred to as the "data Laboratory Technician." The field data are then input to LIMS by the data Laboratory Technician using the sample number given to the water samples collected at each sampling station. This allows retrieval of the in-stream measurements with the laboratory test data. The data Laboratory Technician verifies the data entry into LIMS by checking a hardcopy LIMS report against the Excel® file containing the downloaded water quality data stored in the monitor.

As analyses are completed, the test results are entered into the LIMS, generally by data file upload from the laboratory instrument. Test results are reviewed and verified by each analytical section supervisor. Water quality limits are checked for each sampling station for the applicable General Use or Secondary Contact water quality limit. An exceedance of these limits prompts retesting for confirmation. The highest confirmed value is reported.

When all sample analyses are completed, the approved test data are collected from the LIMS database into Excel® spreadsheets by both the data Laboratory Technician and the Senior Environmental Chemist of the Stickney Analytical Laboratory. The Excel® spreadsheets include all parameters and field measurements.

The spreadsheets are checked for completeness and atypical test data. When atypical test data are found, they are reported to the appropriate analytical section supervisor for further investigation. Retesting for analytes with regulatory limits is only done for a confirmed QC problem in the execution of analysis or if the regulatory limit has been exceeded. No retesting will be performed on the basis of historical limits or multi-day limits without consulting first with the sample submitter for information about any unusual conditions that would corroborate the test results. **When such information is not available and a retest is requested, the sample submitter's authorization to conduct the retest should be in writing for documentation purposes.** In those instances where retesting is performed for reasons other than a QC failure or to confirm a regulatory limit exceedance, then the highest confirmed value is reported unless otherwise specified above.

Generally, analytical data from a sample collection trip are available to data users within six to eight weeks. Also, the analytical data remain available in LIMS. LIMS can be used to create configurable reports of recent and historical data.

GROUP C: ASSESSMENT AND OVERSIGHT

C1: Assessment and Response Actions

As stated in Section B5, the Field Operations Manager and the laboratory managers will submit investigation and corrective action reports for all quality control and other non-conformance problems dealing with field procedures to the Project Coordinator with copies to the other persons listed on the approval sheet of this QAPP. These reports will be assessed to determine whether further actions are needed.

All laboratories maintain internal quality control programs that are described in their quality assurance plans. The Analytical Laboratories Division (ALD) laboratories maintain statistical process control for most analytical procedures. Laboratory assessment activities require investigation and corrective actions for all quality control problems and other nonconformance issues.

Also, the Project Manager and Project Coordinator shall make certain that the project data associated with any quality control or other non-conformance issue is made available to data users with the appropriate data qualification. When data previously released to data users may have been affected by a quality control problem or other nonconformance issue, the Project Coordinator shall notify data users of the problem and put in the appropriate data qualifiers in databases used by the District for storage of project data.

The ALD laboratories participate in two performance testing studies each year. The results from the second performance testing study are used to fulfill the NPDES Discharge Monitoring Report Quality Assurance (DMR-QA) Study requirements. Systematic investigations are conducted for all unacceptable results and corrective actions are implemented as necessary.

The Stickney Analytical Laboratory and the Industrial Waste Analytical Laboratory are accredited by the Illinois EPA under the National Environmental Laboratory Accreditation Program. In accord with their accreditation program requirements, these laboratories are implementing annual internal audits and management reviews.

The Analytical Microbiology Laboratory is certified by the IDPH and must successfully pass an annual on-site audit conducted by the IDPH. If fecal coliform analysis is ever performed by another laboratory because of the limited transport time available due to the short maximum allowable holding time, that laboratory must have IDPH certification for fecal coliform analysis.

C2: Reports to Management

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

GROUP D: DATA VALIDATION AND USABILITY

D1: Data Review, Verification, and Validation

The laboratory data are reviewed and verified as described in Section B10, Data Management.

D2: Verification and Validation Methods

Sample collection records should be verified as necessary by the Field Operations Manager identified in Section A4. Laboratory data shall be verified as necessary by the laboratory manager of the laboratory that produced the data. All field and laboratory records will be kept for a minimum of five years. Laboratory records that are stored include calibration data, raw data, bench records, and data for quality control samples.

When verification of data results in a change to the project related data, the Project Coordinator shall inform data users of the problem and make certain that all databases known to contain the affected data are corrected as necessary.

The Project Manager, Project Coordinator and the QA Officer shall be informed of all situations where data integrity has been found 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 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 adequacy and location of sampling stations.

2. The adequacy of sampling frequency at each location.

3. Sampling procedures.

4. The appropriateness of parameters monitored.

5. Analytical procedures.

6. Corrective actions taken during the previous year for field and laboratory operations.

7. 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. Changes or deviations in the operation of the project shall not be made without authorization of the Project Director. The need of a change in project operation should be conveyed by the appropriate responsible person to the Project Coordinator. Data users and other interested persons may also suggest changes to the project to the Project Coordinator.

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

Following approval, a memorandum documenting each authorized change shall be prepared by the Project Coordinator and distributed to those on the approval list as well as the other Assistant Directors of the Monitoring and Research Department. All approved changes shall be given a sequential number, which includes the year issued, shown as follows: "IWMP Deviation 2001-xx". Approved changes shall be considered an amendment to the QAPP and shall be incorporated into the QAPP when it is updated annually.

Following the annual QAPP review, the QA Officer will revise the QAPP to incorporate any changes made to the project during the previous year, and to incorporate the approved changes to the project decided upon during the annual review of the QAPP. The QA Officer will also prepare a separate report listing the changes made to the QAPP. After approval of the revised QAPP by the Project Director, the Project Manager, and the Project Coordinator the QA Officer will distribute copies of the revised QAPP to those persons listed on the approval sheet.

REFERENCES

American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992.

American Public Health Association, Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

Environmental Protection Agency, "Guidelines Establishing Test Procedures for the Analysis of Pollutants," Code of Federal Regulations, Volume 40, Part 136, March 2007.

State of Illinois Rules and Regulations, Title 35: Environmental Protection, Subtitle C: Water Pollution, Chapter I: Pollution Control Board, January 14, 1999.

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

FIGURE 1

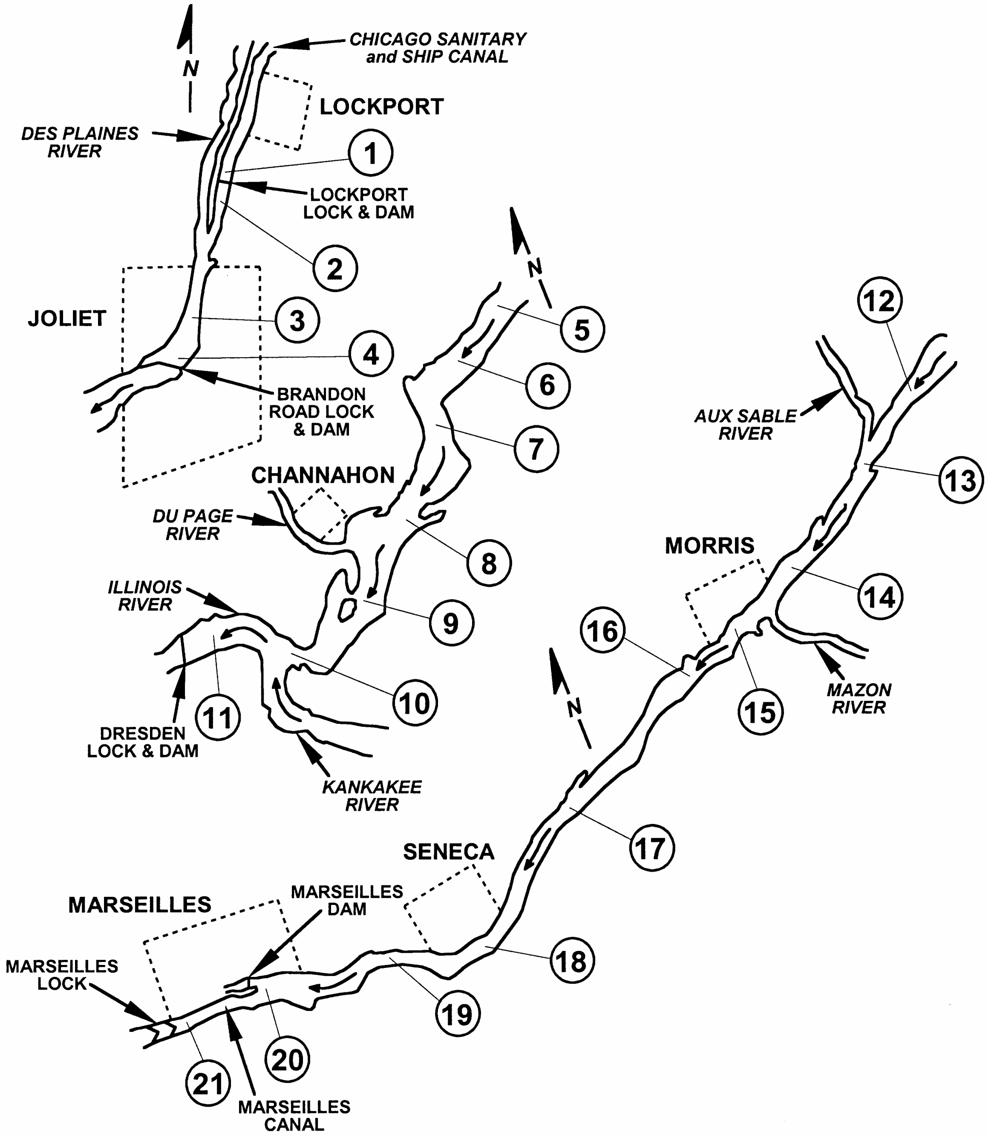
ILLINOIS WATERWAY MONITORING PROJECT ORGANIZATION CHART

```
|---Project Director
|       (Planning, decision making, and
|          ultimate execution of project)
|
|
O----Project Manager
|    |    (Project planning, execution
|    |       and reporting)
|    |
|    |
O----O---QA Officer
|    |   |    (Project QA/QC)
|    |   |
|    |   |
O----O---O-  Project Coordinator
         |  |    (Project coordination, data review and reporting)
         |  |
         |  |
         O--O----Field Operations Manager
         |  |          (Execution of field activities)
         |  |                        |
         |  |                        |
         |  O------Sampling Teams
         |  |          |    (Sample collection and preservation, field
         |  |          |       measurements, and transport of samples)
         |  |          |
         |  |          |
         O--O--  Laboratories
                   Stickney Analytical Laboratory
                   Industrial Waste Analytical Laboratory
                   Analytical Microbiology Laboratory
                   Aquatic Ecology and Water Quality Section
                       (Analysis, data verification,
                         and data storage in LIMS)
```

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

FIGURE 2

MAP OF THE ILLINOIS WATERWAY FROM LOCKPORT TO MARSEILLES SHOWING SAMPLING STATIONS 1 TO 21



METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

FIGURE 3

MAP OF THE ILLINOIS WATERWAY FROM OTTAWA TO PEORIA SHOWING SAMPLING STATIONS 22 TO 49

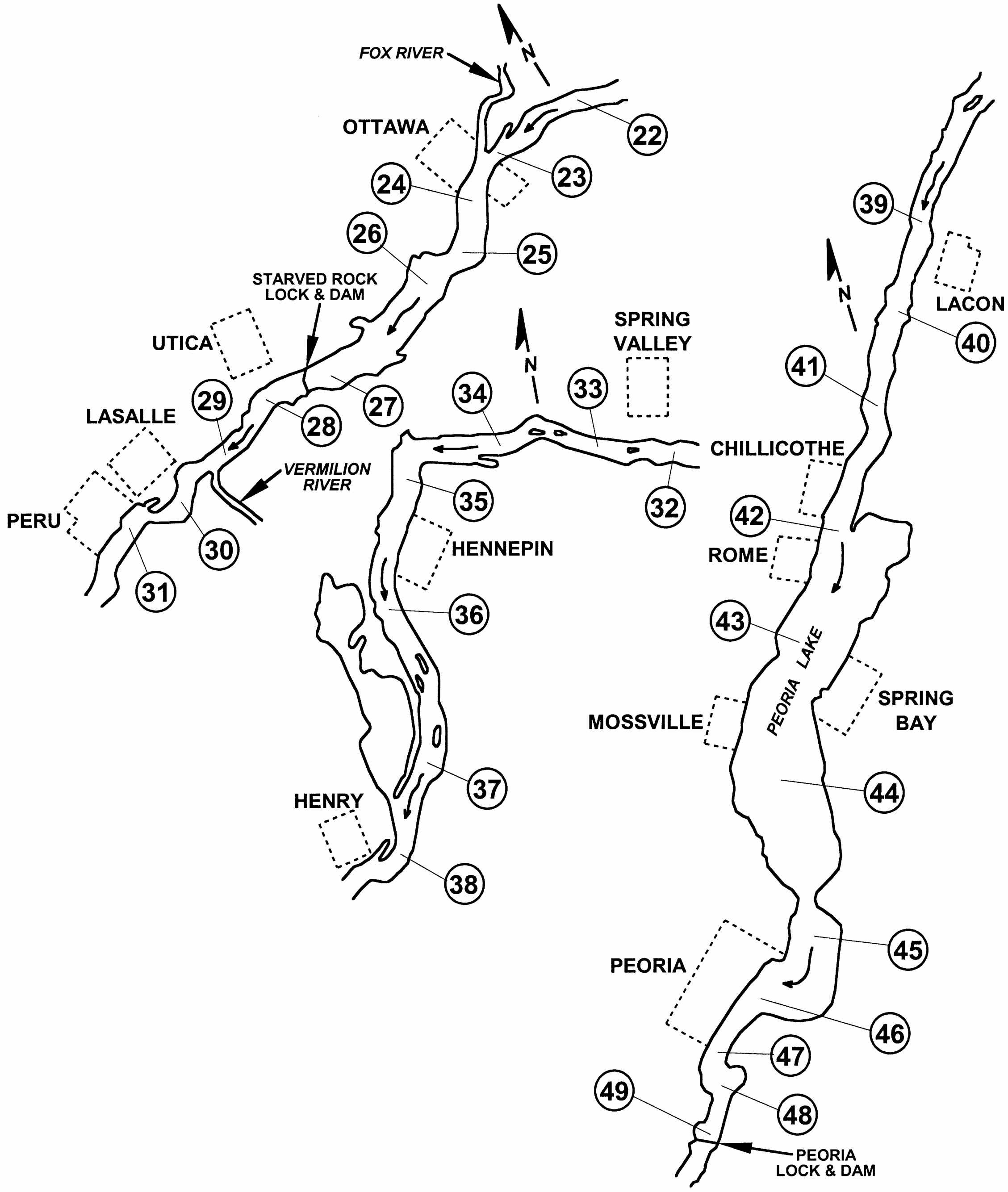


TABLE 1: SAMPLING LOCATIONS ALONG THE ILLINOIS WATERWAY FROM THE LOCKPORT LOCK AND DAM TO THE PEORIA LOCK AND DAM

Station Number	Waterway Mile-Point Location	Navigation Pool	North Latitude	West Longitude
		Chicago Sanitary and Ship Canal[1]		
1[2]	291.5	Lockport	41° 34.340'	87° 04.590'
2[2]	290.5	Brandon Road	41° 33.550'	88° 04.630'
		Des Plaines River[3]		
3	287.3	Brandon Road	41° 31.130'	88° 05.260'
4	286.5	Brandon Road	41° 30.490'	88° 05.680'
5[2]	285.0	Dresden Island	41° 29.730'	88° 06.990'
6	282.8	Dresden Island	41° 28.450'	88° 08.830'
7	280.5	Dresden Island	41° 27.190'	88° 09.930'
8[2]	278.0	Dresden Island	41° 25.320'	88° 11.570'
9	276.1	Dresden Island	41° 24.310'	88° 13.010'
10	274.0	Dresden Island	41° 22.970'	88° 14.490'
		Illinois River		
11	272.4	Dresden Island	41° 23.900'	88° 15.820'
12[2]	270.0	Marseilles	41° 23.530'	88° 18.540'
13	268.9	Marseilles	41° 22.740'	88° 20.240'
14	265.0	Marseilles	41° 21.700'	88° 23.630'
15	263.0	Marseilles	41° 21.180'	88° 25.810'
16	261.6	Marseilles	41° 20.850'	88° 27.320'
17	256.0	Marseilles	41° 19.360'	88° 33.280'
18[2]	253.0	Marseilles	41° 17.930'	88° 36.190'
19	250.0	Marseilles	41° 18.820'	88° 39.180'
20	247.5	Marseilles	41° 19.240'	88° 41.950'
21	246.0	Marseilles	41° 19.500'	88° 43.440'
22	243.7	Starved Rock	41° 19.900'	88° 45.090'
23[2]	240.6	Starved Rock	41° 20.330'	88° 49.380'
24	238.5	Starved Rock	41° 20.200'	88° 51.780'
25	236.8	Starved Rock	41° 19.310'	88° 52.960'

TABLE 1 (Continued): SAMPLING LOCATIONS ALONG THE ILLINOIS WATERWAY FROM THE LOCKPORT LOCK AND DAM TO THE PEORIA LOCK AND DAM

Illinois River (continued)

Station Number	Waterway Mile-Point Location	Navigation Pool	North Latitude	West Longitude
26	234.5	Starved Rock	41° 19.140'	88° 55.340'
27	231.7	Starved Rock	41° 19.270'	88° 58.530'
28[2]	229.6	Starved Rock	41° 19.650'	88° 00.560'
29	226.9	Peoria	41° 19.240'	89° 03.860'
30	224.7	Peoria	41° 18.870'	89° 05.450'
31	222.6	Peoria	41° 19.430'	89° 07.300'
32[2]	219.8	Peoria	41° 18.510'	89° 10.160'
33	217.1	Peoria	41° 18.810'	89° 13.500'
34	213.4	Peoria	41° 18.730'	89° 17.050'
35[2]	209.4	Peoria	41° 17.940'	89° 20.200'
36	205.0	Peoria	41° 13.240'	89° 21.440'
37	200.4	Peoria	41° 09.720'	89° 19.130'
38[2]	196.9	Peoria	41° 06.970'	89° 20.180'
39	190.0	Peoria	41° 07.400'	89° 24.880'
40	186.4	Peoria	40° 59.270'	89° 26.290'
41[2]	183.2	Peoria	40° 57.020'	89° 27.190'
42	179.0	Peoria	40° 53.680'	89° 29.420'
43	174.9	Peoria	40° 50.530'	89° 31.380'
44[2]	170.9	Peoria	40° 47.620'	89° 33.650'
45	165.3	Peoria	40° 42.760'	89° 32.850'
46	162.8	Peoria	40° 41.370'	89° 34.920'
47	160.6	Peoria	40° 40.100'	89° 36.580'
48[2]	159.4	Peoria	40° 39.130'	89° 36.590'
49	158.2	Peoria	40° 38.360'	89° 37.090'

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[1] Secondary contact waterway.

[2] Sediment sampled during the October sample collection trip.

[3] Secondary contact waterway from confluence with Chicago Sanitary and Ship Canal to sampling Station 8.

TABLE 2: ANALYSES PERFORMED FOR WATER SAMPLES, MINIMUM MEASUREMENT CRITERIA, AND MEASUREMENT OBJECTIVES

Parameter	Minimum Measurement Criteria	Minimum Measurement Objectives
Temperature	NA	0.1 degree C[1]
pH	NA	0.1 pH unit[1]
Dissolved oxygen	NA	0.1 mg/L[1]
Conductivity	No standard	
Turbidity	No standard	
Chlorophyll	No standard	
Suspended solids	No standard	
Biochemical Oxygen Demand (5 day)	No standard	
Ammonia nitrogen	15.0 mg/L	3.0 mg/L
Kjeldahl nitrogen	No standard	
Nitrate nitrogen	No standard	
Nitrite nitrogen	No standard	
Phosphorus, total	No standard	
Cyanide, total	0.22 mg/L	0.04 mg/L
Phenols	0.1 mg/L	0.02 mg/L
Arsenic, total	0.36 mg/L	0.07 mg/L
Cadmium, total	0.009 mg/L[2]	0.002 mg/L
Calcium, total	No standard	
Chromium, total	1.0 mg/L[2,3]	0.2 mg/L
Copper, total	0.017 mg/L[2]	0.003 mg/L
Iron, total	No standard	
Lead, total	1.0 mg/L	0.2 mg/L
Magnesium, total	No standard	
Manganese, total	1.0 mg/L	0.2 mg/L
Mercury, total	0.0006 mg/L	0.0001 mg/L
Nickel, total	1.0 mg/L	0.2 mg/L
Silver, total	0.005 mg/L	0.001 mg/L
Zinc, total	1.0 mg/L	0.2 mg/L
Hardness	No standard	
Fecal coliform	200 cfu/100mL	40 cfu/100mL

NA = Not applicable.

[1] Required sensitivity.

[2] Calculated standard based on a minimum water hardness of 100 mg/L as $CaCO_3$.

[3] Standard for total trivalent chromium.

TABLE 3: ANALYSES PERFORMED FOR SEDIMENT SAMPLES

Parameter	Minimum Measurement Criteria	Minimum Measurement Objectives
Total solids	None	None
Total volatile solids	None	None
Ammonia nitrogen	None	None
Kjeldahl nitrogen	None	None
Phosphorus, total	None	None
Cyanide, total	None	None
Phenols	None	None
Arsenic, total	None	None
Cadmium, total	None	None
Chromium, total	None	None
Copper, total	None	None
Iron, total	None	None
Lead, total	None	None
Manganese, total	None	None
Mercury, total	None	None
Nickel, total	None	None
Silver, total	None	None
Zinc, total	None	None

TABLE 4: SAMPLE CONTAINERS AND FIELD PRESERVATION FOR WATER SAMPLES

	Parameters	Container and Field Preservation[1]
1.	Suspended solids, BOD_5, and Nitrite nitrogen[2]	1-gallon polyethylene bottle, chill with ice
2.	Nutrients[3]	1-quart polyethylene bottle with 1 mL of a 50% H_2SO_4 solution, chill with ice
3.	Metals, total	8-ounce certified clean[4] polyethylene bottle with 2-mL conc. HNO_3 to pH<2, chill with ice
4.	Cyanide, total	1/2 gallon polyethylene bottle with 2 mL 50% w:w solution of $NaOH:H_2O$ to pH>12, chill with ice
5.	Phenols	1-quart glass bottle with 1 mL of 50% v:v solution of conc. H_2SO_4:H2O to pH<2, chill with ice
6.	Fecal coliform	4-ounce square polypropylene bottle, sterilized and sealed with 0.45 mL of 15% disodium salt of EDTA adjusted to pH of 6.5, and 0.15 mL of 10% NaS_20_3, chill with ice
7.	Chlorophyll	1-liter high-density polyethylene plastic amber wide-mouth bottle with 1-mg powdered $MgCO_3$, chill with ice

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[1] Laboratory preservation shown in Table 7.
[2] Stickney Analytical Laboratory personnel pour off a 250-mL aliquot for nitrite nitrogen. The aliquot is refrigerated promptly.
[3] Nutrients include ammonia nitrogen, Kjeldahl nitrogen, nitrate nitrogen, and total phosphorus.
[4] To EPA level 1 specifications for trace metals.

TABLE 5: SAMPLE CONTAINERS AND FIELD PRESERVATION FOR SEDIMENT SAMPLES

Parameter	Container and Preservation
1. All analytes[1]	1-quart glass bottle, chill with ice

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[1] Analytes include total solids, total volatile solids, ammonia nitrogen, Kjeldahl nitrogen, total phosphorus, total cyanide, phenols, and total metals. Metals analyzed include arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel and zinc.

TABLE 6: ANALYTICAL METHODS

Parameter	Method	Method Reference
Temperature	Electrode	SM 2550 B
pH	Electrode	SM 4500-H^+ B
Dissolved oxygen	Membrane electrode	SM 4500-O G
Conductivity	Electrode	SM 2510 B
Turbidity	Nephelometric	SM 2130 B
Suspended solids	Gravimetric	SM 2540 D
BOD	Electrode	SM 5210 B
Ammonia nitrogen	Colorimetric	EPA 350.1
Kjeldahl nitrogen	Colorimetric	EPA 351.2
Nitrate and nitrite nitrogen	Colorimetric	EPA 353.2
Phosphorus, total	Colorimetric	EPA 365.4
Cyanide, total	Colorimetric	SM 4500-CN C,E
Phenols	Colorimetric	EPA 420.4
Arsenic, total	ICP	EPA 200.7, SM 3120 B
Cadmium, total	ICP	EPA 200.7, SM 3120 B
Calcium, total	ICP	EPA 200.7, SM 3120 B
Chromium, total	ICP	EPA 200.7, SM 3120 B
Copper, total	ICP	EPA 200.7, SM 3120 B
Iron, total	ICP	EPA 200.7, SM 3120 B
Lead, total	ICP	EPA 200.7, SM 3120 B
Magnesium, total	ICP	EPA 200.7, SM 3120 B
Manganese, total	ICP	EPA 200.7, SM 3120 B
Mercury, total	Cold vapor AA	SM 3112 B
Nickel, total	ICP	EPA 200.7, SM 3120 B
Silver, total	ICP	EPA 200.7, SM 3120 B
Zinc, total	ICP	EPA 200.7, SM 3120 B
Hardness	Calculation	SM 2340 B
Fecal coliform	Membrane filtration	SM 9222 D
Chlorophyll (extraction)	Colorimetric	SM 10200 H 1,2
Total solids[1]	Gravimetric	SM 2540 G
Total volatile solids[1]	Gravimetric	SM 2540 G

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[1] Performed on sediment samples only.

TABLE 7: LABORATORY PRESERVATION AND MAXIMUM HOLDING TIME

Parameter	Laboratory Preservation[1, 2]	Maximum Holding Time
Temperature	NA	NA
pH	NA	NA
Dissolved oxygen	NA	NA
Conductivity	NA	NA
Turbidity	NA	NA
Suspended solids	Refrigerate[3]	7 days
BOD	Refrigerate	48 hours
Ammonia nitrogen	Refrigerate, then H_2SO_4 to pH<2	24 hours, 28 days
Kjeldahl nitrogen	Refrigerate, then H_2SO_4 to pH<2	24 hours, 28 days
Nitrate nitrogen	Refrigerate, then H_2SO_4 to pH<2	24 hours, 28 days
Nitrite nitrogen	Refrigerate	48 hours
Phosphorus, total	Refrigerate	48 hours
Cyanide, total	Refrigerate	14 days
Phenol	Refrigerate	28 days
Metals, total (ex, mercury)	HNO_3 to pH<2	6 months
Mercury, total	HNO_3 to pH<2	28 days
Fecal coliform	Refrigerate	6 hours[4]
Chlorophyll (extraction)	Refrigerate, store in dark	24 hours
Total solids[5]	Refrigerate	7 days
Total volatile solids[5]	Refrigerate	7 days

NA = Not applicable, field measurements.

[1] All samples stored in ice after collection and in transport to laboratory. Thermal preservation and chemical field preservation checked at arrival.

[2] Field preservation shown in Table 4.

[3] Refrigeration at 4 degrees Celsius.

[4] Same day membrane filtration of samples is allowable.

[5] Performed on sediment samples only.

TABLE 8: RESPONSIBLE LABORATORIES AND TEST METHOD IDENTIFICATION

Parameter	Laboratory	Laboratory SOP*
Temperature	Field measurement	
pH	Field measurement	
Dissolved oxygen	Field measurement	
Conductivity	Field measurement	
Turbidity	Field measurement	
Suspended solids	Stickney	ST-TSS/VSS
BOD	Industrial Waste	IW-BOD
Ammonia nitrogen	Stickney	ST-NH3
Kjeldahl nitrogen	Stickney	ST-TKN
Nitrate and nitrite nitrogen	Stickney	ST-NO3/NO2
Phosphorus, total	Stickney	ST-TP
Cyanide, total	Industrial Waste	IW-CN-AUTO
Phenols	Industrial Waste	IW-PHENOL-A
Metals, total (ex. mercury)	Stickney	ST-ICPTJA
Mercury, total	Stickney	ST-CVAAS
Hardness	Stickney	ST-Hardness
Fecal coliform	Microbiology[1]	FC Filtration
Chlorophyll (extraction)	Aquatic Ecology	SOP for Chlorophyll
Total solids[2]	Stickney	ST-TS/TVS
Total volatile solids[2]	Stickney	ST-TS/TVS

---

[*] Laboratory Standard Operating Procedure identifications.

[1] Analysis may be contracted to a laboratory certified by the Illinois Department of Public Health that is closer to the point of sample collection. For 2009 fecal coliform analysis was contracted to PDC Laboratories in Peoria.

[2] Performed on sediment samples only.

TABLE 9: COMPARISON OF LABORATORY METHOD DETECTION LIMITS (MDLs) WITH MINIMUM MEASUREMENT OBJECTIVES FOR WATER SAMPLES

Parameter	Method MDL	Minimum Measurement Objectives
Temperature	NA	0.1 degree C[1]
pH	NA	0.1 pH unit[1]
Dissolved oxygen	NA	0.1 mg/L[1]
Conductivity		
Turbidity		
Suspended solids	3 mg/L	
BOD	2 mg/L[2]	
Ammonia nitrogen	0.02 mg/L	3.0 mg/L
Kjeldahl nitrogen	0.04 mg/L	
Nitrate nitrogen	0.005 mg/L	
Nitrite nitrogen	0.004 mg/L	
Phosphorus, total	0.05 mg/L	
Cyanide, total	0.003 mg/L	0.04 mg/L
Phenols	5 µg/L	0.02 mg/L
Arsenic, total	0.02 mg/L	0.07 mg/L
Cadmium, total	0.002 mg/L	0.002 mg/L
Calcium, total	0.06 mg/L	
Chromium, total	0.0005 mg/L	0.2 mg/L
Copper, total	0.002 mg/L	0.003 mg/L
Iron, total	0.02 mg/L	
Lead, total	0.003 mg/L	0.2 mg/L
Magnesium, total	0.07 mg/L	
Manganese, total	0.0006 mg/L	0.2 mg/L
Mercury, total	0.05 µg/L	0.5 µg/L
Nickel, total	0.002 mg/L	0.2 mg/L
Silver, total	0.0006 mg/L	0.001 mg/L
Zinc, total	0.003 mg/L	0.2 mg/L
Fecal coliform	10 counts/100 mL 40 counts/100 mL	
Chlorophyll (extraction)	1 µg/L	

NA = Not applicable.

[1] Method sensitivity or resolution.

[2] Established by method acceptance criteria.

ILLINOIS WATERWAY MONITORING PROJECT
QUALITY ASSURANCE PROJECT PLAN

APPENDIX I

SAMPLING PROCEDURES

ILLINOIS WATERWAY MONITORING PROJECT
STANDARD OPERATING PROCEDURES

Background

In the Illinois Waterway Monitoring Project, samples are obtained from 49 stations on a 133-mile section of the Illinois Waterway System from the Lockport Lock and Dam to the Peoria Lock and Dam.

The purpose of this study is to determine water quality conditions in the Illinois Waterway System and to also identify any changes that may be occurring within the system.

The Patrol Boat Operator (PBO) positions the boat at the deepest point in the center of the river navigation channel as defined on the sample log sheet for each sampling station. The log sheet for the station indicates the exact sampling location both by visual landmarks and by latitude and longitude (Exhibit 1). Using the cartographic Global Positioning System (GPS) on the boat, the PBO replicates the precise location for each sampling station under all weather conditions or at night.

Industrial Waste Division (IWD) personnel obtain water quality samples at a three-foot depth from the center of the waterway using a Kemmerer Water Sampling Device or a plastic submersible pump. All stations are sampled for cyanide (1/2 gallon), fecal coliform (4 oz.), total suspended solids, biochemical oxygen demand, and nitrite nitrogen (gallon), total Kjeldahl nitrogen, total phosphorus, ammonium nitrogen, and nitrate nitrogen (quart), phenol (quart), and trace metals (8 oz.). Twenty-two stations are sampled for chlorophyll (liter). See Table AI-1 for sample containers and preservation methods.

Laboratory Technicians utilize a YSI 6600 electronic water quality monitor (sonde) to measure dissolved oxygen, pH, water temperature, conductivity, and turbidity directly from the waterway. IWD personnel record the temperature and pH measured by the sonde at each sample point on the sample log sheet provided.

Procedure for the Use of Submersible Pump

A 120-volt submersible pump is suspended from a line and is used to obtain samples at selected depths. The pump is serviced and the impellers are cleaned and replaced prior to each sampling survey. The pump tubing (Tygon or equivalent) is replaced daily during the study.

1. Upon arrival at the sampling location, lower the submersible pump to a depth of three feet. Whenever the sampling device is raised or lowered from the boat, give special attention to insure that there is no contact with the hull or interference with the propellers. If contact with the hull is made, discard the sample and start over.

2. After lowering to the proper depth, activate the pump and allow the water flow to purge and run through the impeller housing and tubing for one minute.

3. After purging and equilibrating the pump, fill each bottle to ½ full from the pump tube. Start with the first bottle and fill each subsequent bottle to the proper level as described in the bottle filling and preparation procedure section.

Procedures for Use of the Kemmerer Water Sampler

The Kemmerer water sampler is used to collect water samples at selected depths. The sampler is constructed of brass and is open at both ends. A messenger weight is dropped down the suspension line to close the opening at both ends of the sampler, thereby sealing the water in the cylinder.

Prior to use, the Kemmerer Sampler must be cleaned and inspected for proper functioning and sealing of both ends. Failure of the seals will allow the introduction of air or other contaminants into the sample.

Upon arrival at each designated sampling location, the following steps must be followed:

a. Lock the Kemmerer Sampler in an open position at both ends prior to placing it in the water.

b. Lower the Kemmerer to the designated depth. Close the sampler ends by sending the messenger weight down the line. Retrieve the sampler and release the enclosed water.

c. If the sampler is leaking because the open ends did not close tightly or the device has captured sediment, discard the sample and collect another sample.

d. Release the water from the sampling device by opening the petcock on the bottom.

5. When filling a BOD bottle, hold the bottle at a 45-degree angle to avoid splashing and to avoid the introduction of O_2 into the sample. Place a length of plastic tubing on the petcock and insert it all the way to the bottom of the bottle. Overfill the bottle by twice its volume to eliminate any extraneous O_2.

Sample Tags and Logsheets

Apply Laboratory Information Management System (LIMS) labels for the appropriate sampling station directly to each sample container.

Special sample log sheets have been created that are designed specifically for this project. Fill out a separate log sheet at each sampling station. Upon completion, submit the sampling logs to the IWD Waterways Supervisor. Provide a photocopy of each log sheet to the Supervising Biologist located at the Stickney Water Reclamation Plant Laboratory.

Complete a daily chain of custody log for all samples collected. The chain of custody log must contain the LIMS identification numbers, the type and number of samples collected the signatures of sampling personnel, transporting personnel and laboratory receiving personnel.

The temperature of the samples upon delivery to the laboratory for analyses should also be noted on the chain of custody log.

Waterway Sampling Procedures

a. Before sample collection, clean the Kemmerer device with a solution of interfering residue-free critical cleaning liquid detergent and water. Rinse it with de-ionized water. When using the submersible pump purge/flush the pump for one (1) minute prior to obtaining the sample.

b. Take the samples from a representative location - the center of the river at the deepest point as defined on the log sheet for that station.

c. If boat traffic is encountered while sampling, delay sampling until the unnatural turbulence caused by the passing vessel's wake subsides. Indicate in the "Remarks" section of the sample log sheet that sampling was interrupted due to river traffic.

d. Upon arrival at each prescribed sampling location, the following steps should be followed:

    a. Lower the clean Kemmerer Sampler or submersible pump into the water.

    b. Empty the Kemmerer, lower and retrieve it two additional times rinsing it thoroughly to equilibrate it to the waterway. Purge/flush the pump for one (1) minute prior to obtaining the sample.

    c. When sampling during precipitation events (rain or snow), cover the sample containers at all times except when the container is being filled.

    d. Whenever the sampling device is being raised or lowered from the boat, give special attention to insure there is no contact with the hull. If contact is made, discard the sample and start over.

    e. After the sample is obtained, pour it into the individual sample aliquot bottles while swirling the sample water in the bucket between pours to ensure a homogeneous distribution of suspended solids.

    f. After all the sample aliquots have been poured-off, rinse the sampling device with de-ionized water.

    g. Properly identify (apply LIMS label to) each sample aliquot and place them into the insulated ice chest filled from one third to one half full of ice cubes or dry ice. If using ice cubes, insure the sample bottles are surrounded in ice and in direct contact with the ice cubes. If using dry ice, avoid direct contact between the sample bottles and the dry ice to prevent freezing of the sample. The samples must be stored at 4°C without freezing.

e. Record the following pertinent information on the sample log sheet.

  a. Date of the Sample.
  b. Signature(s) of the collector.
  c. Signature of the transporter.
  d. Signature of the person who relinquished the sample.
  e. Signature of the laboratory analytical staff member who received the sample.
  f. Weather conditions during sampling (Example: Clear, Cloudy, Rain, Snow, Air Temperature, if possible).
  g. Type of aliquots obtained.
  h. Time the sample was obtained.
  i. Sample pH as obtained with the Sonde.
  j. Sample temperature as obtained with the Sonde.
  k. Dissolved oxygen concentration as obtained with the Sonde.
  l. Sample storage temperature.
  m. In the Remarks column, describe your visual observations of the sample (clear, semi-clear, light sediment, etc.) and indicate if there was any passing boat traffic or any unusual observations of the waterway quality, such as oil, discoloration, or debris.
  n. Record any other noteworthy information in the space provided on the bottom of the log sheet for additional remarks.
  o. Inform the Marine Unit Supervisor of any unusual observations or events that may have impacted sample collection or sample validity. The Marine Unit Supervisor will notify the Supervising Aquatic Biologist of these anomalies.

Bottle Filling and Preparation

1. General Chemistry Samples.

    a. Apply the LIMS label to the sample.

    b. Fill the 1-gallon (wide-mouth, polyethylene plastic) container.

    c. Place the sample into the cooler on ice.

    d. SAL pours off 200-mL aliquot for nitrite nitrogen. No preservative is used and aliquot should be immediately refrigerated.

2. Cyanide Sample.

    e. Apply the LIMS label to the sample.

    f. Fill the polyethylene plastic half-gallon container to the shoulder. NOTE: The bottle contains 1 mL of a NaOH solution as a preservative. (Overfilling may cause a loss of preservative.)

    g. Place the sample into the cooler on ice.

3. Nutrients.

    a. Apply the LIMS label to the sample.

    b. Fill polyethylene plastic 1-quart container to the shoulder. NOTE: The bottle contains 1 mL of a fifty percent H_2SO_4 solution as a preservative. (Overfilling may cause a loss of preservative.)

    c. Place the sample into the cooler on ice.

4. Trace Metals Sample.

    a. Apply the LIMS label to the sample.

    b. Fill the 8-oz. polyethylene plastic bottle.

    c. Leave approximately one quarter of air space at top of bottle. NOTE: The bottle contains 2 mL of nitric acid. (Overfilling may cause a loss of preservative.)

    d. Place the sample into the cooler on ice.

5. Bacterial Sample.

   a. Apply the LIMS label to the sample bottle.

   b. This is a sterilized 4 oz. polyethylene plastic bottle with a foil-covered stopper.

   c. Do not open the bacterial bottle until just prior to sampling, and replace foil covered stopper as soon as possible after filling the bottle.

   d. Exercise care not to touch the neck of the bottle, or the glass stopper, to prevent contamination of the sample.

   e. Do not remove the foil from the stopper.

   f. All bacteria sample bottles contain 0.1 mL of a sodium thiosulfate solution and 0.03 mL of an EDTA solution as preservatives. These are added by Microbiology personnel and appear as a trace of brown residue at the bottom of the bottle.

   g. Pour the water from the sample bucket into the bacteria sample bottle. Fill the bottle to the 125-mL mark. <u>DO NOT OVERFILL</u>

   h. Place the sample into the cooler on ice.

6. Dissolved Oxygen (DO) Sample (when obtained manually).

   a. Apply the LIMS label to the sample.

   b. Place a 300-mL DO glass bottle into the special DO sampling device.

   c. <u>Slowly</u> lower the DO sampling device into the waterway to a depth of approximately 3 feet from the surface taking care to prevent turbulence and the formation of air bubbles while filling.

   d. Raise the sampling device when all the air bubbles have stopped rising.

   e. Remove the DO bottle.

   f. Add 1 mL of manganous sulfate (use Reagent Dispenser #1).

   g. Add 1-mL potassium hydroxide – potassium iodide-azide solution (the alkali-iodide-azide reagent in Dispenser #2). NOTE: When adding the contents of Reagent Dispenser #1 or #2 to the DO sample bottle, keep the top of the dispenser below the surface of the water. This prevents the introduction of extraneous oxygen into the sample.

   h. Replace the glass stopper on the DO bottle carefully to exclude air bubbles.

   i. Rinse the bottle with river water or fresh water, if available.

j. Mix the sample by inverting the bottle several times until dissolution is complete. NOTE: The initial precipitate, manganous hydroxide, combines with the DO in the sample to form manganic hydroxide, a brown precipitate.

k. When the precipitate settles to approximately one third of the bottle height in the sample, add the sulfuric acid, solution (Reagent #3), by removing the glass stopper on the sample bottle and placing the tip of the Reagent Dispenser #3 in the inside neck of the bottle. This allows the acid to run down the inside of bottleneck, and mix with the sample. Once again, this eliminates the introduction of extraneous oxygen into the sample.

l. Replace the glass stopper on the DO bottle.

m. Rinse the bottle with river water or fresh water if it is available.

n. Mix the sample by inverting bottle several times.

o. Place the sample into the cooler on ice.

p. Protect the sample from sunlight.

7. Phenol Sample.

a. Apply the LIMS label to the sample.

b. Fill the 1-quart glass sample bottle to the shoulder; exercise <u>CAUTION</u> as bottle contains 2 mL of a sulfuric acid solution as a preservative. Do not breathe any vapors that may be emitted by the sulfuric acid preservative.

c. Place the sample into the cooler on ice.

8. Chlorophyll Sample.

    a. Apply the LIMS label to the sample.

    b. Fill the 1-liter amber bottle to the shoulder. NOTE: The bottle contains 1 mg of magnesium bicarbonate as a preservative. (Overfilling may cause a loss of preservative.)

    c. Place the sample into the cooler on ice.

    d. Protect the sample from sunlight.

Sample Storage and Transportation

Store all samples on the boat and transport all samples to the laboratory in insulated coolers at a temperature between 0° and 4° centigrade. Coolers must be filled with ice to a level above the tops of the sample bottles. Melted water from the ice must not reach the tops of the sample bottles, drain as required.

As final quality control, the Marine Unit Supervisor or his designee will check the thermometer inside each cooler and the outside of all the samples collected for proper temperature with an infrared thermometer as they are delivered to the laboratory for analyses. Laboratory personnel will take and record the actual temperature of each sample upon receipt from the sample transporter.

Equipment Required for Sampling

1. Bottles (per station).

    a. Gallon (polyethylene) – general chemistry.

    b. ½ Gallon (polyethylene) – cyanide.

    c. Gallon (wide-mouth polyethylene) – alkalinity, turbidity, chloride, solids.

    d. 8 ounce (polyethylene) – trace metals (total).

    e. 4 ounce (polyethylene plastic w/stopper) – fecal coliform.

    f. 300 mL (BOD bottle) – dissolved oxygen.

    g. Quart (Glass) – phenol.

    h. Liter (wide-mouth amber polyethylene plastic) – chlorophyll (collected at 22 stations).

2. Tags - Electronically generated adhesive backed labels with identifying (LIMS) barcode.

3. Sampling Devices.

   a. Stainless steel bucket and lid.

   b. Stainless steel DO sampling device equipped with a lid and a fill tube that extends into the glass 300-mL DO sample bottle stopping just below the bottom. This device is designed to bleed sample into the bottle through the tube and the bottle is filled to overflowing inside the device to prevent turbulence and the formation of air bubbles while filling.

   c. Portable hand-held Corning Checkmate II electronic pH and temperature combination meter.

   d. Kemmerer Sampling device.

   e. Submersible pump.

   f. Recording sondes.

4. Miscellaneous.

   a. Illinois Waterway Monitoring Project (Peoria Run) Log Sheet.

   b. 72-quart ice chest.

   c. two chest coolers.

   d. Ice cubes.

   e. DO Reagents.

5. Safety.

   a. Wear gloves and eye protection when handling DO reagents or filling any pre-preserved sample bottles.

   b. Wear life jacket or suspender inflatable vest at all times while working on deck.

TABLE AI-1: CONSTITUENTS ANALYZED, SAMPLE CONTAINERS, AND PRESERVATION METHODS FOR WATER SAMPLES COLLECTED FOR THE ILLINOIS WATERWAY MONITORING PROJECT

Constituent	Sample Container	Preservative
Dissolved Oxygen	300-mL glass BOD bottle when obtained manually	Measured by Sonde on site
Water Temperature		Measured by Sonde on site
pH		Measured by Sonde on site
Five-Day Biochemical Oxygen Demand	Polyethylene plastic (gal.)	Cool, 4°C
Total Suspended Solids	Polyethylene plastic (gal.)	Cool, 4°C
Nitrogen - Phosphorus Series (Total Kjeldahl Nitrogen Ammonia Nitrogen Nitrite + Nitrate Nitrogen Total Phosphorus)	Polyethylene plastic (qt.)	H_2SO_4 to pH < 2
Total Cyanide	Polyethylene plastic (1/2 gal.)	NaOH to pH 12
Total Phenols	Glass (qt.)	H_2SO_4 to pH < 2
Trace Metals (Arsenic, Cadmium, Chromium, Copper, Iron, Lead, Manganese, Mercury, Nickel, Silver, Zinc and Total Hardness)	Polyethylene plastic (8 oz.)	HNO_3 to pH < 2
Fecal Coliform	Sterile Polyethylene plastic (4 oz.)	Cool, 4°C, EDTA, Thiosulfate
Chlorophyll	Amber polyethylene plastic (1 Liter)	1 mg. magnesium carbonate

PROCEDURE FOR COLLECTING SEDIMENT WITH A PONAR® GRAB SAMPLER

Laboratory Procedures

In a solution of non-phosphate laboratory detergent and hot tap water, soak Ponar grab samplers (Ponar), polyethylene plastic pans, and polyethylene plastic scoops for one to two hours. Remove sediment or oil by scrubbing with a nylon bottlebrush. Allow the equipment to air dry. Store Ponars, pans, and scoops in polyethylene bags. Seal the bags.

Field Procedures

Following the collection of water samples, collect sediment from the center of the waterway. To avoid contamination from the boat deck, place a 9- X 9-inch Ponar and plastic scoop in a plastic pan. The boat should not move during collection of sediment.

Attach 3/4-inch PVC tubing to a submersible pump. Secure the pump with a rope before lowering into the water. Lower the pump three feet below the water surface. Remove the pump from the water when the boat is moving. Disconnect the pump when not in use.

Remove the spring-loaded safety pin on the Ponar and insert into the cross bar. Use an electric winch to lower the Ponar to the bottom of the waterway. Attach the lifting eye on the Ponar to the winch cable. Upward tension must be maintained on the cable in order to keep the safety pin in the cross bar. When the Ponar has been lowered to the bottom, unwind two or three feet of cable. Pull and release the cable by hand two or three times to insure that the safety pin releases from the cross bar. Don't pull too hard as to lift the Ponar off the riverbed.

Use the winch to retrieve the Ponar from the bottom. Place the Ponar in a plastic pan. Press firmly on the cross bar to open the jaws. Insert the safety pin into the cross bar. Finally, remove the Ponar from the pan.

Inspect the sediment sample. The sample should contain fine-grained sediment, sand, and gravel. Discard the sample when the sediment is primarily composed of water and rocks. Repeat three times at the first location. If a sediment sample isn't collected at the center location, move one-half the distance to either bank. Collect a sediment sample at the new location. If no sample is collected following three attempts at the second location, continue moving half the distance towards the bank. If it isn't possible to move the boat close enough to shore to use the electric winch, employ a 6- X 6-inch Ponar and a hand-line from the bow.

Check the LIMS label for accuracy (sampling location, date, etc.) Attach the label securely to the sample bottle. Slowly discard the excess water from the sample. The pour rate must be very slow to avoid losing the fine sediment. Thoroughly mix the sediment with a scoop. Remove large objects that interfere with mixing. With the scoop, fill a one-quart glass bottle with sediment, one inch from the top. Immediately place the sample bottle in a large ice chest.

Following sample collection, detach the Ponar from the winch cable and place on its side on the boat deck. Remove sediment adhering to the Ponar, pan, and scoop by scrubbing thoroughly with a brush. Rinse the equipment with river water from a submersible pump.

Store sampling equipment inside the cabin of the boat when sampling is completed daily.

Equipment List

Quantity	Equipment
24	Quart glass wide-mouth bottle with plastic cap
14	LIMS labels (Stations 1, 2, 5, 8, 12, 18, 23, 28, 32, 35, 38, 41, 44, and 48)
2	9- X 9-inch Ponar grab
2	2 inch diameter tapered nylon bottlebrush, 16-inch handle length
2	Submersible pump (18 gallons/minute) with quick connect and attachment rope
2	25 foot length nylon braid reinforced 3/4-inch PVC tubing with quick connect for pump
2	25-foot extension cord with GFCI
4	Pair PVC-coated, foam-insulated gloves
1	6- X 6-inch Ponar grab
2	50 foot length 1/2-inch nylon line with snap shackle fastener
2	6 ounce polyethylene scoop
2	High density polyethylene pan (20- X 15- X 5-inch)

PROCEDURES FOR OPERATION OF YSI® 6600 WATER QUALITY MONITOR

Laboratory Procedures

Inspect the dissolved oxygen (DO) sensor membrane under a compound microscope with 10X to 30X magnifications. Inspection should include the following:

1. Remove deposits from the subject membrane by gently moving back and forth over the membrane with a foam tipped swab saturated with non-phosphate laboratory detergent.

2. Remove bubbles in the electrolyte solution under the membrane by replacing the DO probe membrane and electrolyte.

3. Remove wrinkles or holes in the membrane by replacing the membrane and electrolyte.

4. Examine the DO sensor anodes for corrosion (discoloration of silver surface). Remove corrosion by following instructions in Section 2.10.2 of the YSI Incorporated, 6-Series Environmental Monitoring Systems Operation Manual® (Operation Manual). Following resurfacing, the anodes should be conditioned by connecting the monitor to a PC with ECOWATCH® software. Operate the DO probe in the "Discrete Sample" mode for five minutes.

Prepare the YSI® 6600 water monitor (monitor) for calibration according to instructions in Section 2.6 of the Operation Manual.

Calibrate DO, pH (pH 7 and pH 10), specific conductivity, turbidity (0 and 100 NTU), and chlorophyll according to instructions in Section 2.6.1 of the Operation Manual. The temperature sensor calibration is fixed. However, the sensor should be checked with a calibrated thermistor thermometer. At least two days before the field measurements, complete the DO calibration in order that the holding tank DO readings logged by the monitor can be checked for stability.

Following the DO calibration, return the monitor to the "Unattended Sample" mode with the logging interval at one hour. At least twice a day, check the DO value recorded by the monitor with the Winkler DO value measured in the tank. Calibration isn't required if the DO value recorded by the monitor is ±0.4 mg/L compared to the Winkler DO value.

In the laboratory, attach a field cable and YSI 650 MDS® display/logger (YSI 650) to the monitor. Verify that the YSI 650 is operating. Instructions on the operation of the YSI 650 is described in the YSI Incorporated, 650 MDS Operation Manual® (650 Manual).

Check the voltage of individual batteries in the monitor. The voltage of each battery should be equal or greater than 1.2 volts. Additionally, the voltage for the YSI 650 should be above 5.5 volts. Replace batteries as needed.

Generate a log file with a 49-site list in the YSI 650 according to instructions for "Logging of Data from Several Different Sites to the Same File-Use of a Multi-Site List" in Section 3.4.3.3 of the 650 Manual.

Field Procedures

When stored overnight on the boat, place the monitor in a covered, 10-gallon, gray, plastic holding tank. Rest the monitor in an upright position. A 4-inch diameter hole in the tank cover will accommodate the monitor. On the Friday before initiation of field monitoring, fill the tank with tap water to within 5 inches of the top. It should be noted that the sensors are very fragile and can be easily damaged. Carefully remove the calibration cup from the monitor when replacing the cup with a probe guard.

Before operating the monitor, attach the field cable and YSI 650 to the monitor. Following daily monitoring activities, disconnect the field cable from the monitor. Replace the dust cap on the monitor connector port.

Daily before monitoring is initiated, measure the DO in the holding tank using the Winkler DO Method. Calibrate the DO value recorded by the monitor using the Winkler DO value. Access the calibration menu with the YSI 650. Additionally, calibrate the DO sensor a second time at approximately 3:00 PM daily. Measure the DO in the bucket using the Winkler DO Method. Calibration isn't required if the monitor DO value is ±0.4 mg/L compared to the Winkler DO value.

Check the pH 7 and 10 calibrations daily, before monitoring is initiated. Adjust the pH values measured by the monitor with the buffer values. Access the calibration menu with the YSI 650.

Before operating the monitor, adjust the depth sensor to zero at the water surface. At each monitoring station, verify that the water depth reads zero before lowering the monitor into the water.

The chlorophyll, specific conductivity, and turbidity sensors aren't calibrated in the field.

Check all connections between the monitor, field cable, and YSI 650. Special attention should be given to the connection between the field cable and the monitor. Examine the subject O-rings daily for wear or damage. Replace O-rings as needed.

Measurements at each monitoring station must be conducted while the boat is traveling slowly with almost no headway through the water. Don't confuse the water movement observed relative to the shore that is related to the current.

Approximately five minutes before arriving at the monitoring station turn on the YSI 650. Observe the stability of the water quality value measurements.

The monitor bail must be attached to the strain relief on the field cable. Secure excess field cable to the boat in order to avoid loss of the monitor, cable, and YSI 650.

To avoid entangling the monitor in the boat propellers, conduct water quality measurements next to the pilot house.

At each monitoring station, lower the monitor slowly into the water using the field cable. When the depth sensor port is just above the water surface, verify that the depth display reads zero feet. If necessary, adjust the depth reading to zero. Continue lowering the monitor until the depth display reads three feet.

At the three-foot depth, check the stability of the turbidity sensor. If the subject measurement is not constant, activate the mechanical wipers on the sensor. Activate the wipers by highlighting "Clean optics" in the data display window of the YSI 650, and pressing the "Enter" key.

Following stabilization, highlight "Log one sample" in the data display window, and press the "Enter" key on the YSI 650. A list of monitoring stations will appear in the data file. Select a station by scrolling and locating the subject station. Press the "Enter" key to store measurements for DO, pH, specific conductivity, turbidity, and water temperature.

As an additional safeguard, record all field measurements on a form entitled "Water Quality Constituents Measured with YSI 6600 Water Quality Monitor." The subject form is available in the "Illinois Waterway" folder of the "Benthos" folder on "server \\Mwrd\Eagle\Stickney\R&D."

Following the field measurements, retrieve the monitor from the water. Place the monitor in a 2-gallon bucket filled with river water. Turn off the power on the YSI 650.

Store the monitor, field cable, and display/logger in the cabin on the boat following field monitoring activities.

Upon return to the laboratory, upload the data file from the YSI 650 to a PC following instructions in Section 3.5.3 of the 650 Manual. The uploaded file will copy to server "\\Mwrd\Eagle\Stickney\R&D\Benthos\ECOWWIN." View the data with ECOWATCH®. Export the subject data file from ECOWATCH® to EXCEL® as a comma-delimited file. Instructions for exporting comma-delimited files from ECOWATCH® are described in Section 4.3.1 of the Operation Manual. Following review of the field measurements, the monitoring data is entered into LIMS.

ILLINOIS WATERWAY MONITORING PROJECT
QUALITY ASSURANCE PROJECT PLAN

APPENDIX II

EXHIBIT I
ILLINOIS WATERWAY PROJECT

Exhibit 1

Illinois Waterway Monitoring Project
Metropolitan Water Reclamation District of Greater Chicago

WATERWAY: Illinois River DATE:________________

STATION NUMBER: 12 LIMS CODE: ILWW12 RIVER MILE: 269.9

STATION DESCRIPTION: Below the Dresden Lock & Dam. Line up on Divine Daymark # 269.9.

GPS LOCATION: N. LAT.: 41° 23.530′ W. LONG.: 88° 18.540′

WATER SAMPLES

WATER SAMPLING LOCATION (ASCENDING): LEFT CENTER RIGHT

DEPTH:__________ TIME:_________ TEMP:_________°C pH:__________

GENERAL CHEMISTRY CYANIDE NUTRIENTS PHENOL

FECAL COLIFORM TRACE METALS SOLUBLE METALS

SAMPLED BY: __________________________ LIMS ID #______________

SEDIMENT SAMPLES

DESCRIPTION	ROCK:________%	PEBBLE:______%	GRAVEL:_______%
(OBSERVED)	SAND:________%	CLAY:________%	SILT:_________%
	SLUDGE:______%	PLANT:_______%	OTHER:________%

SEDIMENT COLOR:_________________ ODOR:________________________

OBSERVED OIL IN SEDIMENT: NONE LIGHT MEDIUM HEAVY

SAMPLED BY: ________________________________

WEATHER

TEMPERATURE:______°C WIND DIRECTION: N NE E SE S SW W NW

WIND SPEED:________________MPH

CONDITIONS: CLEAR SUNNY DARK CLOUDY RAIN SNOW

COMMENTS: