Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

MONITORING AND RESEARCH DEPARTMENT

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ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

2010

ANNUAL REPORT

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100 East Erie Street * Chicago, IL 60611-2803 * (312) 751-5600

ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

2010

ANNUAL REPORT

Monitoring and Research Department
Thomas C. Granato, Director

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DISCLAIMER

STRUCTURE AND RESPONSIBILITIES OF THE ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

The Environmental Monitoring and Research Division (EM&RD) has 65 employees, and is comprised of five Sections. These are illustrated in Figure 1 and Appendix V with a breakdown of the number of employees. The five Sections are:

1. Administrative
2. Wastewater Treatment Process Research
3. Biosolids Utilization and Soil Science
4. Analytical Microbiology and Biomonitoring
5. Aquatic Ecology and Water Quality

The major areas of focus of the Division were as follows:

- Monitoring the environmental quality of Lake Michigan, area rivers and canals, and the Illinois River to document the effectiveness of the Metropolitan Water Reclamation District of Greater Chicago's (District) wastewater treatment program.

- Assisting in the resolution of sewage treatment and solids disposal operation problems.

- Providing technical assistance to other departments and agencies with respect to issues related to wastewater treatment; combined sewer overflow (CSO) management; waterways management; and solids processing, utilization, and marketing.

- Conducting applied and operations research to achieve improvement and cost reductions in District wastewater treatment, waterways management, and solids processing and biosolids utilization activities.

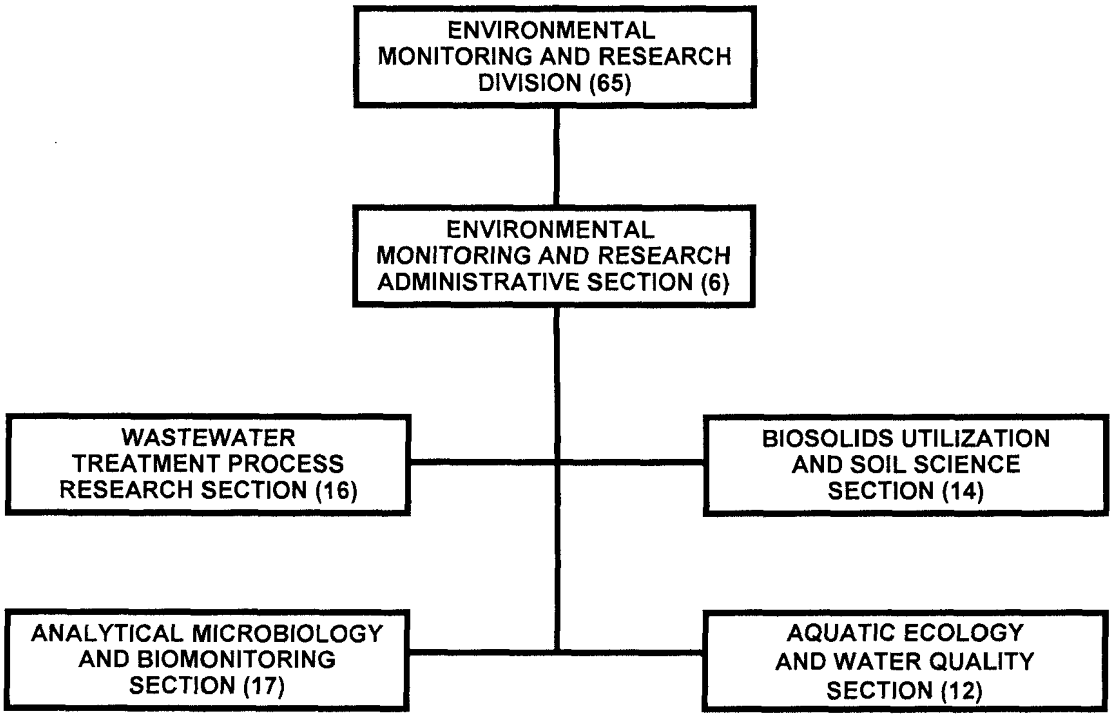
- Assessing the impacts of new or proposed regulations on District activities. Notably in 2010, the Division continued formulating the District's case in the Illinois Pollution Control Board (IPCB) Rulemaking R08-9 Chicago Area Waterway System (CAWS) Use Attainability Analysis.

- Generation and transmittal of environmental monitoring reports to regulatory agencies to ensure compliance with requirements of Tunnel and Reservoir Plan (TARP), water reclamation plant (WRP) National Pollutant Discharge

- During 2010, EM&RD participated in numerous Meetings and Seminars (Appendix I), presented several papers, Power Point presentations, and poster presentations (Appendix II), and also published several papers (Appendix III).

FIGURE 1

ENVIRONMENTAL MONITORING AND RESEARCH DIVISION
ORGANIZATION CHART



ADMINISTRATIVE SECTION

ADMINISTRATIVE SECTION

The Administrative Section provides technical guidance, scientific review, and administrative support for the work being carried out by EM&RD staff. The Section also organizes a monthly seminar series, open to all District employees and interested public individuals through prior registration, which presents information on areas of interest to the District operations. In 2010, 1,698 people attended these seminars. A list of the seminar topics is shown in Appendix IV.

In addition to the overall administrative and supervisory functions performed by the Administrative Section, the Experimental Design and Statistical Evaluation Group and Radiochemistry Group, which are part of the Administrative Section, provided the following support to the rest of the EM&RD.

Experimental Design and Statistical Evaluation Group

The Experimental Design and Statistical Evaluation Group (EDSEG) is responsible for providing assistance in the design of laboratory and full-scale experiments, collection of appropriate data, development of guidelines for data collection methodology, and statistical analyses. Personnel in this section also develop multistage automation programs to interconnect different software programs such as Latex, Visual Basic, SAS, Access, Excel, Outlook, and PowerPoint. This computer automation has enabled the section to produce reports, tables, and texts in suitable designs, and to respond to many requests in a shorter period of time.

Statistical and Computing Support. During 2010, a Biostatistician provided statistical and computing support to various projects. The following is a description of some of the activities.

1. Statistical support was provided to the Analytical Microbiology and Biomonitoring Section to study antibiotic resistant bacteria in wastewater. This work is published in Water Science and Technology in 2009.

2. Extensive statistical analyses support was provided on the reduction of sampling frequencies at the District's drying sites.

3. The EDSEG provided data management support to the Biosolids Utilization and Soil Science Section to produce quarterly reports on biosolids management at the District's Biosolids Management Areas in accordance with the Illinois Environmental Protection Agency (IEPA) permit requirements.

4. Drying site reports were produced for the Harlem Avenue Solids Management Area, Lawndale Avenue Solids Management Area, Ridgeland Avenue Solids Management Area, 122^{nd} and Stony Island

Solids Management Area, Calumet East Solids Management Area, Calumet West Solids Management Area and the Hanover Park Solids Management Area for the first, second, third, and fourth quarter of 2010.

5. Statistical support was provided to the Biosolids Utilization and Soil Science Section for research investigating the availability of phosphorus in biosolids.

6. Statistical support was provided to the Wastewater Treatment Process Research Section to assess the polymer dose and total solids cake produced in the post-digestion centrifuge operation.

7. Continuous support is being provided to the Aquatic Ecology and Water Quality Monitoring Section for the production of Continuous Dissolved Oxygen (DO) Monitoring Reports (deep-draft, and wadeable) annually.

8. Statistical support was provided to Aquatic Ecology and Water Quality Monitoring Section on the study of fish abundance in the District's receiving streams.

9. Two Ambient Water Quality Monitoring Exceedance Reports were produced by this Section for first two quarters of 2010.

10. Numerous statistical support was provided to develop comments regarding proposed changes to support IEPA regulations.

11. Statistical support and consulting was provided on data management, automation of reports, etc. to various sections in the Division.

12. Numerous support was provided to individuals working in academics, non-governmental organizations and other agencies who requested data and statistical analyses of District data.

Water Quality Data. Each year, the EDSEG summarizes results of the District's Ambient Water Quality Monitoring program for the CAWS. Surface water quality data for 2010 were evaluated regarding compliance with water quality standards set by the IPCB. In 2010, 67 water quality parameters were analyzed and reported for monthly samples collected from 59 monitoring stations in area waterways impacted by District operations.

General Use Water. In 2010, 30 water quality parameters had IPCB General Use Standards. Two parameters (benzene and total mercury) had IPCB Human Health Standards. Twenty-two water quality parameters were in total compliance with the standards in all river systems. They were temperature, ammonium nitrogen, phenols, weak acid dissociable cyanide, fluoride, gross beta radioactivity, benzene, ethylbenzene, toluene, xylene, total silver, total barium, total boron, total manganese, total selenium, soluble arsenic, soluble cadmium, soluble chromium, soluble iron, soluble lead, soluble nickel, and soluble zinc. Two parameters, benzene and total mercury, were in total compliance due to the Human Health Standard in all river systems.

Of the remaining eight parameters, six parameters (DO, pH, chloride, sulfate, total hexavalent chromium, and soluble copper) had compliance rates greater than 89.0 percent in all river systems. Total dissolved solids had compliance rates of 83.3, 78.4, and 85.8 percent, respectively, in the Chicago, Calumet, and Des Plaines River Systems. Fecal coliform had the lowest compliance rate in the range of 50.3 to 62.5 percent in all river systems.

Secondary Contact Water. Twenty-three water quality parameters measured in the secondary contact waters during 2010 had applicable IPCB standards. Eighteen parameters were in complete compliance with the IPCB standards for the Chicago and the Calumet river systems in 2010. They were temperature; phenols; fats, oils, and greases; total cyanide; fluoride; total silver; total arsenic; total barium; total cadmium; total copper; total hexavalent chromium; total lead; total nickel; total manganese; total mercury; total zinc; total selenium; and soluble iron. The remaining five parameters (DO, pH, un-ionized ammonia, total dissolved solids, and total iron) had compliance rates greater than 93.0 percent in both river systems.

Radiochemistry Group

The Radiochemistry Group is responsible for the radiological monitoring of waters, wastewaters, sludge and biosolids, and the maintenance of radiation safety at the District. It also performs any special tasks involving the use of ionizing radiation and radioisotopes.

Radiological Monitoring of the Chicago Area Waterway System. Radiological monitoring is a part of the overall monitoring program of the water quality within the waterways system of the District. Radiological monitoring involves the determination of gross alpha and gross beta radioactivity of samples collected from the waterways. The program includes the Calumet, Chicago, and Des Plaines River systems comprising 170 miles (273.6 km) of waterways. There are sixteen sampling locations on the Chicago River system, nine on the Calumet River system, and twenty on the Des Plaines River system. Each location was sampled once per month.

The samples were analyzed for gross alpha and gross beta radioactivity by the Eberline Analytical Corporation, Oak Ridge, Tennessee. The data is presented in the 2010 Annual Summary Report Water Quality Within the Waterways System of the Metropolitan Water Reclamation District of Greater Chicago (Monitoring and Research Department [M&R] Report No. 11-59). The concentrations of radioactivity in all samples analyzed were well within the United States Environmental Protection Agency (USEPA) Drinking Water Standards of 15 pCi/L for gross alpha (excluding radon and uranium), and 50 pCi/L (screening level) for gross beta particle activity minus the naturally occurring potassium-40 beta particle activity.

Levels of Radioactivity in Raw and Treated Wastewaters. Radiological monitoring of raw wastewater and final effluent samples from the District's seven WRPs continued in 2010. Data from the monitoring serves as a measure of present-day radioactivity levels in comparison to levels in past years. The IPCB has established General Use water quality standards for radioactivity in the waters of Illinois. According to IPCB regulations, (Title 35, Chapter 1, Section 302.207) gross beta concentration shall not exceed 100 pCi/L, and the strontium-90 concentration must not exceed 2 pCi/L. The annual average radium-226 and 228 combined concentration must not exceed 3.75 pCi/L in General Use waters. There are no IPCB or USEPA radioactivity standards for raw sewage or final effluents. However, the District uses the IPCB General Use waters limits for radioactivity as the reference for monitoring WRP effluent.

The analysis of radioisotopes was conducted on 24-hour composite samples of raw sewage and final effluent collected monthly at all WRPs. The samples were analyzed by Eberline Analytical Corporation, Oak Ridge, Tennessee. The data are presented in the 2010 Annual Report entitled Radiological Monitoring of the Raw Sewage, Final Effluent, Sludge, and Biosolids of the Metropolitan Water Reclamation District of Greater Chicago (M&R Report No. 11-56).

The results show that the amount of gross alpha, gross beta, combined radium-226 and radium-228, and strontium-90 radioactivity in the final effluent is less than the allowable contaminant levels in drinking water standards set by the USEPA National Primary Drinking Water Regulations 40 CFR Part 141. The concentration of radioisotopes in the final effluent is also less than the General Use Water Quality Standards established by the IPCB. The monitoring data indicate that the discharge of the final effluent from the seven WRPs is not likely to have any adverse effect on the radiological quality of the District's receiving streams.

Levels of Radioactivity in Sludge and Biosolids. In 1993, the Radiochemistry Group revised and expanded its radiological monitoring program of District sludge in response to the increased emphasis on monitoring biosolids quality brought about by adoption of the USEPA's Part 503 Sewage Sludge Regulations. Although there are no standards for radioactivity in these regulations, it was felt that the District should expand its database on the radiological characteristics of its sludge and biosolids as a result of incidents that occurred at other publicly owned treatment works where high levels of radioactivity were discovered in sludges and incinerator ash.

During 2010, sludge or biosolids samples were collected monthly at all WRPs. Biosolids samples were also collected monthly from the solids drying sites of the District from May through September. The samples were analyzed for gross alpha and gross beta radioactivity by the Eberline Analytical Corporation, Oak Ridge, Tennessee.

Sludge and biosolids samples were also analyzed for eleven gamma-emitting radionuclides with a potential for reconcentration in biosolids. Only two of these radionuclides (radium-226 and potassium-40) were detected at measurable levels. Both of these radionuclides are of natural origin. The 2010 data are presented in M&R Report No. 11-56.

Radiation Safety. The Radiochemistry Group maintains a radiation safety program for the District. The District possesses a radioactive material license from the Illinois Emergency Management Agency, Division of Nuclear Safety (IEMA-DNS). The radiation protection program is conducted in accordance with the license conditions and regulatory requirements of IEMA-DNS. The program includes:

- maintaining the IEMA-DNS radioactive material license;
- managing low-level radioactive waste;
- monitoring personnel for radiation exposure;
- testing the operation of radiation survey meters;
- leak testing the radioactive sealed sources; and
- maintaining a physical inventory of licensed radioactive materials.

The Illinois Low-Level Radioactive Waste Management Act requires all generators and brokers of low-level radioactive waste in Illinois to file an annual survey with the IEMA-DNS. In 2010, the relevant forms were received from the IEMA-DNS, completed, and returned to the IEMA-DNS.

The monitoring of District employees for radiation exposure was carried out using dosimeter badges and finger ring dosimeters. The dosimeters are worn by the users of moisture/density gauges. No District employee was exposed to an overdose of radiation in 2010.

The operational checks of radiation survey meters were carried out on the day radioactive materials were used or at least once a quarter. A record was maintained for the operational checks of radiation survey instruments.

In accordance with IEMA-DNS regulations, radioactive sealed sources are tested for leakage or contamination at intervals not to exceed six months. All of the radioactive sealed sources used by the District personnel were tested for leakage twice in 2010.

Nickel-63 sources constitute a part of the electron capture detectors of gas chromatographs used by M&R. Leak tests were performed on six detectors from three gas chromatographs in 2010. No leaks were discovered in any of these detectors.

The APD2000 Chemical Warfare (CW) detector is equipped with a nickel-63 sealed source. Leak tests were performed in 2010 on the APD2000 CW Detector owned by the Safety Section of the Human Resources Department. No leaks were discovered in these detectors.

Leak tests were also performed on four Troxler surface moisture/density gauges used by the Construction Division of the Engineering Department. No leaks were discovered in any of these gauges in 2010.

A physical inventory of the radioactive sealed sources possessed by the District was carried out twice in the year 2010. A record of this inventory was maintained as per license requirements.

WASTEWATER TREATMENT PROCESS RESEARCH SECTION

WASTEWATER TREATMENT PROCESS RESEARCH SECTION

The Wastewater Treatment Process Research (WTPR) Section mission is to provide technical support to the Maintenance and Operations Department (M&O) and Engineering Departments (Engineering), to conduct applied research regarding both current treatment processes and new technologies, and to conduct regulatory monitoring, reviews, and develop technical information for pending regulations. Technical assistance is provided to M&O for solving WRP operating problems. The investigation of current operations may originate as the result of a WRP problem, or interest in arriving at new knowledge concerning some aspect of a wastewater treatment process. Plans and specifications are also reviewed at the request of Engineering for the purpose of optimizing process design criteria.

The Section is responsible for conducting basic, applied, and problem-solving research on various wastewater and sludge treatment processes currently utilized by the District. This Section also investigates innovative treatment processes for potential future use. Studies of new technologies address maximizing the efficiency of an existing process at the lowest cost or the development of new processes. Investigations may take the form of surveys, literature reviews, laboratory bench-scale testing, pilot-plant studies, full-scale testing, special analyses, or a combination or progression of any or all of the above.

The major areas of study in 2010 included the following.

Technical Support to the Maintenance and Operations Department for Plant Operation Needs

In 2010, the WTPR Section assisted M&O in plant operations through the following projects.

Polymer Tests at the Stickney Water Reclamation Plant. Full-scale tests were conducted at the Stickney WRP post-centrifuge dewatering complex during September/October 2010 for the selection and purchase of summer polymer used in the post-digestion centrifuge dewatering process.

During 2010, a total of six polymers from three manufacturers were submitted and tested at full scale followed by bench-scale tests. The polymers that do not produce a minimum of 95 percent solids capture during full-scale testing are disqualified from competing for the Stickney dewatering polymer contract. All six polymers were found to be eligible for bidding for summer polymer purchase for dewatering application. Table II-1 lists the polymers eligible for bidding, along with the sludge cake solids and dosages determined from the testing program. The polymer that passes the test performance criteria as described in the bid documents and has the lowest cost for conditioning per unit mass of sludge is the polymer of choice for purchase. The test results were transmitted to M&O via memorandum dated March 7, 2011.

Polymer Tests at the Calumet Water Reclamation Plant. In October 2010, bench-scale polymer testing was carried out at the Lue-Hing Research and Development Complex for the selection and purchase of polymers used in the gravity concentration tanks to thicken the primary and waste-activated sludge at the Calumet WRP. A total of two polymers from the same manufacturer were submitted and tested. The polymers that do not meet the performance requirement are disqualified from competing for the polymer contract. Both submitted polymers were found to be eligible for bidding for thickening operations at the Calumet WRP. Table II-2 lists the polymers eligible for bidding, along with the dosages determined from the testing program. The polymer that passes the test performance criteria as described in the bid documents and has the lowest cost for thickening per unit mass of sludge is the polymer of choice for purchase. The test results were transmitted to M&O via memorandum dated December 6, 2010.

Excess Flow Disinfection Improvement Study for the John E. Egan Water Reclamation Plant. The goals of the disinfection improvement study were to determine the causes of fecal coliform (FC) exceedence of the excess flow discharge at the John E. Egan (Egan) WRP and to develop operations procedures to consistently meet the NPDES permit limit of 400 colony forming units (CFU)/100 mL. The main objective of the study was to evaluate factors influencing disinfection efficiency. The factors evaluated were mixing intensity, contact time, temperature, and suspension of solids. The chlorine doses for each trial ranged from two to five mg/L. The batch tests were conducted from August through December 2010 with Egan WRP primary effluent.

The batch tests evaluated temperature, contact time, solids suspension during contact, and initial mixing intensity. Of the factors evaluated, initial mixing intensity appears to have the most significant impact on disinfection efficiency. An adequate amount of total residual chlorine following insufficient initial mixing may lead to false confidence in FC reduction.

A detailed description of the tests and result analyses will be documented in an M&R Report in 2012.

Metropolitan Water Reclamation District of Greater Chicago - Wide Aeration Tank Performance Survey. A District-wide aeration survey was conducted at all seven District plants during the late summer and fall of 2010. The objective of the study was to evaluate and compare the energy efficiency of aeration tanks at the seven District WRPs. At each plant, profile sampling was completed in a minimum of one tank from each battery at least three times during the study. Profile sampling included the measurement of DO, ammonia nitrogen (NH_3-N), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), mixed liquor suspended solids (MLSS), mixed liquor volatile suspended solids (MLVSS), and phosphorus (P) down the lengths of the aeration tanks. Operational parameters were also collected for the evaluations.

Profile sampling for the aeration tanks consisted of in-situ DO concentration and temperature measurements along with sample collection at seven equidistant locations (nine locations at the Stickney WRP) per each tank surveyed. At least one tank from each battery at each WRP was included in this project, except for the aeration batteries that were not in service during the field sampling. Profile sampling for each selected tank was repeated at least three times on three different days. The field sampling was conducted between September 7 and November 16, 2010. Following field sampling, pertinent and historical operational data were collected, along with pertinent analytical data for these aeration tanks. The evaluation of the data will be completed in 2011 and the details of this project, including methodology, sampling results, conclusions, and recommendations, will be documented in an M&R report.

Assessment of Odor and Corrosion in the Metropolitan Biosolids Management Recycle Line. M&R conducted sampling and analysis of the flow in the recycle line of the Metropolitan Biosolids Management (MBM) pelletizer facility to evaluate the odor emissions and corrosion potential in the conduit running from MBM to the District sewer at the Stickney WRP from December 14, 2009, to January 13, 2010. A total of seven samples were taken during the seven sampling events, and the results of analysis were transmitted to M&O. This monitoring was made for total sulfide and dissolved sulfide concentrations as well as direct headspace hydrogen sulfide (H_2S) measurement using an OdaLog at the manhole that directly takes the recycle from the MBM facility. The average concentrations for dissolved and total sulfides were 9.3 mg/L and 11.3 mg/L. The range of H_2S concentrations in the headspace were 0 and 404 parts per million by volume (ppm_v). Total sulfide and dissolved sulfide concentrations at the manhole are given in Table II-3. The results of the direct monitoring from the manhole using OdaLog showed elevated H_2S levels in this specific manhole, which was on average 12 times higher than the threshold values for corrosion of the concrete based on Water Environment Research Foundation (WERF) Report #04-CTS-1. M&R has established routine ambient monitoring in the vicinity of the manhole to inform M&O regarding possible high level H_2S emissions.

Other Activities Supporting Maintenance and Operations Department Plant Operations. The WTPR Section provided assistance to Stickney WRP operations during June 2010 to investigate floating solids in secondary clarifiers in Batteries A and B. The investigation identified that denitrification was the cause of floating solids. Settling and sludge volume index tests and microbiological analyses were performed to confirm the findings. Investigation results were immediately communicated with the Stickney WRP via emails.

The WTPR Section teamed up with the Analytical Microbiology and Biomonitoring Section and provided assistance to Calumet WRP operations throughout 2010 to mitigate foaming problem in the digesters. Support included microbiological analyses, foaming potential and related tests in WTPR laboratories.

Providing Technical Support to the Engineering Department for Planning and Design Requests

Support to the Engineering Department for the Hanover Park Water Reclamation Plant Master Plan Study. The WTPR Section provided technical support to Engineering for the Hanover Park WRP Master Plan Study. The study evaluates alternatives for improving and updating the infrastructure and process facilities to meet future needs. In 2010, the support included attending meetings to discuss two approaches for future design, status quo versus a network approach. The steady-state and dynamic GPS-X models were also reviewed in 2010.

Odor Management and Corrosion Control in Select Interceptors in the James C. Kirie Water Reclamation Plant Service Area (Phase II). The second phase of this study was initiated to determine the kinetics of Bioxide® (a nitrate salt) to optimize the dosing level and the possible locations for Bioxide® injection along Upper Des Plaines (UDP) interceptors 14A, 14B, and 20B leading to Drop Shaft 5 (DS5).

For Phase II of this study, a bench-scale test was conducted on nine samples that were taken during March 2010 from a single station immediately upstream of the present Bioxide® injection point where the average headspace H_2S concentration was higher than at other locations in the interceptor based on the results of Phase I of the study. During the sampling for Phase II, the headspace H_2S concentration was also measured at this station. The average and maximum H_2S concentrations were 8 ppm_v and 45 ppm_v, respectively.

Out of nine samples taken from the interceptor at the sampling location and examined for oxidation-reduction potential (ORP), only four samples showed initial ORP values that indicated an onset of anaerobic condition (<-50 millivolts [mV]) in the interceptor.

The bench-scale tests, in which 0 to 2,500 µL/L of Bioxide® was dosed, showed that except for very high doses of Bioxide® (1,000 and 2,500 µL/L), which is equivalent to roughly 8,000 to 9,000 gallons/day dosing in UDP 14A, no noticeable difference between the control (with no Bioxide®) and other samples was observed. Based on these results, the mechanisms of the reaction are more complicated than bench-scale tests can demonstrate.

The summary of the results of the bench-scale test is as follows:

1. Based on the results of Phase I, which showed that Bioxide® is effective in minimizing H_2S generation, and considering the average hydraulic residence time (HRT) of 125 minutes from the sampling station to a station in the vicinity of DS5 for an average flow of five million gallons/day, injection of Bioxide® to the flow stream will not be effective beyond two miles downstream of the sampling location.

2. In order to remove H_2S effectively along the interceptor from the Bioxide® injection point to DS5, two more Bioxide® injection points, one upstream and one downstream of the present injection point, with 75–80 gallons/day Bioxide® at each location is recommended. The total volume of Bioxide® will not exceed 300 gallons/day. Multi-dose and multi-injection points should prove more beneficial than single location injection to provide sufficient residence time for the Bioxide® to react.

3. Side-by-side examination of Bioxide®, Golden Eagle calcium nitrate (GE $Ca(NO_3)_2$), ferric chloride ($FeCl_3$), and Byo-Gon® (a biostimulant) to evaluate the effectiveness of each compound in removing H_2S from the sewer headspace environment was recommended.

Following Bioxide® dosing tests with the field-collected samples, different chemicals and their effect on H_2S were evaluated through laboratory headspace tests in order to address concerns of odor abatement, H_2S generation, and corrosion in the District interceptors. Different concentrations of Bioxide®, GE $Ca(NO_3)_2$, $FeCl_3$, and Byo-Gon® were evaluated. The diluted sludge mixture was used in the tests and analyzed for total solids, five-day biochemical oxygen demand (BOD_5), NO_3^--N, sulfate (SO_4^{2-}), total sulfide (TSulf), dissolved sulfide, ORP, DO, temperature, and pH prior to dosing. The dilute sludge was then added to a respirometer bottle, dosed with the chemical additive, and mixed. H_2S headspace concentrations were measured periodically over the course of three hours. The diluted sludge was then analyzed for NO_3^--N, SO_4^{2-}, and TSulf after testing. There were no direct correlations between any single initial water quality parameter concentration and initial H_2S concentrations. However, a combination of the following indicated elevated H_2S concentrations: high total suspended solids (TSS), BOD_5, and SO_4^{2-} concentrations, low DO concentrations, elevated temperatures, and ORPs below -50 mV.

Bioxide® and GE $Ca(NO_3)_2$ performed similarly as they are both essentially calcium nitrate (Figures II-1 and II-2). The control (no dose) for each treatment group showed increasing H_2S concentrations over the three-hour study period, whereas the additive treatments indicated decreases in H_2S concentrations over the same time frame. However, the additives were consumed during the three-hour testing period. At the lower additive doses, i.e. 10, 50, and 100 µL, H_2S concentrations eventually decreased. At the highest doses, 250 µL and 500 µL, nitrate was still available to suppress H_2S generation even after three hours. By hour three, the control treatment had increased in H_2S concentration by 356 percent whereas the 500 µL Bioxide® treatment had decreased it by 84 percent. In the GE $Ca(NO_3)_2$ treatment evaluation, the control treatment had increased in H_2S concentration by 96 percent whereas the 500 µL GE $Ca(NO_3)_2$ treatment had decreased by 87 percent.

$FeCl_3$ also showed the ability to reduce H_2S concentrations via sulfide oxidation and precipitation (Figure II-3). In the $FeCl_3$ evaluation, the control treatment was observed to decrease in H_2S concentrations over the three-hour monitoring period. However, the $FeCl_3$ treatments were observed to decrease to a greater degree. By hour two, the control had decreased in H_2S concentration by 41 percent whereas the 2500 µL $FeCl_3$ treatment had decreased by nearly 100 percent. Byo-Gon® was also evaluated but failed to reduce H_2S concentrations. In all treatments, including the control, the H_2S concentration remained elevated over the course of the monitoring period (Figure II-4).

Given the results of this study, either Bioxide® or GE $Ca(NO_3)_2$ at a dose of 250 µL provides the most viable measure to reduce H_2S for a period of three hours. While $FeCl_3$ does suppress H_2S generation, acidic conditions and increased solids via ferric precipitates will occur, which in turn disrupts the availability of SO_4^{2-} to the microorganisms to produce more H_2S. Additional bench-scale testing will be conducted to study the concentration of Bioxide® and GE $Ca(NO_3)_2$ needed to suppress the generation of H_2S at the optimum cost.

Support for Studies Related to Gas Utilization at the Stickney, Calumet, and Hanover Park Water Reclamation Plants. In support of the feasibility studies to capture and utilize the excess digester gas, the WTPR Section provided assistance in collection, analysis, and interpretation of results of analysis for gas samples collected at these WRPs to Engineering and the consultant, Malcolm Pirnie, Inc. The WTPR Section addressed concerns about the change in gas constituents and siloxane concentrations upon conveyance of digester gas through a long pipeline between the compressor room and the boiler room at the Stickney WRP. M&R had also actively participated in meetings, reviewed study documents, and made recommendations on digester gas utilization to Engineering and M&O.

The gas sampling was made at the compressor room and boiler room at the Stickney WRP. At the Calumet WRP the samples were taken at the location of Digester Number 6 and flare tower, and at the Hanover Park WRP the samples were taken at the Digester Number 4 and flare tower. The samples were taken on four separate occasions (June and September 2010 and March and April 2011) and analyzed for major gas constituents including methane (CH_4) and carbon dioxide (CO_2), sulfur compounds including H_2S and total sulfur, volatile organic compounds (VOCs), siloxanes, and the dry heating value of the digester gas. The gas analysis for all compounds but siloxanes was performed by Analytical Solutions, Inc., and siloxane analysis was performed by two laboratories, Analytical Solutions and the Gas Technology Institute (GTI) due to the lack of a standard method for this analysis to gain assurance on the accuracy of the results. In general, the results from Analytical Solutions were higher than the results reported by GTI. The siloxane congeners D4 and D5 concentrations for the Stickney WRP ranged from 0.71–3.39 ppm_v for D4 and 0.37–5.41 ppm_v for D5. For the Calumet WRP, D4 ranged from 3.29–5.14 ppm_v, and D5 ranged from 1.70 to 8.14 ppm_v. The concentrations of D4 and D5 for the Hanover Park WRP ranged from 0.58–1.43 ppm_v and 4.42–8.38 ppm_v, respectively. The ranges of concentrations for siloxanes appeared to be always higher from one of the laboratories. The results of this monitoring showed that H_2S level detected at the digesters were lower than the usual range of 300–1,000 parts per million, the major VOC detected in all plants was toluene, and siloxane congeners D4 and D5 were the most dominant congeners in the digester gas. The dry heating value of the digester gas ranged from 626–654 British thermal units (Btu)/cubic foot (cf) for the Stickney WRP, 612–652 Btu/cf for the Calumet WRP, and 610–671 Btu/cf for the Hanover Park WRP, which are all in the typical range for wastewater treatment plant anaerobic digesters. The results of analysis were transmitted to Engineering in 2011.

Grit Sampling at the North Side Water Reclamation Plant. In support of computational fluid dynamics modeling of the aerated grit tanks at the North Side WRP that was done by the University of Illinois at Urbana-Champaign, grit samples from the raw influent wastewater were collected in the fall and winter of 2010. To collect a grit sample, a sampling device was designed and built. The sampling device consisted of a submersible pump with screen, hosing, and a rectangular chamber with baffles and roughly 3.88 (length) by 2 (width) by 1.94 (depth) feet in size. A schematic of the chamber is shown in Figure II-5. The submersible pump was located just downstream of the raw influent pumps and upstream of the channel feeding the grit tanks. A screen at the suction section of the pump was required to prevent clogging of the pump with rags and debris not caught by influent course screens. A schematic of the pump location is shown in Figure II-6.

To collect a grit sample, raw influent was pumped into the sampling chamber via the submersible pump, the raw influent traveled through the chamber and then exited over a weir. The flow rate of the raw influent entering the chamber was controlled to maintain an HRT of less than five minutes. During the testing, the HRT ranged between 3.4 and 5.6 minutes. Three grit samples were collected by pumping raw influent through the chamber for eight to ten days. After the eight to ten days, the pump was turned off and the chamber slowly decanted so as not to disturb any grit collected. Once drained sufficiently, the grit was poured into a sample bottle. Water was used to get as much grit out of the chamber as possible.

Once in the laboratory, the sample was allowed to settle and the supernatant was discarded. The sample was placed in drying trays and placed in a fume hood until all the water evaporated. Once the sample was dry, it was weighed and then ignited at 550°C to remove the organic content. Once cool, a dry sieve analysis was completed to determine the size distribution of the particles. The sieve analysis results for the three samples collected are provided in Tables II-4 to II-6, and operating data for both the plant and grit sampling chamber are provided in Table II-6 to II-9. A memorandum report including the results from the sampling was prepared and transmitted to Engineering in December 2010.

Digester Mixing Study at the Calumet Water Reclamation Plant. Mixing is one of the most important physical factors that affect the anaerobic digestion process. To evaluate the effectiveness of mechanical mixing, six mechanical digester sludge mixers were installed on the floating cover of digester number 5 at the Calumet WRP. The sampling for this study was conducted from February 2009 through November 2009. The analytical and operational data were collected and analyzed. A memorandum report was prepared in 2010 and transmitted to Engineering.

Stickney Water Reclamation Plant Permeable Pavements Evaluation. The EM&RD staff is investigating the effect of stormwater flow and pollutant load reduction in three different permeable pavement lots compared to a control lot at the Stickney WRP. The permeable lots examined are: (1) a permeable paver lot (PP); (2) a permeable concrete lot (PC); and (3) a permeable asphalt lot (PA). On April 20, 2010, the second year of the effort to evaluate the four surfaces with respect to stormwater flow and pollutant load reduction at the Stickney WRP was initiated. The four lots were still in good condition from their construction in 2008 with some minor vegetation, raveling, cracking, and scours from snow plows. However, the PP lot was also showing chipped pavers, lost fill, and surface depressions which may affect lot performance.

Rainfall, subsurface water levels, infiltrated flow, and total flow were continuously measured for each lot through November 15, 2010, except for June 26 through October 21, 2010, due to power loss. A total of 36.7 inches of rainfall was estimated over the course of the entire monitoring season (Figure II-7). Increased water levels within the lots and infiltration flows during rainfalls suggested that significant infiltration was occurring at the permeable lots during rainfall events (Figures II-7 and II-8). However, due to the unreliability of the data collected via the flow and subsurface water level meters and potential unknown water sources such as sublateral flows, comparisons between the infiltration potential of the lots could not be made.

However, results from infiltrometer tests did indicate that all three lots could accept over one inch of rainfall per second before runoff would occur (Table II-10). The PC lot had the highest infiltration capacity, and the PP lot had the lowest. Infiltration capacities measured in 2010 were slightly lower than the 2009 results, possibly due to clogging. However, no standing water or runoff was ever observed during site visits during wet weather.

The lower pollutant concentrations observed in the permeable lots relative to the control lot during the 2009 monitoring season was not observed during the 2010 monitoring season (Table II-11). It is suspected that infiltrated pollutants are entering the sampling system through the perforated drain pipes and leaking catch basins making it difficult to compare the different permeable lots.

Numerous troubleshooting efforts during the off-season to retrofit the system design and flow measuring equipment were performed in order to collect accurate flow data and stormwater samples in 2011. An attempt to understand the water input and subsurface hydrology will also be made. Additionally, the monitoring plan may be altered to provide better data.

Evaluating Two Different Aeration Systems at the John E. Egan Water Reclamation Plant. This project was initiated to compare the operational efficiency of two different aeration systems at the Egan WRP: full floor, fine bubble, disc ceramic diffusers in a tapered configuration in the North Aeration Battery and the original, spiral roll aeration system using square ceramic diffusers placed on one side of the aeration tank in the South Aeration Battery. Major field testing which included process oxygen transfer efficiency (OTE) measurement using the off-gas technique and profile sampling along the length of aeration tanks to evaluate oxygen uptake rates (OURs), nitrification, and DO distribution was completed in 2007. Supplemental field tests on process OTE measurements were conducted in 2008, 2009, and 2010.

The supplemental field tests conducted in 2009 and 2010 involved a comparison of the standard oxygen transfer efficiency (SOTE) determined using three different off-gas hood configurations to verify the experimental method used in the 2007 testing. Specifically, the supplemental tests examined whether the size and location of the hood had an impact on the measured oxygen transfer efficiency. The three configurations examined are shown in Figure II-9. The first configuration included a small hood, 3 feet by 6 feet, with an angular side which fit under the side wall of the aeration tank. The second configuration included the small hood as described in the first configuration, with a 10 foot by 3 foot hood behind so that a greater width of the tank was sampled. The third configuration included the large hood, 10 foot by 3 foot, along the side wall of the tank.

The supplemental field tests conducted during 2010 took place on nine days during September and October. Two to four tests were completed at five different locations down the length of one aeration tank in the South Battery, resulting in a total of 15 tests. One test comprised of testing all three hood configurations, one right after the other, so that conditions were relatively the same and results for each hood configuration could be compared at a specific location.

Of the three configurations, the second configuration using the two hoods (and a weighted average SOTE) resulted in higher SOTE results. On average the percent SOTE measured via the second configuration was 0.73 higher than the first configuration and 0.37 higher than the third configuration. Although not a configuration by itself, the large hood by itself and positioned in the middle of the tank width (as shown in second configuration) resulted in the highest percent SOTE measurements, 2.69 and 2.32 times larger than the first and third configuration, respectively.

More detailed results and analyses will be included in the M&R Report for this project, which is expected to be completed in 2012.

GPS-X Modeling of the North Side Water Reclamation Plant. A steady-state model of the North Side WRP was developed by CTE|AECOM using the GPS-X software as part of a Master Plan completed in 2007. The model will be further developed into a dynamic model. To calibrate and validate the dynamic model, special discrete sampling was completed in 2009 and 2010 to get discrete raw influent and effluent concentration data. Hach's Sigma refrigerated automatic samplers were used to sample the influent just upstream of the primary settling tanks and the final effluent just upstream of the discharge into the receiving water body.

The special discrete sampling included dry weather and weather events. Three dry weather events were sampled on January 25, 2010, February 22, 2010, and July 26, 2010. Each dry weather event consisted of two-hour composite sampling of the raw influent and treated effluent for a duration of three days. One wet weather event was sampled on June 15, 2010. The wet weather event consisted of hourly composite sampling of the raw influent and treated effluent for a duration of 12 hours. During both dry and wet weather events, the raw influent discrete samples were tested for NH_3-N, TSS, volatile suspended solids (VSS), total Kjeldahl nitrogen, total P (TP), and chemical oxygen demand (COD), and the final effluent discrete samples were tested for NH_3-N, TSS, VSS, NO_3-N, NO_2-N, and COD. Additional parameters were also added to the routine daily composite samples as needed for better characterization of the influent and effluent flows.

The detailed results from the special sampling are not presented here. Additional wet weather sampling will be completed in 2012. The complete sampling results will be included in an M&R report, which will be generated at the completion of the modeling project. The calibrated and validated dynamic model, when complete, will be used to evaluate plant capacity, plant operations and will assist in evaluating plant expansion options.

Process Design and Review of Design Documents for Proposed Battery E at the North Side Water Reclamation Plant. At the request of Engineering, the WTPR Section conducted engineering analyses for the proposed Battery E at the North Side WRP. These analyses included (1) determining the design flows and loads to the battery, (2) determining the air flow requirements and distribution for aeration tanks, (3) evaluating the need to operate the aeration tanks in step feed, (4) evaluating the use of anoxic zones in the beginning of the aeration tanks for energy savings, and (5) assessing plant-wide needs for nutrient removal to a total nitrogen (TN) level of 5 mg/L and a TP level of 0.5 mg/L in the final effluent of the plant.

The design flows and loads to the battery were determined via statistical analysis of the historical flows and loads to the plant. Applying the actual flows and loads along with the USEPA's *Design Manual: Fine Pore Aeration Systems*, the air requirements for the new battery were calculated along with the distribution of required air along the length of the tank taking into account air flow needed to maintain mixing. Desktop calculations were then done to determine if operating in step feed could lower air flow required by distributing the loads. Distributing load via step feed results in less air demand at the upstream end of the tank, since more load is sent further downstream, so that the required air becomes more load dependent rather than mixing dependent at the downstream end of the tank. Likewise, desktop calculations were also completed to see if operating the aeration tanks with an anoxic zone in the upstream portion of the tank could result in a lower air requirement by removing BOD_5 in the presence of nitrate instead of oxygen. The results showed air savings can be achieved when operating in step feed and with anoxic zones. However, work was not completed to evaluate whether the air savings were worth the capital cost for additional valves, piping, mixers, and baffles required for this type of operation.

An assessment of plant needs for removing TN and TP to 5 mg/L and 0.5 mg/L, respectively, was completed for each battery at the North Side WRP. This assessment was done using a mass balance approach, historical flow and load data, and nutrient removal information, such as denitrification and nitrification rates, from literature. The assessment also took into account existing infrastructure and the type and complexity of modifications that would need to be completed to adopt the various TN and TP removal technologies. The desktop calculations suggest that the Modified Ludzack-Ettinger process for TN removal along with chemical TP removal using $FeCl_3$ would be the preferred alternatives for Batteries A, B, C, and D. For Battery E, step feed with anoxic zones and $FeCl_3$ addition were shown to be the preferred alternatives for TN and TP removal. These results are preliminary. As rates found in literature were used for the analysis, it is suggested that the nitrification and denitrification rates at the North Side WRP be determined through testing. Also, use of a calibrated process model, using software such as GPS-X, will provide further verification of the expected performance of those technologies considered the best alternatives.

Preliminary design work submitted by the consultant for Battery E at the North Side WRP were reviewed and comments provided as necessary. Comments on the submittals as well as all the process design work that was completed, as described above, were transmitted to Engineering via memoranda.

Regulatory Monitoring, Reviews, and Technical Development

Methane and Nitrous Oxide Emissions from Wastewater Treatment. According to the USEPA, wastewater treatment contributes to atmospheric CH_4 via anaerobic digestion and atmospheric nitrous oxide (N_2O) via nitrification and denitrification processes. In 2010, WTPR staff (in collaboration with the University of Illinois at Chicago) performed comprehensive monitoring of these greenhouse gas (GHG) emissions including CH_4, N_2O, and CO_2 and the isotopic character of these emissions from Stickney WRP aeration tank B-1, a four-pass tank, as well as select monitoring from the preliminary settling tanks and anaerobic digesters. Diurnal GHG sampling was performed between June and November 2010 in concert with mixed liquor (ML) sampling. ML quality analysis and isotopic characterization of the ML samples were also performed.

The study results show that the N_2O emissions from the aeration tanks are mainly a result of incomplete nitrification and denitrification which may be an indication of inefficiencies in aeration. Further exploration will support EM&RD efforts to improve oxygen utilization efficiency in the District's secondary treatment processes. The results of all of the GHG investigations for the past three years will be documented in an M&R report in 2012.

Tunnel and Reservoir Plan Groundwater Monitoring Reports and Thornton Transitional Reservoir Fill Events for 2010. Groundwater monitoring for the TARP systems was performed in 2010 as required by the IEPA. The monitoring results for 2010 were summarized in six M&R reports, each of which represents an individual TARP system. These reports are M&R Report Nos. 11-21, 11-22, 11-23, 11-26, and 11-29, for the Gloria Alitto Majewski Chicagoland Underflow Plan Reservoir, Des Plaines, UDP, Calumet, and Mainstream Tunnel systems, respectively. The Thornton Transitional Flood Control Reservoir report was published as M&R Report No. 11-38. All six reports were submitted to the IEPA as well as the USEPA in 2011.

One of the requirements for the Thornton Transitional Flood Control Reservoir (Reservoir) is to prepare a narrative of fill events that have occurred during the year. There were three fill events at the Reservoir during 2010: June 24–25, August 3–5, and December 31, 2010–January 1, 2011. Samples were collected from the Reservoir and the four surrounding groundwater quality monitoring wells as required during and after all three fill events. The monitoring results for the water quality monitoring wells were compared event by event with the statistical background monitoring data from these wells. The description and analyses of the monitoring results for each fill event are included in the annual M&R report to the IEPA and USEPA.

Additional Anaerobic Digestion Tests for the Calumet Water Reclamation Plant Digester Draw. Additional anaerobic digestion tests were conducted as part of a continuous monitoring program that assesses whether the requirements for vector attraction reduction (VAR) are met during biosolids processing at the Calumet WRP, which employs Option 2 of Section 503.3(b) of the 40 CFR Part 503 Regulations (Option 2). Option 2 states that vector attraction is demonstrated if after anaerobic digestion of the biosolids the volatile solids (VS) in the biosolids are reduced by less than 17 percent in an additional 40-day batch-scale anaerobic digestion test at a temperature between 30° and 37°C.

In 2010 a total of 28 bench-scale additional anaerobic digestion tests were performed in the WTPR Laboratory for the digester draw from the Calumet WRP. Of the 28 tests conducted in 2010, the additional VS reductions in 16 tests were less than 17 percent as shown in Table II-12. An additional VS reduction of greater than 17 percent occurred in 12 tests, one test each in January, March, April, May, October, and December of 2010 and two tests each in February, September, and November of 2010. However, VS reduction of 38 percent through the plant-scale anaerobic digesters at the Calumet WRP, which meets the requirements for VAR according to Option 1 of Section 503.3(b) of the 40 CFR Part 503 Regulations, was achieved in January through April and August through December of 2010. Therefore, the combined monitoring results indicated that requirements for VAR were met at the Calumet WRP for every month of 2010 except for May. The frequent exceeding of 17 percent VS reduction in the additional anaerobic digestion tests in 2010 could be due to the change of operational practice of converting two-stage digestion to one-stage digestion at the Calumet WRP.

Estimation of Emission of Hazardous Air Pollutants. Under Section 112 of Part A, Title I, of the Clean Air Act, a publicly owned treatment works (POTW) is considered a major source of hazardous air pollutants (HAPs) if it emits or has the potential to emit ten tons per year or more of any individual HAP or 25 tons per year or more of any combination of HAPs.

Samples of the influent sewage to each of the District's WRPs are collected twice a year and analyzed by the Organic Compounds Analytical Laboratory for 65 of the HAP compounds of concern to POTWs. Estimates of the emissions of these HAPs from the wastewater treatment process units (grit chamber, primary settling tanks, aeration tanks, and secondary settling tanks) are made using the Bay Area Sewage Toxics Emissions (BASTE) computer model developed by CH2M Hill. The average concentration of each HAP detected in the influent sewage was used as input to the model along with the annual running average operating conditions. The physical properties of the individual compounds were taken from the USEPA database.

During 2010, influent samples were collected in January and July. The average influent concentrations found are presented in Table II-13 for the three major District WRPs. The estimated emissions of individual HAPs for the three major District WRPs are summarized in Table II-14.

According to the BASTE model, all of the individual HAP emissions were less than the ten ton/year criterion. Acetaldehyde, propionaldehyde, toluene, and carbon disulfide were the predominant compounds emitted from the wastewater treatment processes at the Stickney WRP. Carbon disulfide was the predominant compound emitted from the Calumet WRP. The HAP emissions from individual HAPs at the North Side WRP were very low, mostly less than 0.2 ton/year. The total estimated HAP emissions were substantially less than the 25 ton/year threshold at each of the three WRPs. Therefore, the wastewater treatment process units at the District's WRPs are not a major source of HAPs.

Conducting Applied Research on Process Optimization and Evaluation of New Technologies

Evaluation of Disinfection Using Ferrate. Ferrate Treatment Technologies, LLC (FTT), has a patented technology for wastewater disinfection that uses on-site synthesized ferrate. The technology was promoted as a cost-effective alternative to chlorination/ dechlorination and ultraviolet disinfection. The WTPR Section evaluated the ferrate disinfection technology developed by FTT via bench-scale tests in the WTPR laboratory in 2010. A pilot test at the Hanover Park WRP would be proposed if the bench-scale evaluation showed promising results.

The FTT personnel demonstrated the ferrate synthesis methods and provided training to District staff in April 2010. Detailed manuals and spreadsheets were provided by FTT for two synthesis methods, one using calcium hypochlorite ($Ca(ClO)_2$), and the other sodium hypochlorite (NaClO). The bench-scale evaluation included (1) synthesizing ferrate in the laboratory using both methods, and (2) dosing the synthesized ferrate to secondary effluent samples for examining its disinfection efficacy. The FC analysis from the tests was performed by the Analytical Microbiology and Biomonitoring Section.

The ferrate yield during synthesis is an important factor for economic reasons. Higher yields are more economically favorable. The yield is determined by the amount of $FeCl_3$ converted into ferrate during synthesis. The final ferrate concentrations of all batches synthesized during the tests are shown in Table II-15. The concentration of the April 15, 2010, demonstration batch, using the $Ca(ClO)_2$ method, was the greatest at 43.34 g/L. According to FTT, a typical ferrate concentration with the $Ca(ClO)_2$ method is 40 g/L. The ferrate concentrations from the three batches synthesized by the District staff were lower. The lower concentrations may be the result of equipment, procedures, or techniques, or the combination of all these factors. The reactor used during the demonstration and training batches was smaller than the reactor used by the District staff. Laboratory equipment identical to the FTT equipment was ordered to eliminate this variable. The concentration of ferrate generated using the NaClO method is typically near 17 g/L, according to FTT. The concentrations of ferrate in the three batches synthesized with NaClO are shown in Table II-15. The last two batches were synthesized by the District staff and the ferrate yield was slightly lower than that from the training batch. It appeared that the laboratory procedures and synthesis techniques should be improved to ensure that the appropriate yield would be achieved.

Four bench-scale trials of dosing synthesized ferrate to secondary effluent samples were made to evaluate FC reduction. The ferrate synthesized with the $Ca(ClO)_2$ method was used in three trials and the NaClO method was used in the fourth trial. The ferrate dosages ranged from 2.0 to 5.0 mg/L. FTT recommended procedures for ferrate solution stability, dosage, and sample mixing were followed during all trials. The results of trials using the $Ca(ClO)_2$ method are shown in Table II-16. Ferrate dosages of 3.0 mg/L or greater reduced FC of the effluent samples to below the target level of 400 CFU/100 mL. The wastewater pH increased as the ferrate dose increased. The dosed wastewater samples with a pH greater than 9.0, which is an upper permit limit for pH, were adjusted with sulfuric acid to below 9.0. The dose-response for the three trials was consistent. The NaClO stock solution used for ferrate synthesis had nine percent available chlorine, whereas FTT recommended NaClO with 13 to 15 percent available chlorine for ferrate synthesis. The degraded NaClO was still used in the synthesis to evaluate a worst-case scenario. It is important to know the effects on both treatment efficacy and economics if NaClO degrades on site. The bench-test results using the NaClO synthesis method are shown in Table II-17. The disinfection results show the ferrate is effective at the dose level of 2.0 mg/L. However, it is unclear whether the added NaClO may have played a role in the disinfection process because of the low yield of ferrate with the NaClO synthesis method. Similar to the disinfection process using the $Ca(ClO)_2$ produced ferrate solution, the wastewater pH increased with the dose. FTT advised that the ferrate synthesis using the $Ca(ClO)_2$ has a better economic benefit than the NaClO method. The trials with the NaClO method were then discontinued.

The ferrate disinfection process involves adding chemicals into the wastewater. As a result, total solids in the wastewater increases as the dose of ferrate increases. The results of total solids in the secondary effluent with and without ferrate addition from the May 13, 2010, trial are shown in Figure II-10. The increase in total solids, mostly dissolved solids, needs to be taken into consideration for both water quality and economic reasons. Other considerations for the application of this technology are the ferrate process control and pH adjustment strategies. Ferrate creates a positive response when using the amperometric chlorine residual analysis, which is an IEPA-approved method for chlorine residual analysis. Also, the addition of chemical for pH adjustment adds to the operational complexity of the system and will increase the cost of disinfection while meeting the permit requirements.

In summary, the FTT disinfection technology is effective at reducing FC in secondary effluent to a level which meets the NPDES permit. The ferrate dosage for effective disinfection may result in pH close to or above the permit limit, which requires pH adjustment. More detailed information is needed for the ferrate dosage control and pH adjustment systems. The increase in total solids and effect on apparent chlorine residual analysis, as a result of the ferrate technology application, need to be further investigated. Chemical cost to operate the ferrate process versus chlorination/dechlorination showed that the ferrate process resulted in roughly a 40 percent increase in chemical cost, so further evaluation was not pursued.

Characterization of Recycle Streams at the Stickney, Calumet and Egan Water Reclamation Plants. M&R initiated a study in July 2008 to characterize the recycle streams at the Stickney, Calumet and Egan WRPs in order to evaluate the nutrient loads to the headwork contributed by these recycle streams. The District does not routinely monitor the flows of recycle streams or nutrient contents in the recycle streams at these plants. However, grab samples are collected from certain recycle streams for total and suspended solids analyses for process control information. The parameters analyzed in this study have been chosen such that a range of nutrient treatment strategies may be considered to be prepared for stricter nutrient regulations for TN and TP. Thus, the characterization of nutrient loads in recycle streams will provide important information for formulating the nutrient reduction strategies for these WRPs. Sampling for this project continued through August 2009. In 2010, the data collected in 2009 were analyzed. The findings of the study was presented at the November 2010 M&R seminar which included the details of the sampling plan, data, and a set of recommended technologies for nutrient removal and recovery based on the data collected. A final report detailing this study will be completed in 2012.

Chemical Phosphorus Removal at the John E. Egan Water Reclamation Plant. For the Salt Creek Phosphorus Reduction Demonstration Project, the TP concentrations in the final effluent of the Egan WRP met a target level of 0.5 mg/L. Chemical precipitation of P with $FeCl_3$ was utilized in the project. A full-scale chemical P removal test was conducted from February 2007 through December 2008. Monitoring of the impact of chemical P removal on plant operations including both liquid and sludge streams continued until 2009. The data collected in this two-year study were analyzed, and an M&R report describing this project in detail and presenting the results from the entire study was prepared and finalized in 2010 and published as M&R Report 10-56.

Energy-Saving Projects at the Hanover Park Water Reclamation Plant Using Anoxic Zone and at the John E. Egan Water Reclamation Plant Using Enhanced Settling of Primary Solids. The WTPR Section initiated full-scale test projects for energy savings at selected District WRPs in 2009. As a part of its energy savings initiative, the WTPR Section proposed to introduce an anoxic zone in an aeration tank at the Hanover Park WRP and polymer and $FeCl_3$ aided enhanced solids settling in the primary settling tanks at the Egan WRP. In order to verify the energy savings at each WRP, full-scale test facilities were proposed with the help of Engineering and M&O. During 2010, the WTPR Section developed design parameters and other necessary design details for both projects for Engineering to prepare scope of work and contract specifications under Engineering project 06-494-3P. The full-scale tests have been postponed due to priority adjustment.

Side-by-Side Comparison of Plug Flow and Step-Feed Operations at the James C. Kirie Water Reclamation Plant. Operating the aeration tanks of a conventional activated sludge treatment plant in a step-feed mode has many documented benefits. These benefits include a decrease in the required tank volume for treating a given flow; an increase in capacity when using existing tank volume; a better and more reliable effluent quality; and the ability to handle shock loads more efficiently. It is also thought that for some aeration tanks operated in a plug flow mode, particularly those with a uniform distribution of diffuser plates and less robust air flow control, operating in step feed can result in energy savings by distributing the oxygen demand more evenly down the length of the tank.

In 2009, profile sampling of the aeration tanks at the James C. Kirie (Kirie) WRP was completed to evaluate treatment performance and determine if there was opportunity to achieve energy savings if the aeration tanks were operated in step feed, where portions of the raw influent is fed to two or three passes instead of 100 percent of it going to the first pass. The 2009 results showed that minimal air flow was used in the first pass of tanks resulting in little to no nitrification and even some denitrification occurring in this pass. In addition, the full length of the aeration tanks were used for nitrification, so air was not "wasted" at the downstream end of the tanks solely to keep the solids in suspension. Based on these results, it was unclear whether operating in step feed would result in energy savings via a decrease in air use. Further testing was conducted in 2010 to: (1) compare the performance and air usage of the aeration tanks under plug flow and step feed operations, and (2) determine if operating aeration tanks in step feed will result in energy savings due to a reduction in air.

The Kirie WRP is a conventional wastewater treatment plant which utilizes aeration tanks for nitrification and the oxidation of organic compounds. The Kirie WRP has two aeration batteries, each containing six aeration tanks. Battery A is currently used for biological treatment while Battery B is used as finishing tanks following aeration and final clarification in Battery A. Each tank in Battery A is comprised of three 250-foot passes and is operated in plug flow, with the raw influent and return activated sludge entering the beginning of the first pass.

Testing was completed in the fall of 2010 and involved a side-by-side comparison of plug flow and step feed operations in parallel aeration tanks. The testing included two operational strategies. In Operational Strategy 1, roughly 20 percent of the raw influent was fed to pass 2 of the step feed tank. In Operational Strategy 2, roughly 50 percent of the raw influent was fed to pass 2 of the step feed tank. To compare the step feed and plug flow tanks, profile sampling was completed along with a comparison of aeration tank distributed control system data such as influent flow, air flow, and return flow. The profile sampling was conducted along the length of the tanks and included the following: DO concentration, OUR, MLSS, MLVSS, NH_3-N, NO_3-N, NO_2-N, and P.

The NH_3-N and DO profile sampling results for both operational strategies are shown in Figures II-11 to II-16. For both operational strategies, the NH_3-N profile results show similar nitrification performance, except for the results from October 19, 2010. On this day, the plant received high strength raw influent flow due to sewer work being done in the service area. The October 19, 2010, results demonstrated one benefit of operating in step feed: the ability to efficiently handle shock loads. The DO profile results from the plug flow and step feed tanks were similar for both operational strategies, with the exception of the DO concentration measured at the end of the tanks. The DO at the end of the step feed tank was consistently higher than the DO at the end of the plug flow tank.

Only a few study results are presented here. The complete results and collected data were analyzed in early 2011. A detailed report was transmitted to M&O via memorandum in 2011 upon completion of the data analyses.

Technical Support to Other Requests

Chicago Department of Transportation Blue Island Sustainable Streetscape Project. WTPR Section staff in collaboration with the Chicago Department of Transportation (CDOT) and the United States Geological Survey (USGS) are investigating the effect of best management practices (BMPs) such as permeable pavements, bioswales, infiltration basins, and planters on stormwater flow and pollutant load reduction in the Sustainable Streetscape Project (SSP) located on West Cermak Road between South Halsted Street and South Ashland Avenue, and

South Blue Island Avenue between South Ashland Avenue and South Western Avenue in the City of Chicago (Figure II-17). In 2010, background monitoring of the rainfall, combined sewer flow, and groundwater levels at numerous SSP locations and quality of sewage and groundwater continued. Rain gauge (RG), monitoring well (MW), combined sewer manhole (MH), and catch basin (CB) monitoring locations at the study site are shown in Figure II-17.

The cumulative precipitation over the study time period (January through September 2010) for all three rain gauges is shown in Figure II-18. Cumulative rainfall was considered to be between 30–35 inches over the study period; RG2 was in need of cleaning and recalibration. Figure II-19 shows the water level depths for all four monitoring wells over the study period (ft) and the precipitation (inches) throughout 2010. It is often difficult to attribute water level fluctuations strictly to precipitation; it is expected that water levels were also controlled by the local groundwater. MW3 showed insignificant change in water table levels. Reasons for the anomalous character of the MW3 water levels have been investigated since 2009 by the USGS but are still unknown.

All four wells showed seasonal responses to groundwater temperatures with colder groundwater temperatures occurring from January through mid-May 2010 and warmer groundwater temperatures occurring from mid-May through September 2010. Figure II-20 shows the groundwater conductivity of the monitoring wells over the 2010 study period. It was expected that salt addition from roadway deicing efforts and snowmelt may influence the conductivity in the groundwater upon infiltration. MW1 and MW3 showed much higher conductivities than MW2 and MW4. Groundwater samples were collected in September 2010 from MW1, MW2, and MW3 and submitted for water quality analysis, which is summarized in Table II-18. MW1 and MW3 showed elevated COD and chlorine concentrations relative to MW2. The elevated chlorine concentrations for MW1 and MW3 were expected due to the high conductivities observed in these wells. MW3 also indicated some elevated trace metal concentrations. These high concentrations could indicate an influence of exfiltrated wastewater from the local sewer system.

Figures II-21a–II-21d show the gauge height data in the combined sewer as well as concurrent precipitation for all three combined sewer monitoring locations during their respective time of service; due to equipment problems, MH1 was not monitored throughout the entire period. Diurnal variations in stage and flow with peaks occurring in the morning were expected, but this pattern was difficult to discern due to low domestic and industrial contributions. However, spikes in stage and flows were observed during rainfall events. Often irregular flow patterns were observed which may be due to sewer clogging upstream and downstream from the flow meters and groundwater infiltration.

Decreases in wastewater temperature during the winter and early spring were caused by snow melt events, whereas increases during the late spring were a function of warmer rains. Conductivity was expected to increase during snowmelt events. This trend was readily seen at MH3 (Figure II-22b), but higher variability was observed in MH2 (Figure II-22a). By late spring, both plots trended towards low conductivity levels. Finally, wastewater samples were collected from all three manhole locations in late September. The water quality results are summarized in Table II-19. MH2 had much higher COD, TSS, and alkalinity concentrations than the other locations, which may indicate greater industrial wastewater discharge input. MH3 has low TSS and chlorine concentrations. MH2 and MH3 have much higher nutrient concentrations than MH1, and all three locations show significant heavy metal concentrations.

This project with CDOT and USGS will continue in 2011. Beginning in 2011, autosamplers will be installed at all three sewer locations to periodically collect water quality samples for analysis. The USGS is also planning to install three pressure transducers to continuously measure water levels and indirectly run off flow in the three CB locations (Figure II-17). Additionally, autosamplers will be installed to collect stormwater runoff from these locations for analysis. Streetscape construction began in late August 2010, and the first phase of construction is expected to be complete in November 2011. Therefore, much of the 2011 monitoring will be considered as a transition phase from background to full BMP implementation.

TABLE II-1: POLYMER TEST RESULTS AT THE STICKNEY WATER RECLAMATION PLANT CENTRIFUGE COMPLEX – SEPTEMBER THROUGH OCTOBER 2010

Polymer Manufacturer	Polymer Identification	Sludge Cake Solids (%)	Polymer Dose (lbs/dry ton)
Polydyne	CE-1142	24.2	207.8
Polydyne	CE-1000	27.4	166.3
Ashland Specialty Chemical Company	Praestol-K274FLX[1]	24.6	58.1
Ashland Specialty Chemical Company	Praestol-K260FL[1]	23.4	57.9
BASF	Zetag 8818[1]	23.7	43.9
BASF	Zetag 8848 FS[1]	24.5	62.3

[1]These are emulsion polymer products.

TABLE II-2: POLYMER TEST RESULTS AT THE CALUMET WATER RECLAMATION PLANT GRAVITY CONCENTRATION TANKS – OCTOBER 2010

Polymer Manufacturer	Polymer Identification	Polymer Dose (lbs/dry ton)
Polydyne	CE-1510	117.65
Polydyne	CE-1509	88.24

TABLE II-3: TOTAL SULFIDE AND DISSOLVED SULFIDE CONCENTRATIONS AT THE MANHOLE RECEIVING THE RECYCLE FLOW FROM THE METROPOLITAN BIOSOLIDS MANAGEMENT FACILITY

Sampling Date	Sampling Time	Total Sulfide (mg/L)	Dissolved Sulfide (mg/L)
12/14/2009	10:58	14.0	12.2
12/21/2009	9:35	13.8	11.7
12/23/2009	10:08	14.0	9.3
1/4/2010	9:35	9.9	9.6
1/6/2010	10:37	9.0	8.3
1/11/2010	10:35	8.6	7.9
1/13/2010	10:32	10.0	6.4
Average		11.3	9.3

TABLE II-4: GRIT CHARACTERIZATION OF THE NORTH SIDE WATER RECLAMATION PLANT SAMPLE COLLECTED DURING SEPTEMBER 21, 2010, TO SEPTEMBER 30, 2010

Sieve Size µm (No.)	Retained (%)	Pass (%)
1000 (18)	2.1	97.9
600 (30)	2.3	97.7
425 (40)	3.1	96.9
300 (50)	5.0	95.0
212 (70)	9.0	91.0
150 (100)	14.5	85.5
106 (140)	15.1	94.9
75 (200)	16.1	83.9
Pan	32.8	67.2
Total	100.0	
Initial Weight (g):	511.4	
Total Volatile Solids (%):	40.4	

TABLE II-5: GRIT CHARACTERIZATION OF THE NORTH SIDE WATER RECLAMATION PLANT SAMPLE COLLECTED DURING OCTOBER 28, 2010, TO NOVEMBER 4, 2010

Sieve Size µm (No.)	Retained (%)	Pass (%)
1000 (18)	0.7	99.3
600 (30)	1.6	98.4
425 (40)	3.5	96.5
300 (50)	4.8	95.2
212 (70)	6.4	93.6
150 (100)	9.6	90.4
106 (140)	14.7	85.3
75 (200)	17.1	82.9
Pan	41.5	58.5
Total	100.0	
Initial Weight (g):	348.4	
Total Volatile Solids (%):	57.6	

TABLE II-6: GRIT CHARACTERIZATION OF THE NORTH SIDE WATER RECLAMATION PLANT SAMPLE COLLECTED DURING NOVEMBER 15, 2010, TO NOVEMBER 22, 2010

Sieve Size µm (No.)	Retained (%)	Pass (%)
1000 (18)	0.4	99.6
600 (30)	1.1	98.9
425 (40)	2.1	97.9
300 (50)	3.1	96.9
212 (70)	5.8	94.2
150 (100)	10.9	89.1
106 (140)	16.7	83.3
75 (200)	18.1	81.9
Pan	41.6	58.4
Total	100.0	
Initial Weight (g):	494.8	
Total Volatile Solids (%):	55.7	

TABLE II-7: OPERATION DATA FROM PLANT AND GRIT SAMPLER AT THE NORTH SIDE WATER RECLAMATION PLANT FROM SEPTEMBER 21, 2010, TO SEPTEMBER 30, 2010

	Plant Data			Grit Sampler Chamber Data		
Date	Rainfall Inches	Total Flow MG	Grit Tank HRT Minutes	Total Flow Gallons	Average Flow Gallons/minute	Average HRT Minutes
9/21/2010	0.02	195	8.08	14,470	15.77	3.91
9/22/2010	0	192	8.21	22,478	15.08	4.18
9/23/2010	0	188	8.38	18,920	13.31	4.65
9/24/2010	0.19	240	6.57	16,415	11.56	5.55
9/25/2010	0	189	8.34	20,239	14.36	4.34
9/26/2010	0	186	8.47	21,764	15.08	4.09
9/27/2010	0	188	8.38	22,416	15.53	3.98
9/28/2010	0	173	9.11	21,329	14.61	4.25
9/29/2010	0	190	8.29	21,708	14.66	4.35
9/30/2010	0	171	9.22	8,474	18.16	3.44
Totals	0.21	1,912		188,213		
Average			8.31		14.81	4.27

TABLE II-8: OPERATION DATA FROM PLANT AND GRIT SAMPLER AT THE NORTH SIDE WATER RECLAMATION PLANT FROM OCTOBER 28, 2010, TO NOVEMBER 4, 2010

	Plant Data			Grit Sampler Chamber Data		
Date	Rainfall Inches	Total Flow MG	Grit Tank HRT Minutes	Total Flow Gallons	Average Flow Gallons/minute	Average HRT Minutes
10/28/2010	0	166	9.47	13,512	15.43	4.00
10/29/2010	0	159	9.94	18,941	12.87	4.82
10/30/2010	0	165	9.56	18,171	13.59	4.65
10/31/2010	0	162	9.71	23,129	15.89	3.88
11/1/2010	0	167	9.45	20,951	14.29	4.32
11/2/2010	0	170	9.26	19,903	14.39	4.34
11/3/2010	0.01	156	10.11	22,305	15.10	4.11
11/4/2010	0	179	8.80	5,770	11.57	5.33
Totals	0.01	1,324		142,681		
Average			9.54		14.14	4.43

TABLE II-9: OPERATION DATA FROM PLANT AND GRIT SAMPLER AT THE NORTH SIDE WATER RECLAMATION DISTRICT FROM NOVEMBER 15, 2010, TO NOVEMBER 22, 2010

	Plant Data			Grit Sampler Chamber Data		
Date	Rainfall Inches	Total Flow MG	Grit Tank HRT Minutes	Total Flow Gallons	Average Flow Gallons/minute	Average HRT Minutes
11/15/2010	0	183	8.63	15,091	15.71	3.94
11/16/2010	0	154	10.26	22,449	15.54	3.97
11/17/2010	0	158	10.00	23,179	16.14	3.83
11/18/2010	0	173	9.13	19,455	13.41	4.74
11/19/2010	0	152	10.37	16,002	11.10	5.62
11/20/2010	0	163	9.65	23,163	15.90	4.10
11/21/2010	0	168	9.41	22,510	15.46	3.99
11/22/2010	1.36	303	5.20	10,059	15.45	3.99
Totals	1.36	1,452		151,907		
Average			9.08		14.84	4.27

TABLE II-10: RINGED INFILTROMETER TEST RESULTS FOR THREE PERMEABLE LOTS IN 2009 AND 2010

Date	Lot	Infiltration Rate (inch/sec)				
		Trial 1	Trial 2	Trial 3	Trial 4	Average
11/19/09	PA	1.25	1.20	1.15	1.30	1.23
11/19/09	PC	1.50	1.43	1.58	1.50	1.50
11/19/09	PP	1.03	1.00	1.00	0.97	1.00
6/1/10	PA	1.20	1.30	1.11		1.20
6/1/10	PC	1.25	1.15	1.42		1.27
6/1/10	PP	0.96	1.00	0.88		0.95

TABLE II-11: TOTAL SUSPENDED SOLIDS AND CHEMICAL OXYGEN DEMAND ANALYSIS FOR RUNOFF SAMPLE DURING SEVERAL 2009 AND 2010 RAINFALL EVENTS

	SS (mg/L)				COD (mg/L)			
Date	PA	PC	PP	Control	PA	PC	PP	Control
4/20/09	9	5	4	101	48	26	99	91
4/28/09	70	13	45	410	45	32	54	169
5/8/09	10	21	63	291	71	34	<25	210
8/28/09	5	20	18	33	32	64	34	146
5/3/10	586	689	52	596	106	142	55	167
5/12/10	71	20	73	6	89	26	47	41
5/14/10	72	38	92	99	72	<25	38	98
6/2/10	36	47	26	10	116	44	69	65
6/7/10	20	89	40	45	45	29	26	91
6/17/10	17	16	36	28	85	<25	42	<25
6/22/10	10	15	31	117	63	<25	<25	35
6/25/10	11	103	24	8	85	39	39	<25

TABLE II-12: RESULTS OF ADDITIONAL ANAEROBIC DIGESTION TESTS FOR THE CALUMET WATER RECLAMATION PLANT PER OPTION 2 OF SECTION 503.33(b) OF THE CODE OF FEDERAL REGULATIONS TITLE 40 PART 503 FOR 2010

Test Start Date	Before Test		After Test[1]		Volatile Solids Reduction (%)	
	TS (%)	%VTS (%)	TS (%)	%VTS (%)	By Equation[2]	By Mass
1/14/2010	2.02	58.62	1.84	50.76	27.2	21.0
1/28/2010	2.12	59.72	1.95	55.57	15.6	14.3
2/11/2010	2.24	59.74	2.01	54.38	19.7	18.4
2/25/2010	2.13	62.72	1.92	54.42	29.0	21.7
3/11/2010	2.15	62.98	1.93	59.00	15.4	16.0
3/29/2010	2.40	62.68	2.15	58.02	17.7	17.0
4/8/2010	2.43	60.53	2.24	57.49	11.8	12.2
4/22/2010	2.52	61.37	2.26	56.36	18.7	17.5
5/6/2010	2.57	59.22	2.36	53.35	21.3	17.3
5/20/2010	2.75	56.66	2.56	52.85	14.3	13.3
5/27/2010	2.60	56.49	2.38	51.95	16.7	15.6
6/10/2010	3.07	54.29	2.70	50.58	13.8	18.2
6/24/2010	2.78	53.23	2.58	49.31	14.5	13.8
6/30/2010	2.81	51.10	2.60	50.81	1.2	8.1
7/8/2010	3.37	51.50	2.94	47.38	15.2	19.8
7/21/2010	2.97	48.90	2.76	46.17	10.4	12.3
7/29/2010	3.13	46.86	2.77	43.65	12.2	17.7
8/12/2010	3.08	47.13	2.77	43.39	14.0	17.1
8/18/2010	2.93	45.21	2.77	43.28	7.5	9.5
8/26/2010	2.79	47.00	2.58	45.15	7.2	11.1
9/9/2010	2.71	50.50	2.53	44.85	20.3	17.2
9/23/2010	2.44	54.88	2.20	48.23	23.4	20.7
10/7/2010	2.10	53.24	1.96	50.44	10.6	11.6
10/21/2010	2.16	59.09	1.86	51.91	25.3	24.2
11/4/2010	1.97	52.72	1.82	48.07	17.0	15.5
11/10/2010	2.42	60.76	2.01	51.64	31.1	29.4
12/2/2010	1.81	52.42	1.70	46.90	19.8	16.0
12/16/2010	1.74	58.01	1.61	54.02	15.0	14.0

TABLE II-12 (Continued): RESULTS OF ADDITIONAL ANAEROBIC DIGESTION TESTS FOR THE CALUMET WATER RECLAMATION PLANT PER OPTION 2 OF SECTION 503.33(b) OF THE CODE OF FEDERAL REGULATIONS TITLE 40 PART 503 FOR 2010

Test Start Date	Before Test		After Test[1]		Volatile Solids Reduction (%)	
	TS (%)	%VTS (%)	TS (%)	%VTS (%)	By Equation[2]	By Mass
Monthly Mean						
Jan 2010					21.44	
Feb 2010					24.36	
Mar 2010					16.56	
Apr 2010					15.26	
May 2010					17.43	
Jun 2010					9.84	
Jul 2010					12.58	
Aug 2010					9.58	
Sep 2010					21.85	
Oct 2010					17.92	
Nov 2010					24.01	
Dec 2010					17.41	
Yearly Summary						
Mean	2.51	55.27	2.28	50.71	16.64	16.45
Min	1.74	45.21	1.61	43.28	1.16	8.09
Max	3.37	62.98	2.94	59.00	31.05	29.44

[1]After 40 days of incubation at 35.5°C in bench-scale reactors.
[2]The Van Kleeck Equation was used in calculations.

TABLE II-13: INFLUENT HAZARDOUS AIR POLLUTANT CONCENTRATIONS AT THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S MAJOR WATER RECLAMATION PLANTS IN 2010[1]

HAP Organic Compound	Concentrations in µg/L		
	Stickney	Calumet	North Side
Dichloromethane	0.4	0.8	4.2
Chloroform	3.3	2.1	3.4
Benzene	0.0	8.6	0.0
Tetrachloroethene	0.3	0.7	1.8
Toluene	45.1	12.3	2.9
Carbon disulfide	11.0	16.2	0.0
Methyl ethyl ketone	5.1	0.0	0.0
Styrene	3.6	0.8	0.6
Xylene (total)	5.0	0.0	0.0
Cresol (total)	11.3	1.3	11.0
Acetophenone	0.0	23.0	0.0
Cumene	0.2	5.8	0.0
2,4-D, salts and esters	0.0	4.6	0.0
Acetaldehyde	236.9	0.0	0.0
Propionaldehyde	103.3	0.0	0.0
Ethylbenzene	0.7	0.0	0.0
2,2,4-Trimethylpentane	0.5	0.0	0.0

[1]Average results of the two influent samples collected in January and July 2010.

TABLE II-14: HAZARDOUS AIR POLLUTANT EMISSIONS FROM THE METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO'S MAJOR WATER RECLAMATION PLANTS IN 2010[1]

HAP Organic Compound	Emissions in tons/yr		
	Stickney	Calumet	North Side
Dichloromethane	0.0	0.0	0.2
Chloroform	0.3	0.1	0.1
Benzene	0.0	0.3	0.0
Tetrachloroethene	0.1	0.1	0.2
Toluene	3.7	0.4	0.2
Carbon disulfide	1.7	1.0	0.0
Methyl ethyl ketone	0.1	0.0	0.0
Styrene	0.2	0.0	0.0
Xylene (total)	0.4	0.2	0.0
Cumene	0.0	0.2	0.0
Acetaldehyde	5.7	0.0	0.0
Propionaldehyde	4.5	0.0	0.0
Ethylbenzene	0.1	0.0	0.0
2,2,4-Trimethylpentane	0.5	0.0	0.0

[1]Emissions estimated using the BASTE model.

TABLE II-15: FERRATE CONCENTRATIONS OF SYNTHESIZED FERRATE

Date	FeO_4^{2-} Concentration, g/L
Calcium Hypochlorite Method	
4/15/2010	43.34
4/16/2010	40.00[1]
5/3/2010	36.68
5/6/2010	36.18
5/13/2010	37.02
Sodium Hypochlorite Method	
4/16/2010	17.00[1]
4/21/2010	15.71
4/22/2010	15.04

[1]Approximate concentration per FTT.

TABLE II-16: FECAL COLIFORM REDUCTION WITH FERRATE SYNTHESIZED USING THE CALCIUM HYPOCHLORITE METHOD

Date	Dose, mg/L	pH Before Adjustment	pH, Final (Adjusted if pH > 9.0)	Avg. FC, CFU/100 mL
4/15/2010	0	NA[1]	not adj.	3,900
4/15/2010	2	8.37	not adj.	2,500
4/15/2010	4	8.88	not adj.	80
5/6/2010	0	7.14	not adj.	3,300
5/6/2010	2	8.63	not adj.	1,500
5/6/2010	4	9.11	6.92[2]	140
5/13/2010[3]	0	6.66	not adj.	7,900
5/13/2010	3	7.81	not adj.	300
5/13/2010	4	8.94	not adj.	140
5/13/2010	5	9.25	8.89[2]	20

[1]Not available.
[2]pH adjusted with one to two drops of 10M H_2SO_4.
[3]Sample collected during wet weather.

TABLE II-17: FECAL COLIFORM REDUCTION WITH FERRATE SYNTHESIZED USING THE SODIUM HYPOCHLORITE METHOD

Date	Dose, mg/L	pH Before Adjustment	pH, Final (Adjusted if pH > 9.0)[1]	Avg. FC, CFU/100 mL
4/22/2010	0	6.80	not adj.	3,500
4/22/2010	2	9.11	2.50	20
4/22/2010	3	9.67	7.65	9
4/22/2010	4	10.04	7.80	<10
4/22/2010	5	10.32	7.90	<10

[1]The pH was adjusted with one to two drops of 10M H_2SO_4 for the 3, 4, and 5 mg/L ferrate doses. The 2 mg/L ferrate dose was over adjusted for pH with about six drops of 10M H_2SO_4.

TABLE II-18: GROUNDWATER QUALITY DATA FOR SEPTEMBER 2010 SAMPLING EVENT FROM MONITORING WELL 1 (MW1), MONITORING WELL 2 (MW2), AND MONITORING WELL 3 (MW3)

	MW1	MW2	MW3
COD (mg/L)	187	<25	233
TSS (mg/L)	ND	ND	ND
VSS (mg/L)	ND	ND	ND
Cl (mg/L)	4,163	112	5,082
Alkalinity (mg/L)	540	317	633
Cu (mg/L)	<0.01	<0.01	0.0136
Ni (mg/L)	<0.01	<0.01	<0.01
Cd (mg/L)	<0.01	<0.01	<0.01
Pb (mg/L)	<0.03	<0.03	0.035
Zn (mg/L)	<0.02	<0.02	0.03
Cr (mg/L)	<0.01	<0.01	0.0093
Tot P (mg/L)	0.02	0.09	0.09
NO_3-N(mg/L)	0.012	0.004	0.108
NO_2-N(mg/L)	0.003	0.007	0.026
TKN (mg/L)	0.62	0.09	0.03
NH_3-N (mg/L)	0.55	0.15	0.28

ND = No data.

TABLE II-19: SEWER WATER QUALITY DATA FOR SEPTEMBER 2010 SAMPLING EVENT FROM MANHOLE 1 (MH1), MANHOLE 2 (MH2), AND MANHOLE 3 (MH3)

	MH1	MH2	MH3
COD (mg/L)	145	523	155
TSS (mg/L)	230	634	78
VSS (mg/L)	54	162	40
Cl (mg/L)	1,033	1,295	231
Alkalinity (mg/L)	343	739	299
Cu (mg/L)	0.1007	0.0563	<0.01
Ni (mg/L)	<0.01	0.018	<0.01
Cd (mg/L)	<0.01	<0.01	<0.01
Pb (mg/L)	0.092	0.051	<0.03
Zn (mg/L)	0.447	0.29	0.033
Cr (mg/L)	0.0131	0.01	<0.01
Tot P (mg/L)	0.58	3.33	3.21
NO_3-N(mg/L)	0.117	0.008	0.00
NO_2-N(mg/L)	0.026	0.057	0.049
TKN (mg/L)	3.05	23.93	27.89
NH_3-N (mg/L)	1.22	15.37	25.02

FIGURE II-1: PLOT OF HYDROGEN SULFIDE HEADSPACE CONCENTRATIONS VERSUS TIME FOR BIOXIDE® TREATMENTS

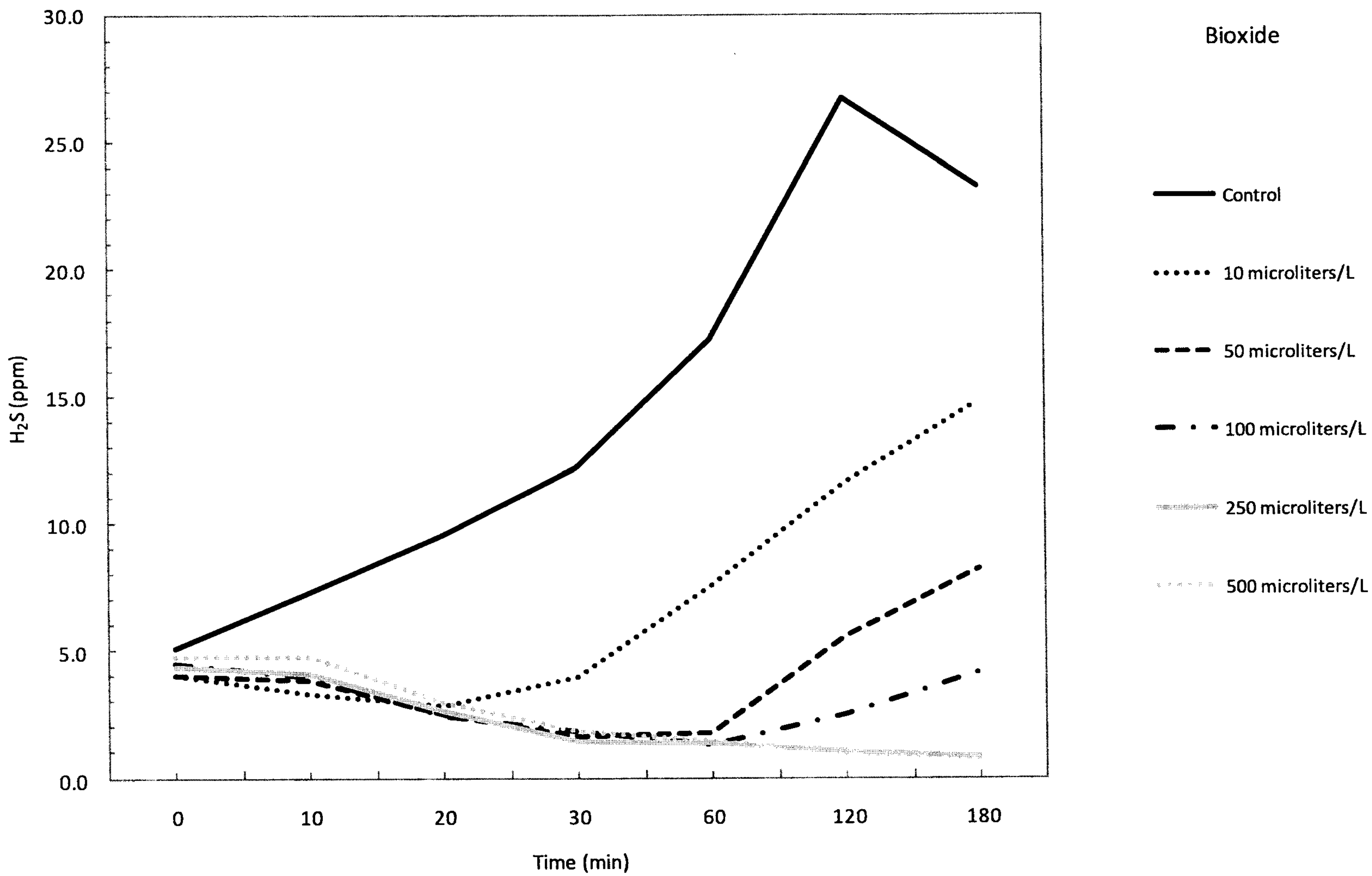


FIGURE II-2: PLOT OF HYDROGEN SULFIDE HEADSPACE CONCENTRATIONS VERSUS TIME FOR GOLDEN EAGLE CALCIUM NITRATE TREATMENTS

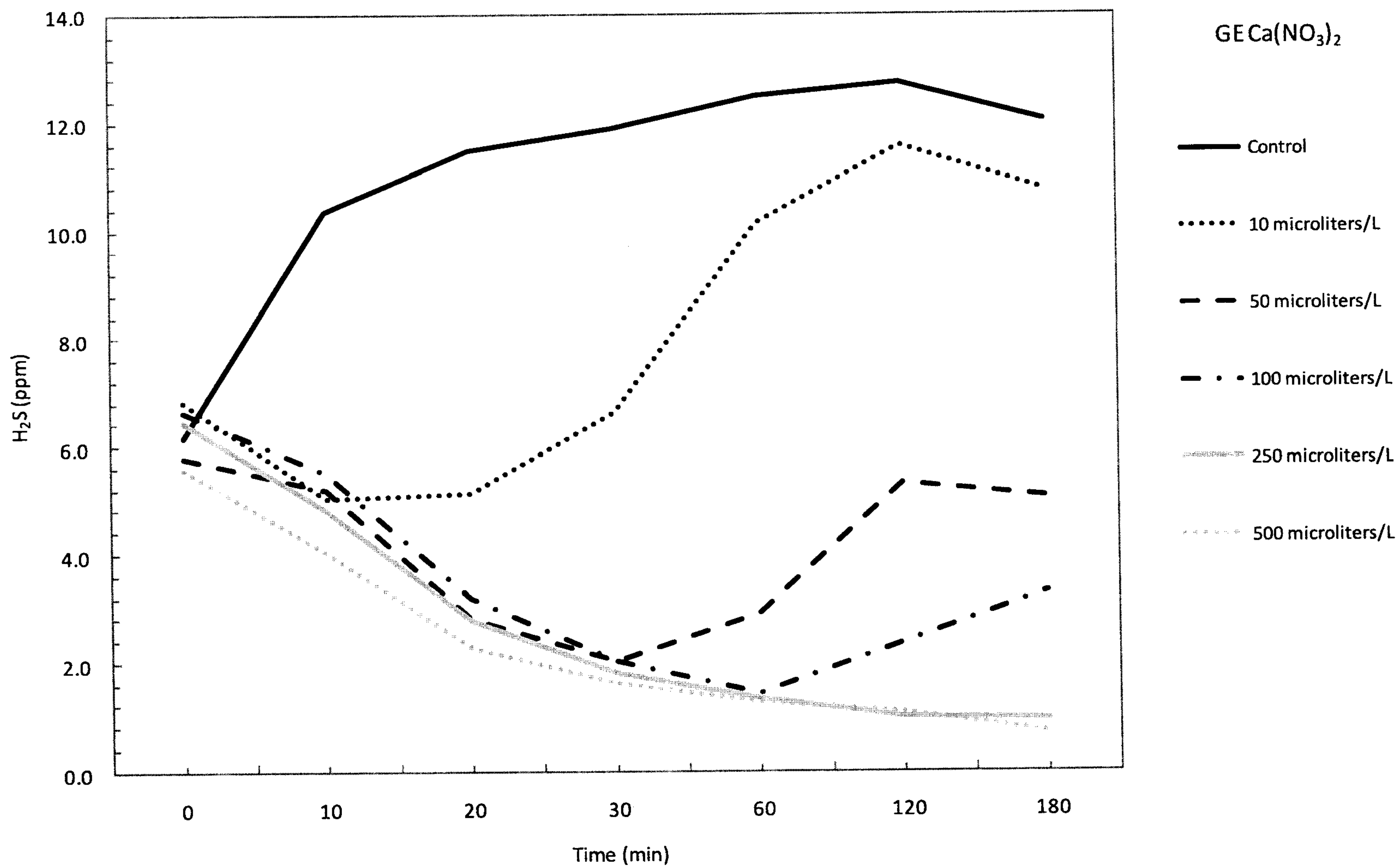


FIGURE II-3: PLOT OF HYDROGEN SULFIDE HEADSPACE CONCENTRATIONS VERSUS TIME FOR FERRIC CHLORIDE TREATMENTS

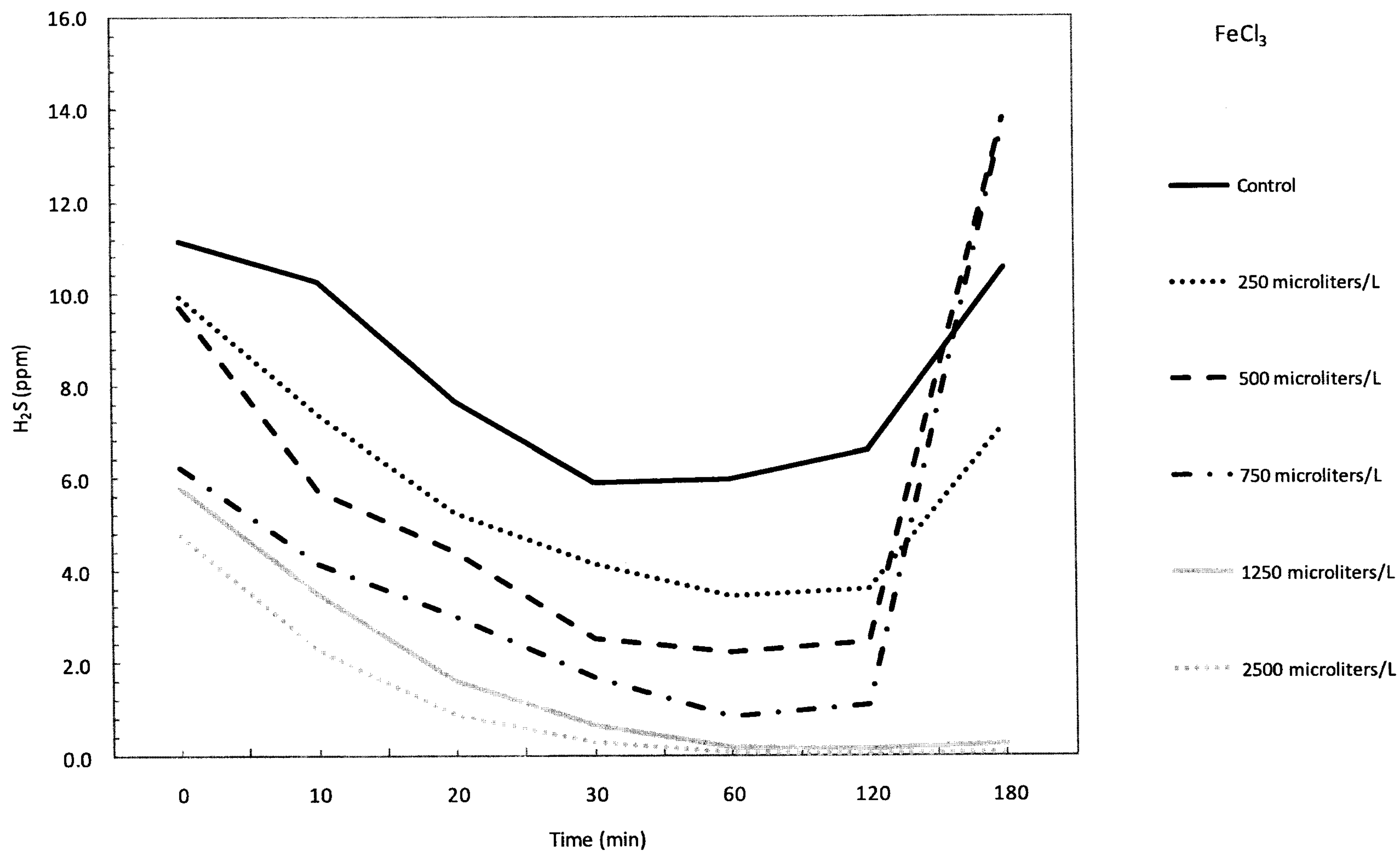


FIGURE II-4: PLOT OF HYDROGEN SULFIDE HEADSPACE CONCENTRATIONS VERSUS TIME FOR BYO-GON® TREATMENTS

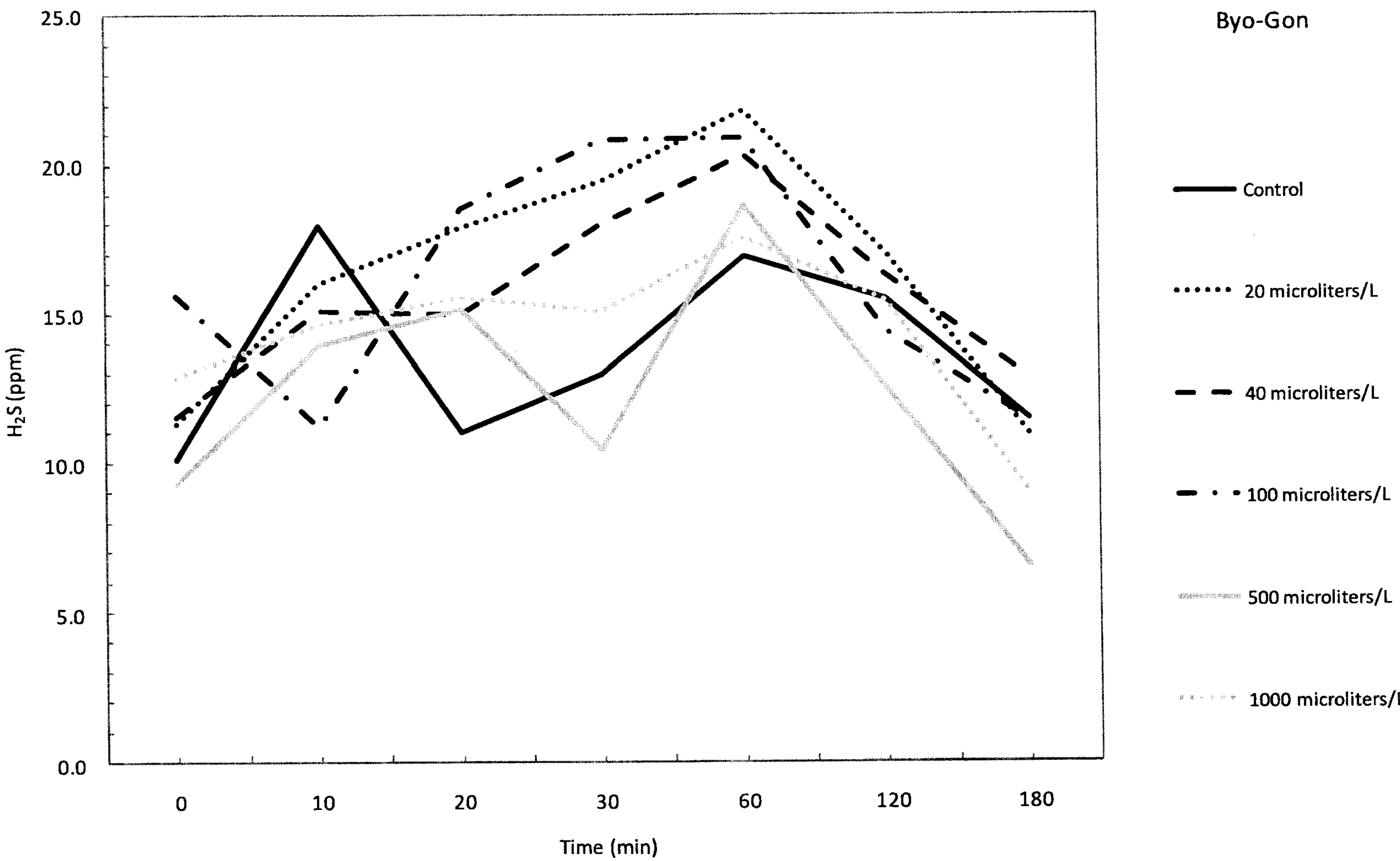


FIGURE II-5: SCHEMATIC OF GRIT SAMPLING CHAMBER

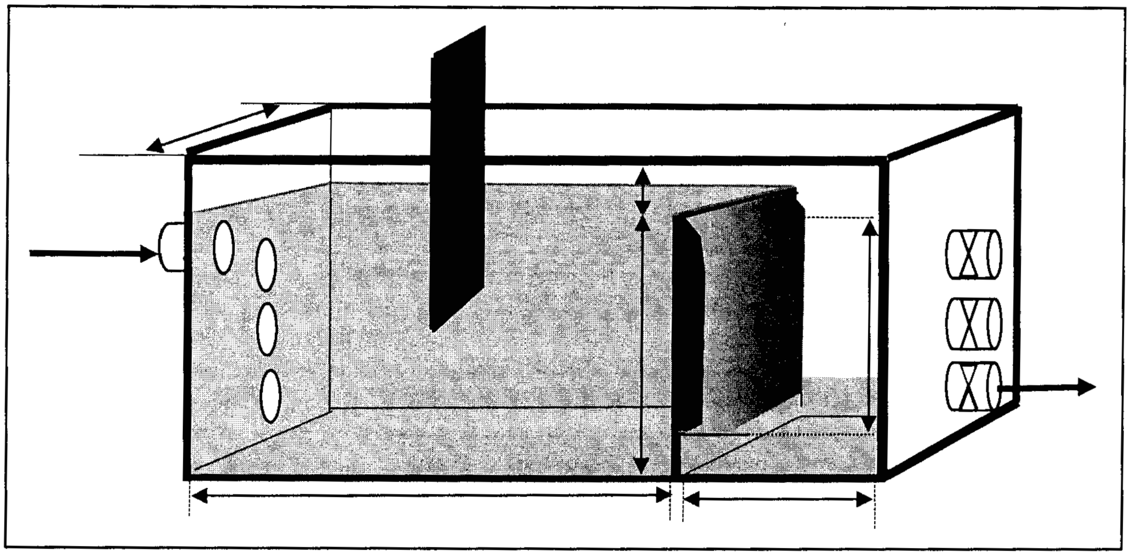


FIGURE II-6: SCHEMATIC OF GRIT SAMPLING PUMP LOCATION

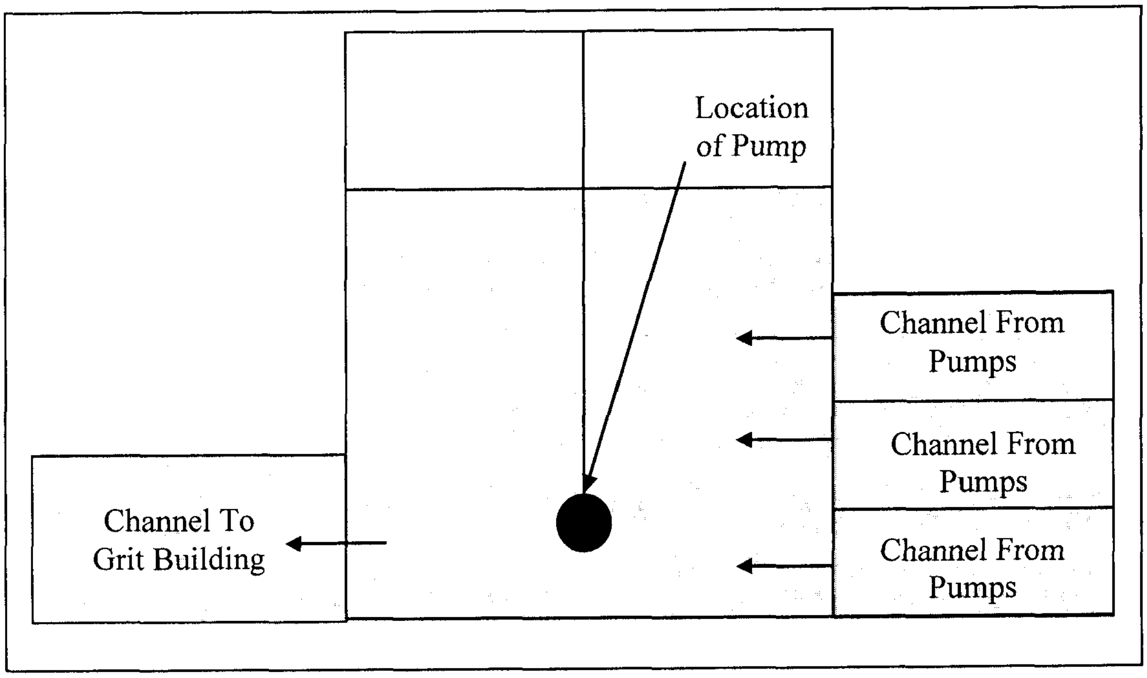


FIGURE II-7: 2010 CUMULATIVE RAINFALL FOR THE EASTERN AND WESTERN STICKNEY WATER RECLAMATION PLANT LOTS

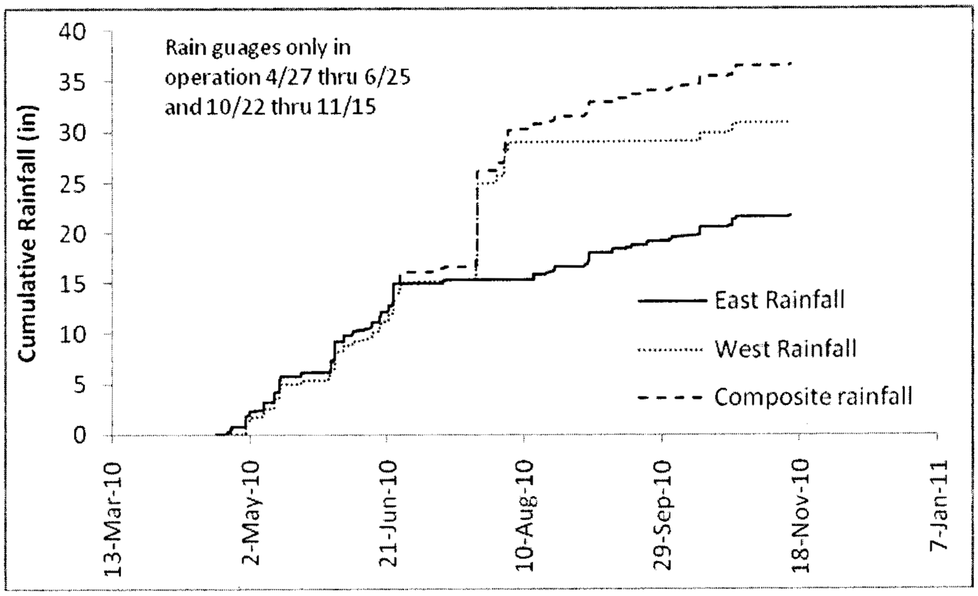


FIGURE II-8: 2010 NEAR-SURFACE WATER LEVEL INCREASES AND RAINFALL FOR THE: (a) POROUS ASPHALT; (b) POROUS CONCRETE; AND (c) POROUS PAVER LOTS

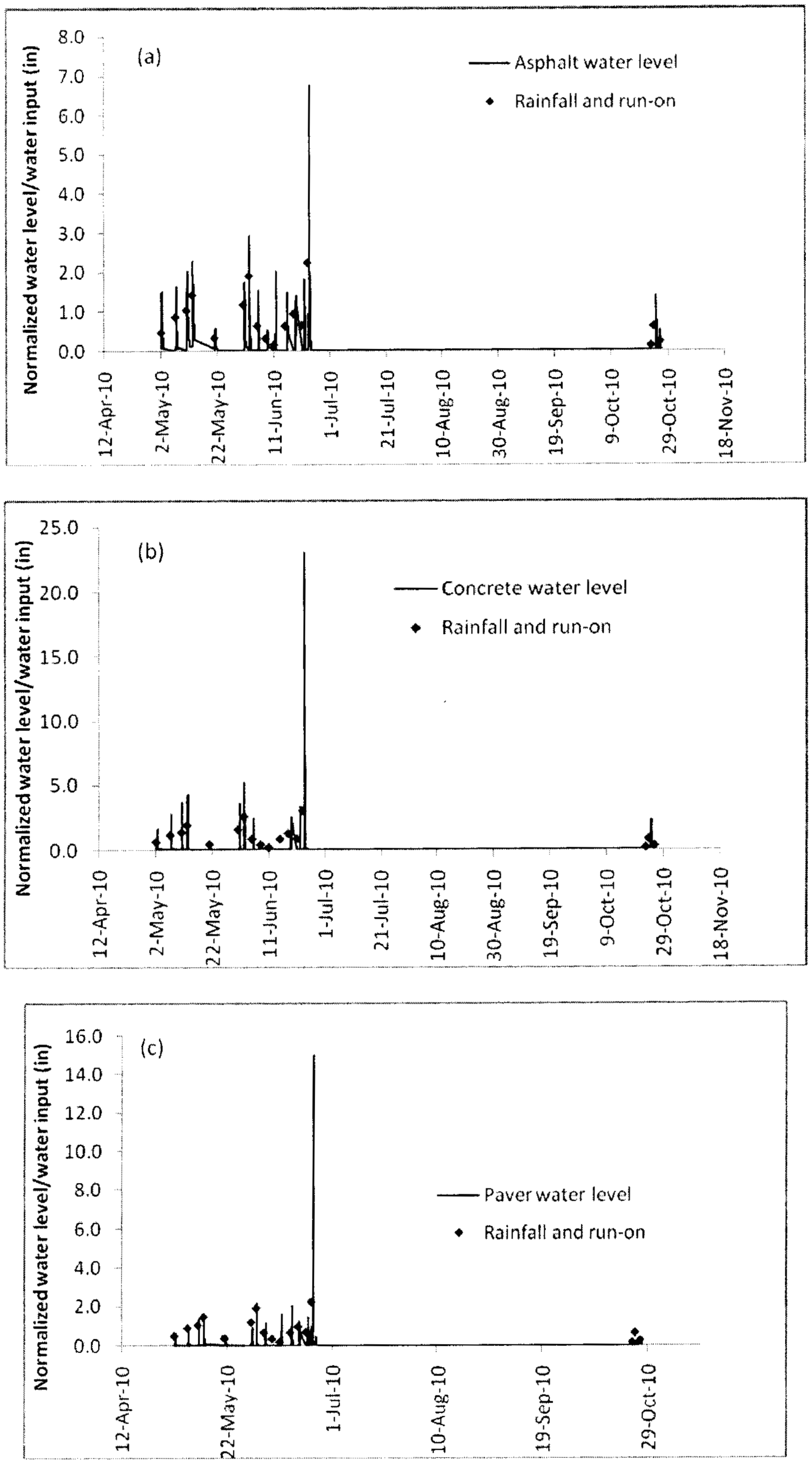


FIGURE II-9: THREE OFF-GAS HOOD CONFIGURATIONS USED DURING SUPPLEMENTAL TESTING

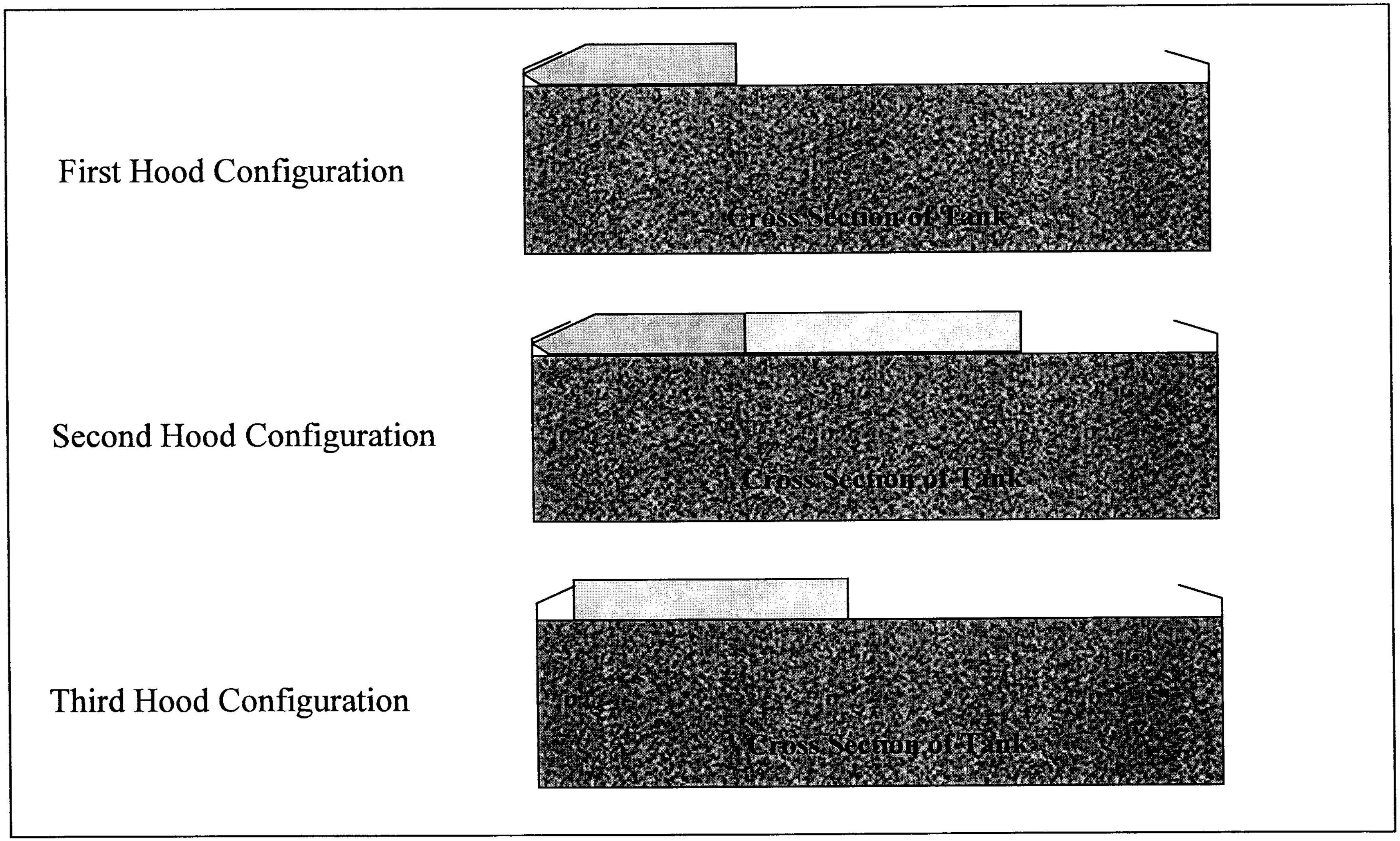


FIGURE II-10: TOTAL SOLIDS IN THE FERRATE-DOSED SECONDARY EFFLUENT SAMPLES FROM THE MAY 13, 2010, TRIAL

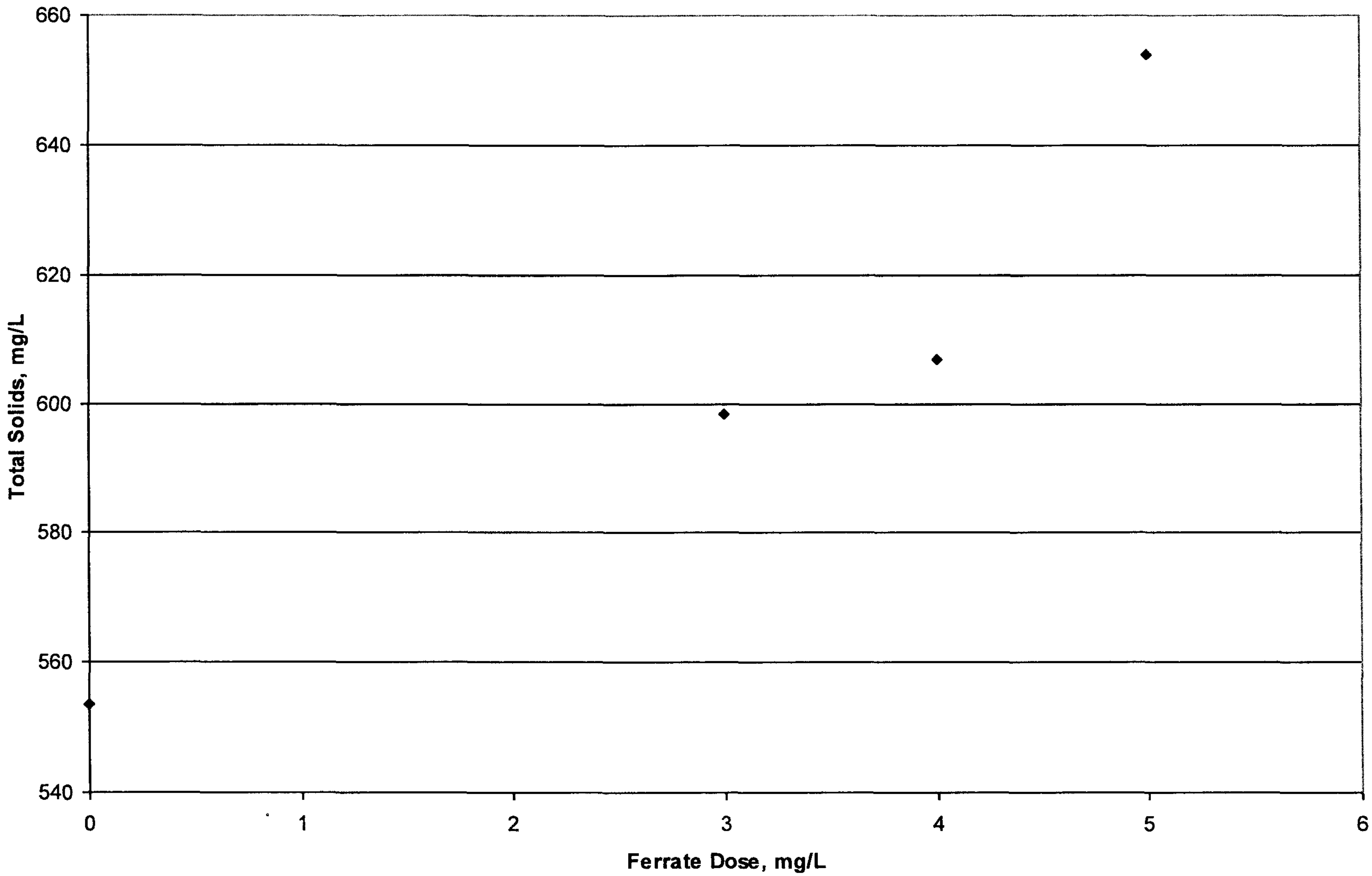


FIGURE II-11: AMMONIA-NITROGEN PROFILE FOR PLUG FLOW AND STEP-FEED TANKS DURING OPERATIONAL STRATEGY 1

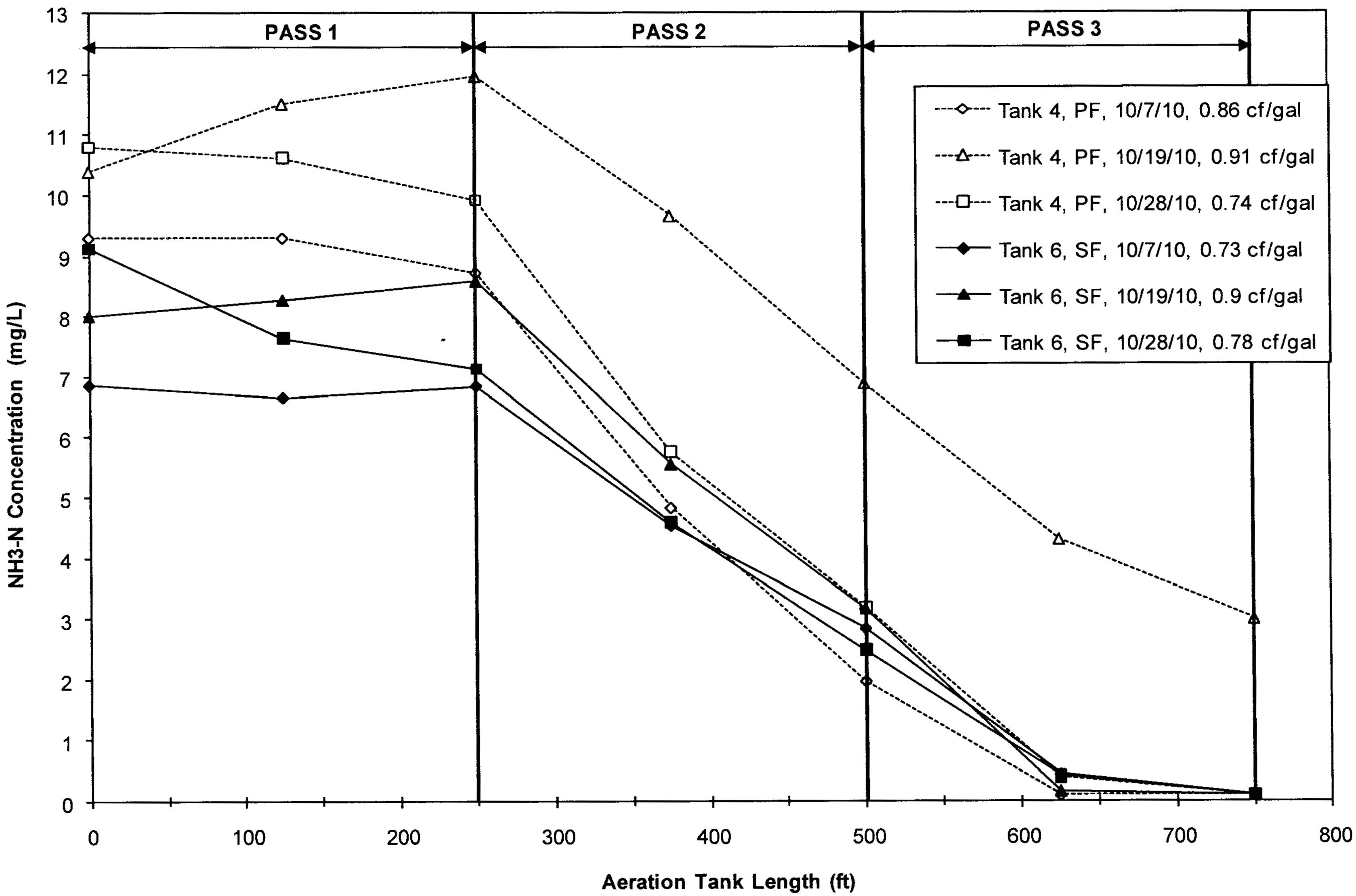


FIGURE II-12: DISSOLVED OXYGEN PROFILES OF PLUG FLOW AND STEP-FEED TANKS DURING THE FIRST HALF OF OPERATIONAL STRATEGY 1

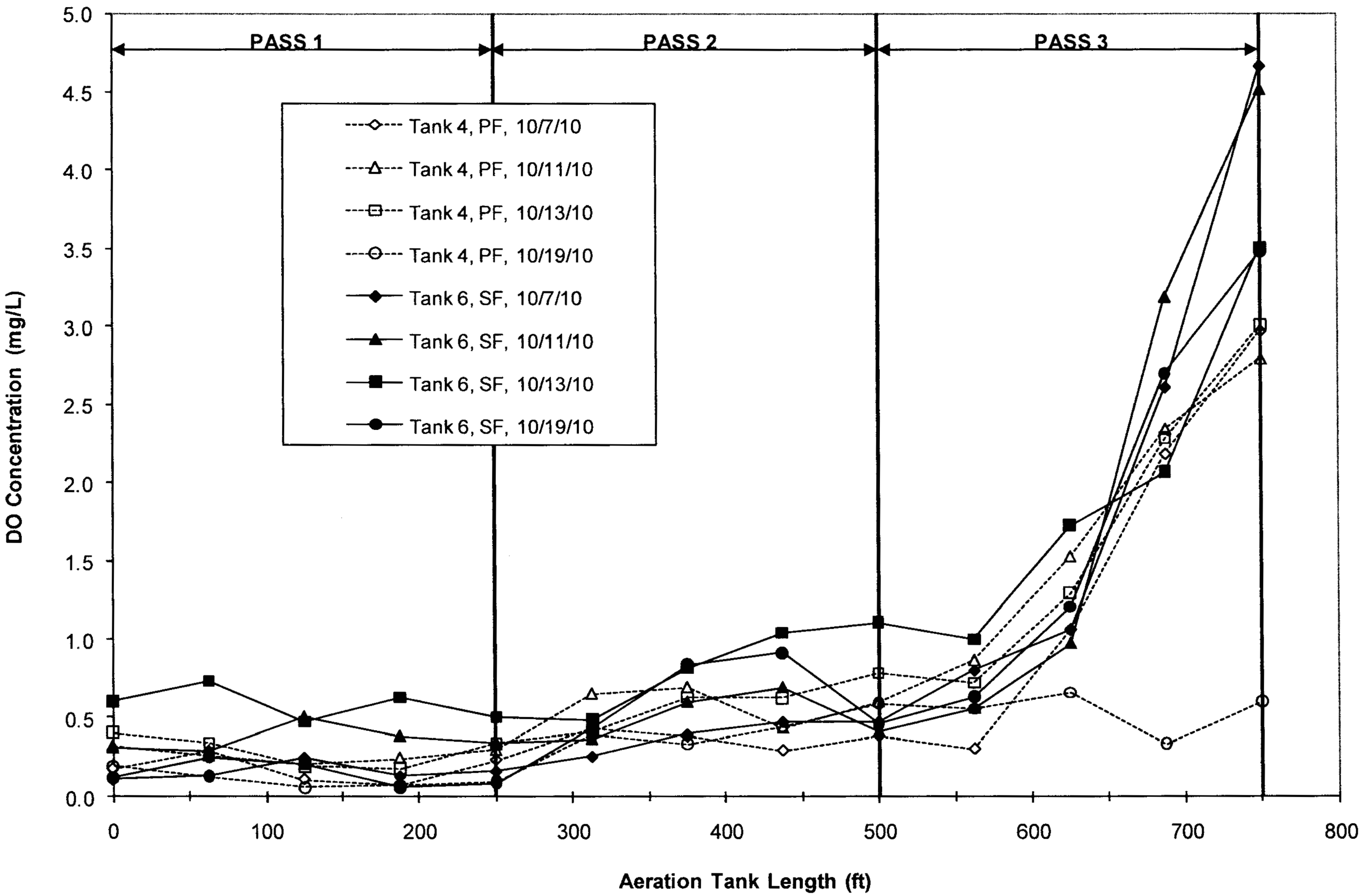


FIGURE II-13: DISSOLVED OXYGEN PROFILES OF PLUG FLOW AND STEP-FEED TANKS DURING THE SECOND HALF OF OPERATIONAL STRATEGY 1

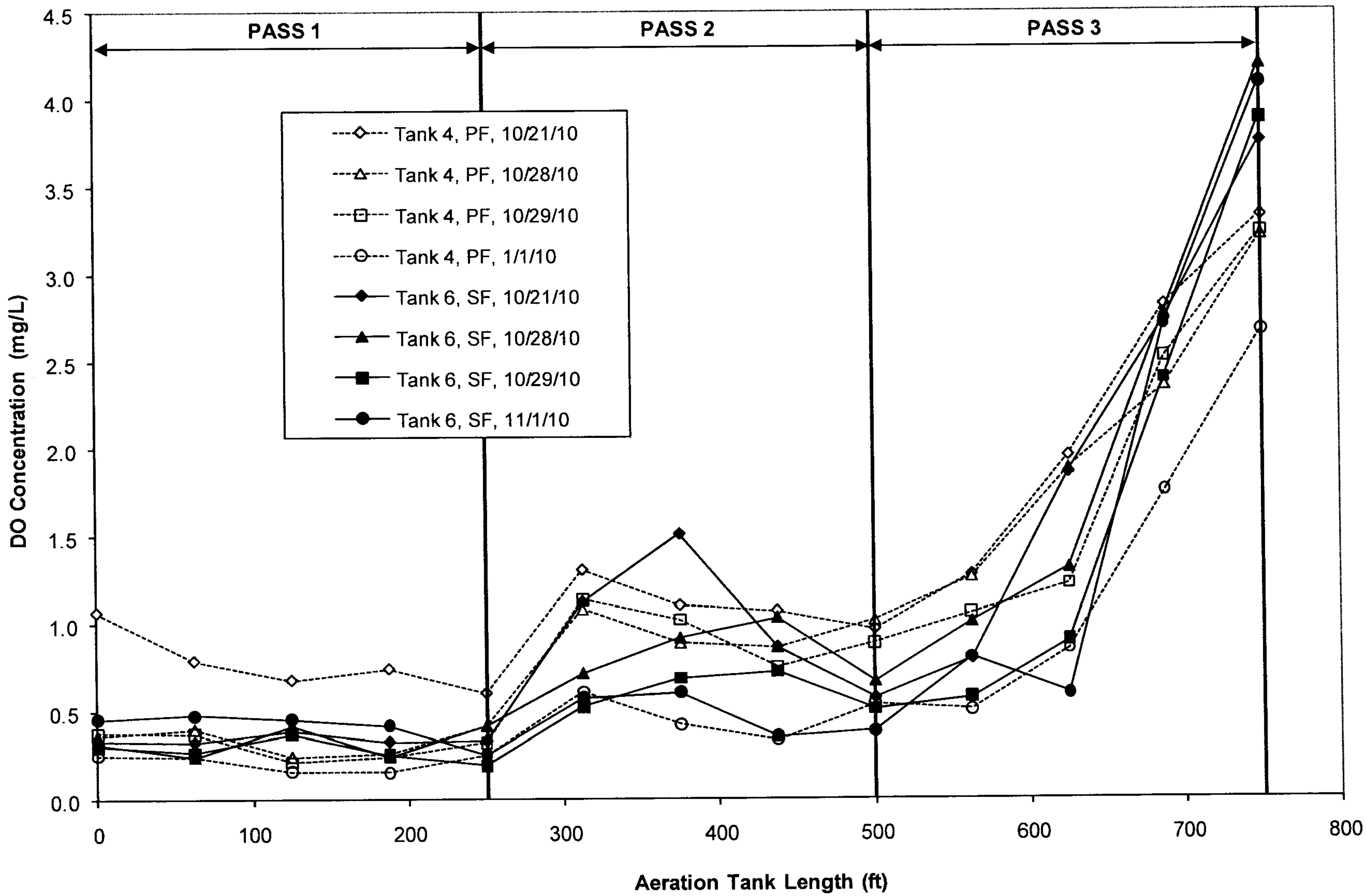


FIGURE II-14: AMMONIA-NITROGEN PROFILES FOR PLUG FLOW AND STEP-FEED TANKS DURING OPERATIONAL STRATEGY 2

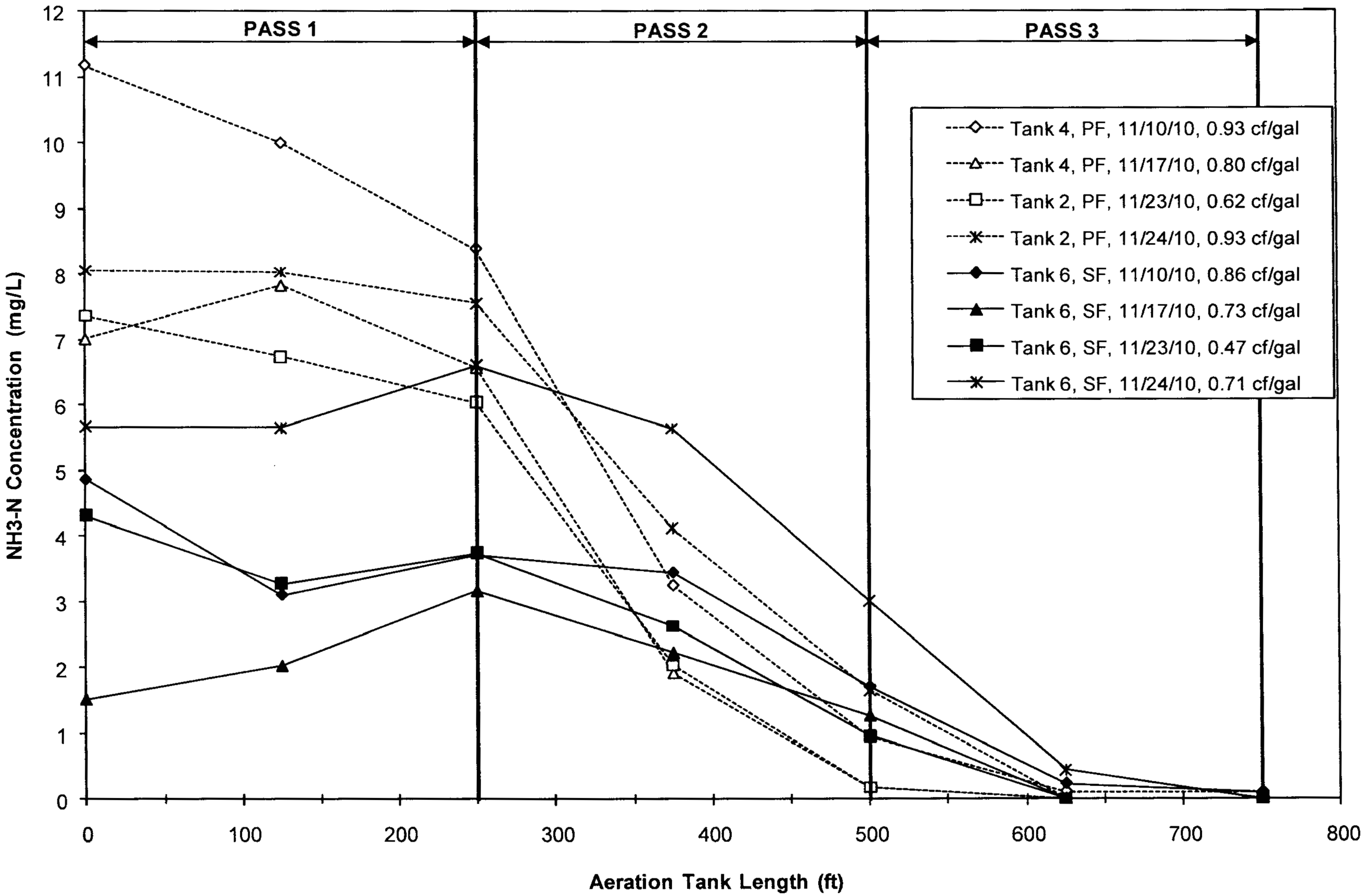


FIGURE II-15: DISSOLVED OXYGEN PROFILES FOR PLUG FLOW AND STEP-FEED TANKS DURING THE FIRST HALF OF OPERATIONAL STRATEGY 2

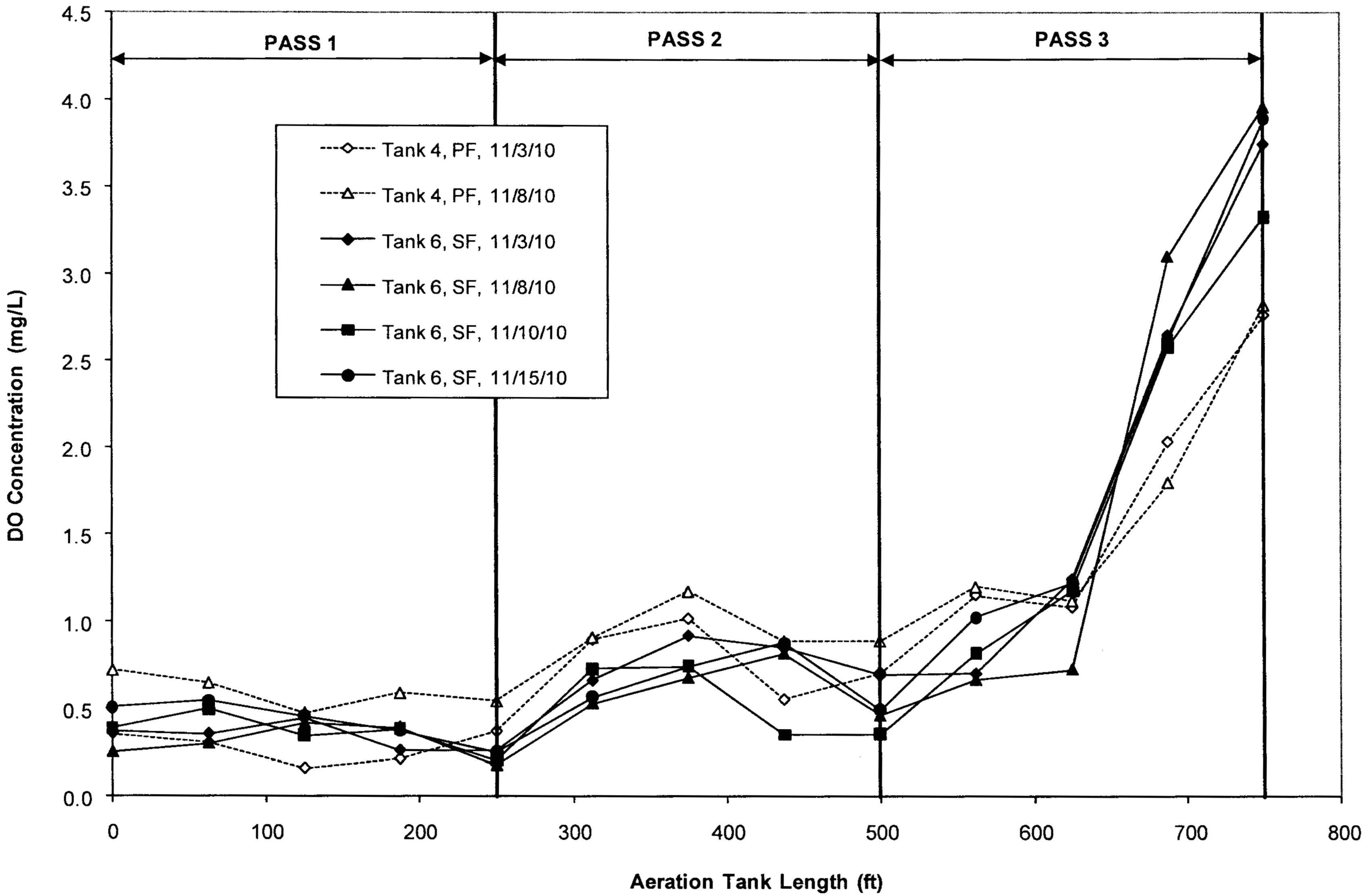


FIGURE II-16: DISSOLVED OXYGEN PROFILES FOR PLUG FLOW AND STEP-FEED TANKS DURING THE SECOND HALF OF OPERATIONAL STRATEGY 2

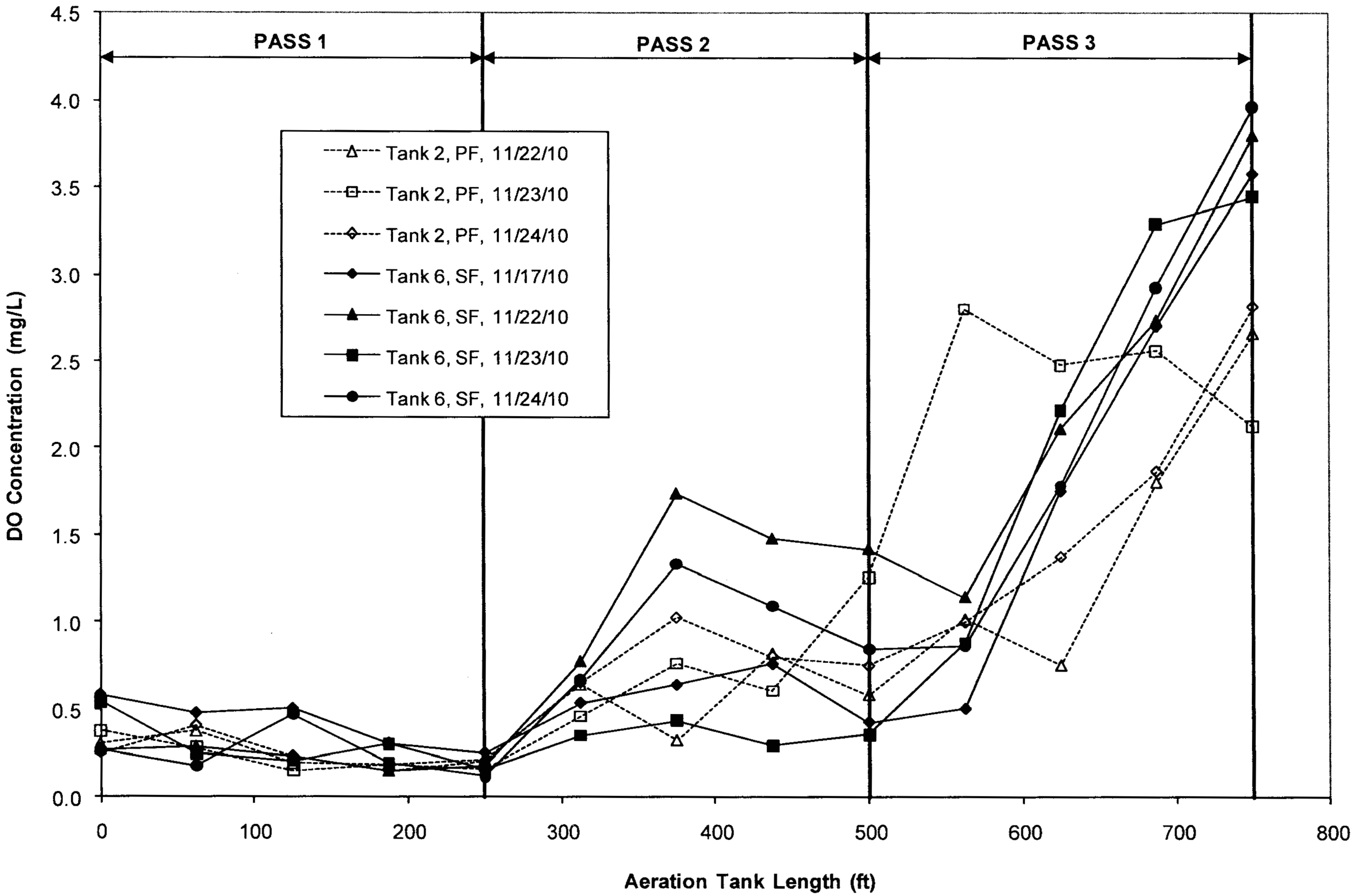


FIGURE II-17: SUSTAINABLE STREETSCAPE PROJECT STUDY AREA AND MONITORING LOCATION

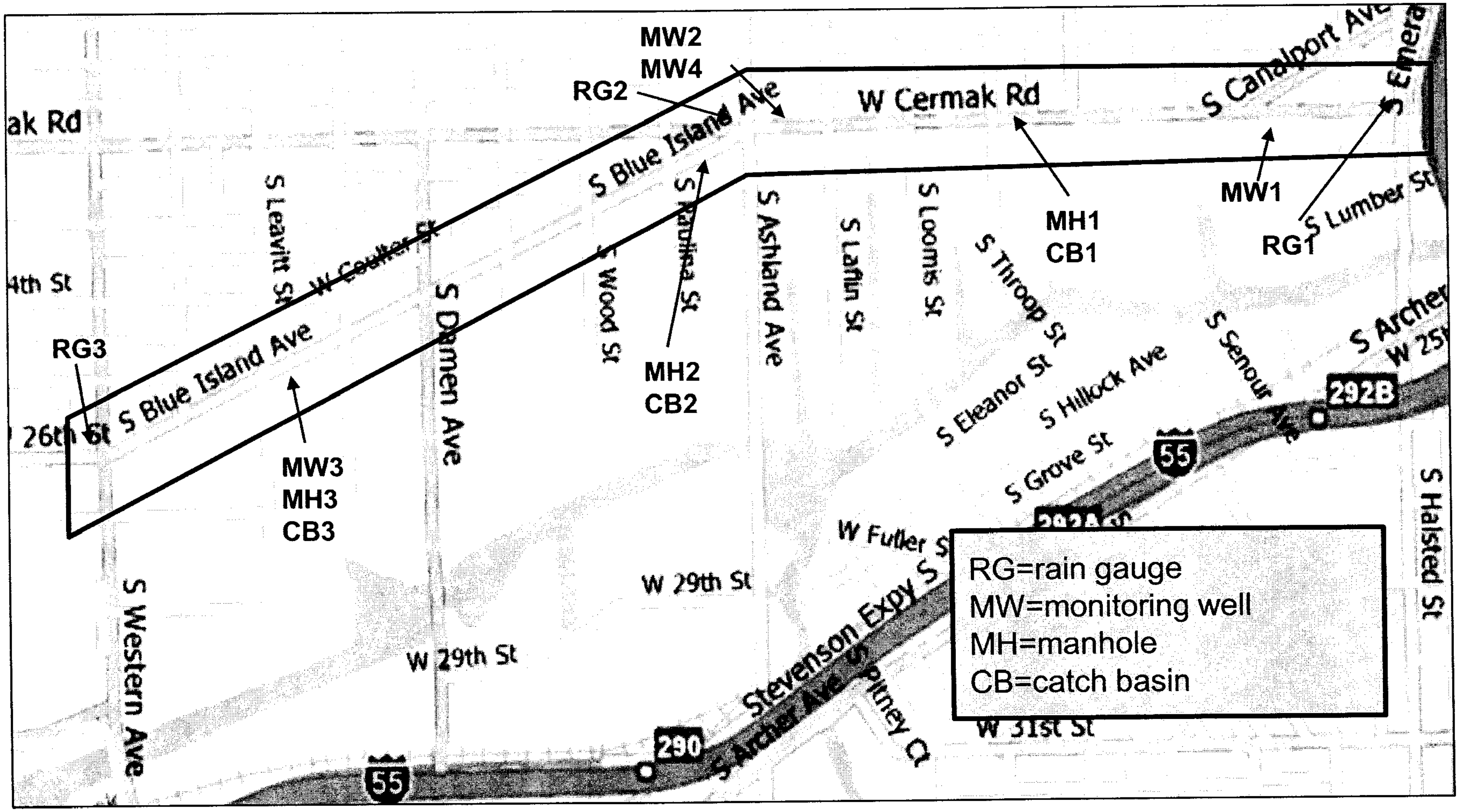


FIGURE II-18: CUMULATIVE PRECIPITATION FROM JANUARY 2010 THROUGH OCTOBER 2010 FOR RAIN GAUGE 1 (RG1), RAIN GAUGE 2 (RG2), AND RAIN GAUGE 3 (RG3)

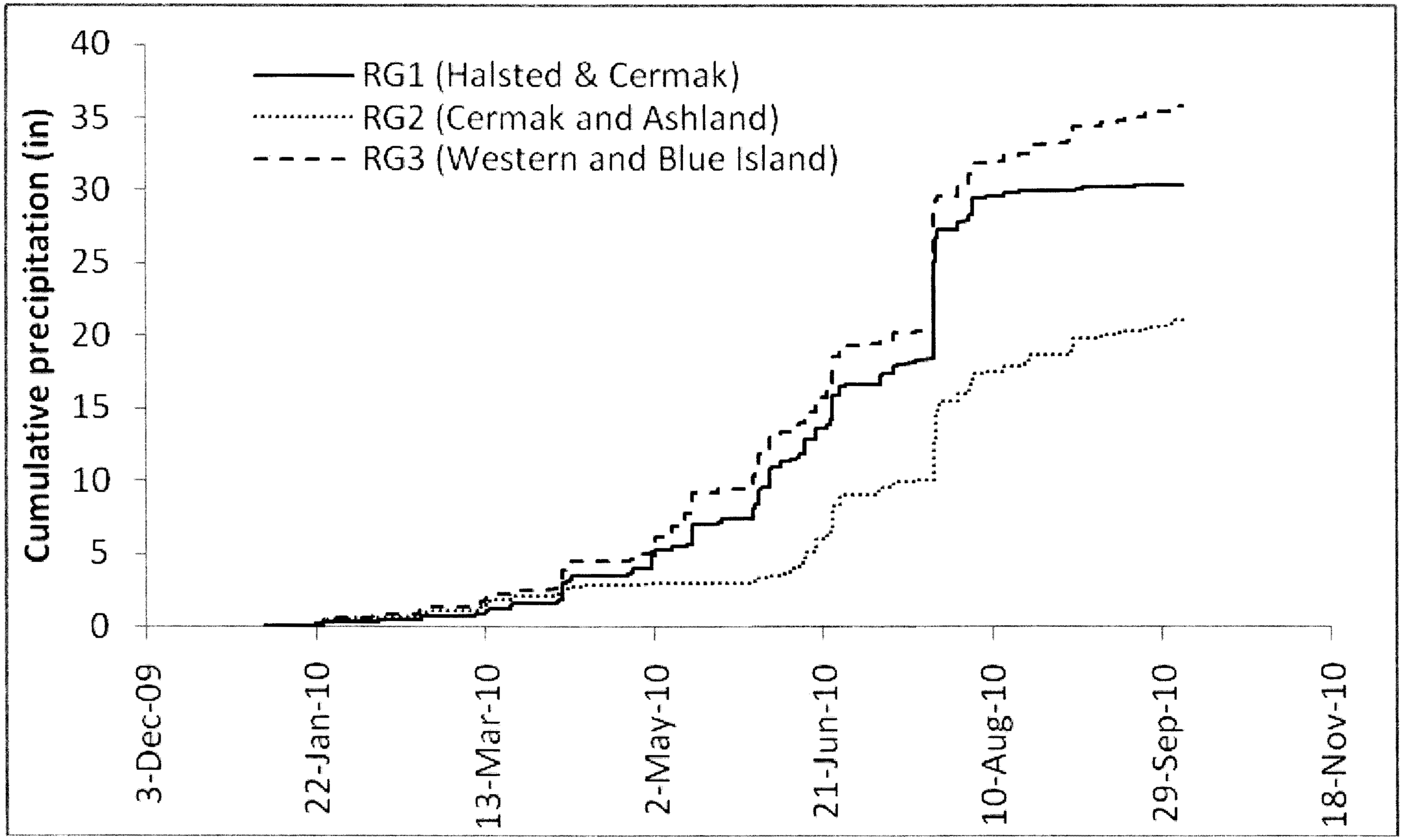


FIGURE II-19: TEMPORAL PLOTS OF DEPTH TO GROUNDWATER FROM GRADE LEVEL FOR THE UNITED STATES GEOLOGICAL SURVEY MONITORING WELLS (MWs) AND PRECIPITATION FOR 2010

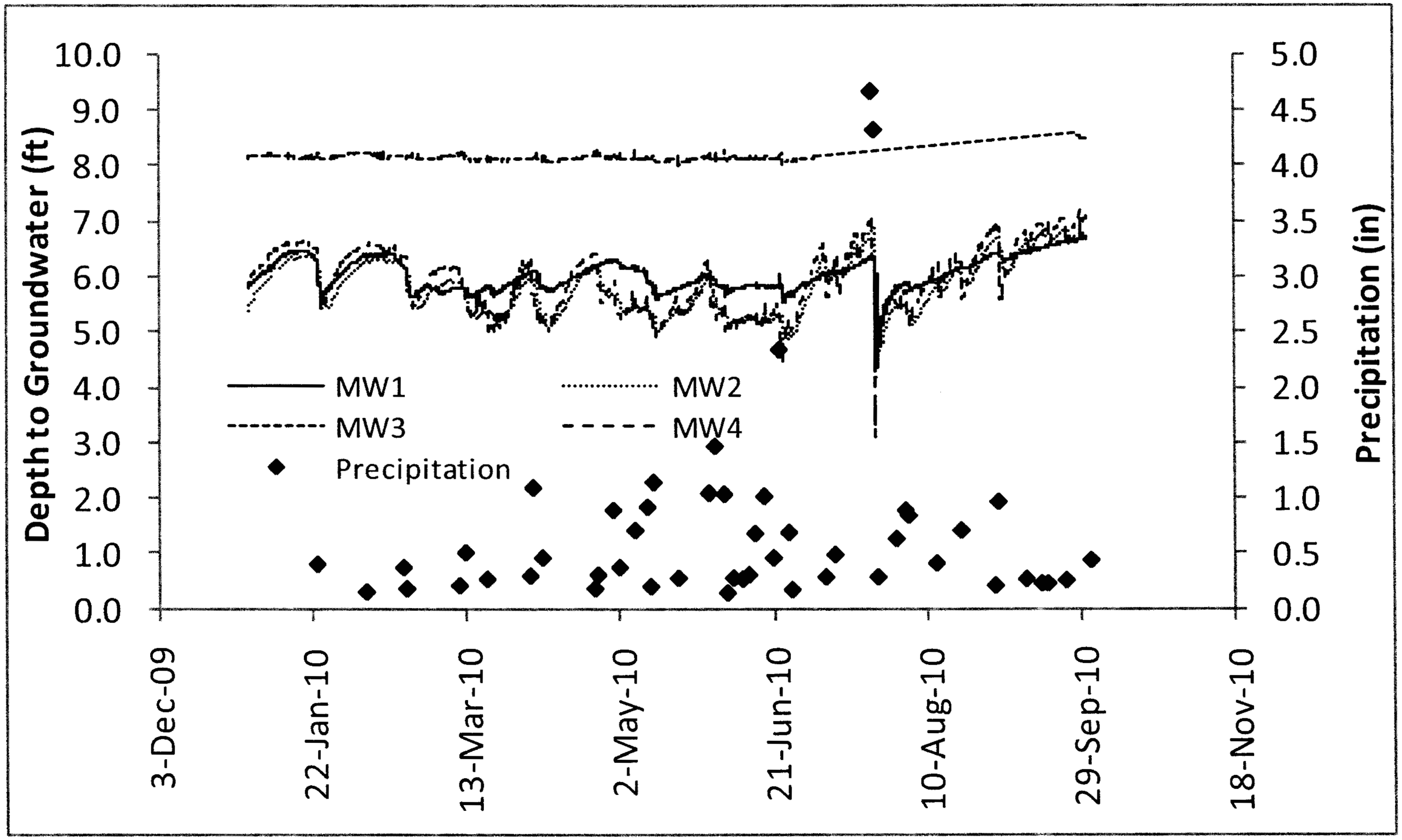


FIGURE II-20: TEMPORAL PLOTS OF GROUND WATER CONDUCTIVITY FOR UNITED STATES GEOLOGICAL SURVEY MONITORING WELLS (MWs)

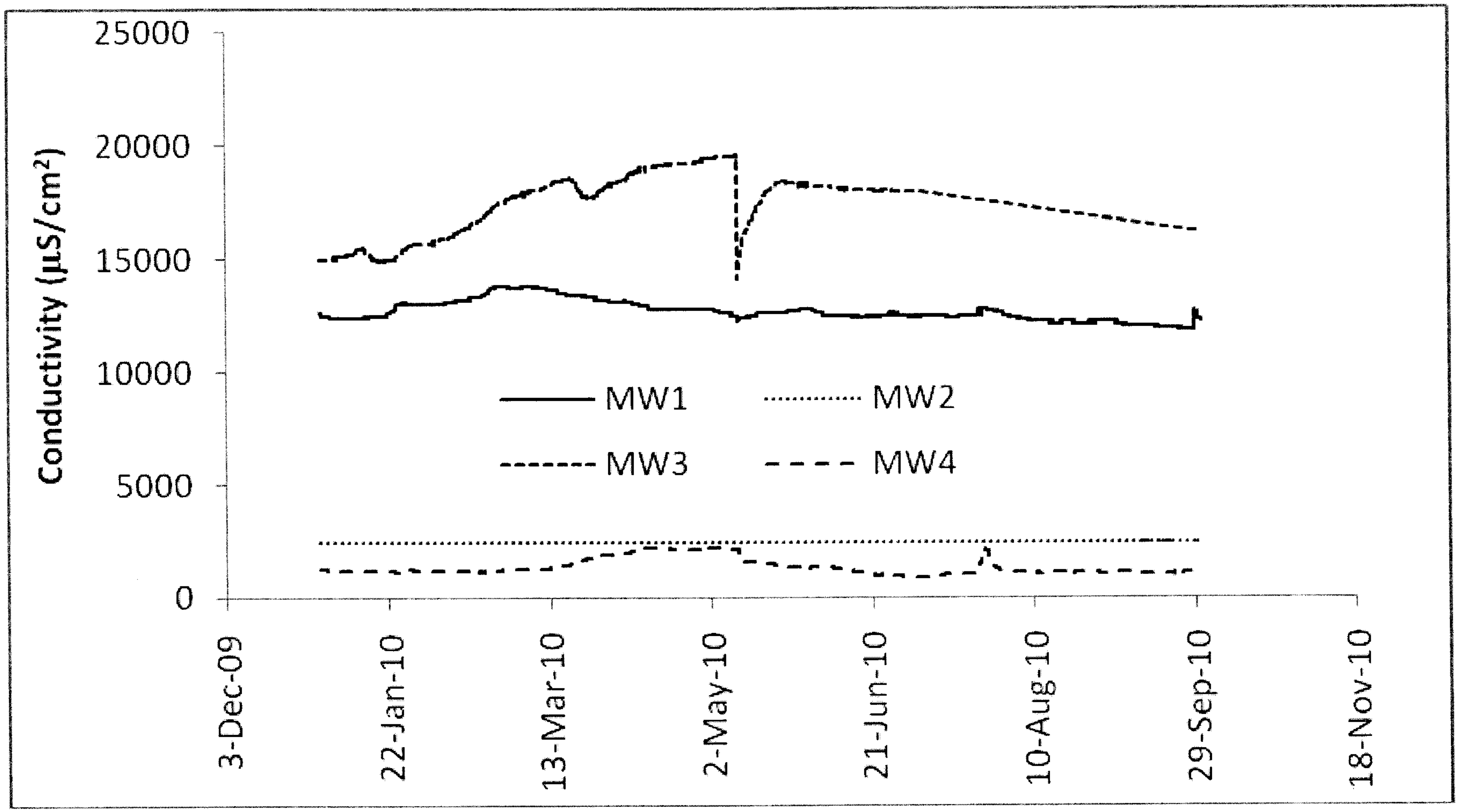


FIGURE II-21: PLOT OF 2010 GAUGE HEIGHT AND PRECIPITATION DATA FOR (a) FLOW METER 1 (FM1); (b, c) FLOW METER 2 (FM2); AND (d) FLOW METER 3 (FM3)

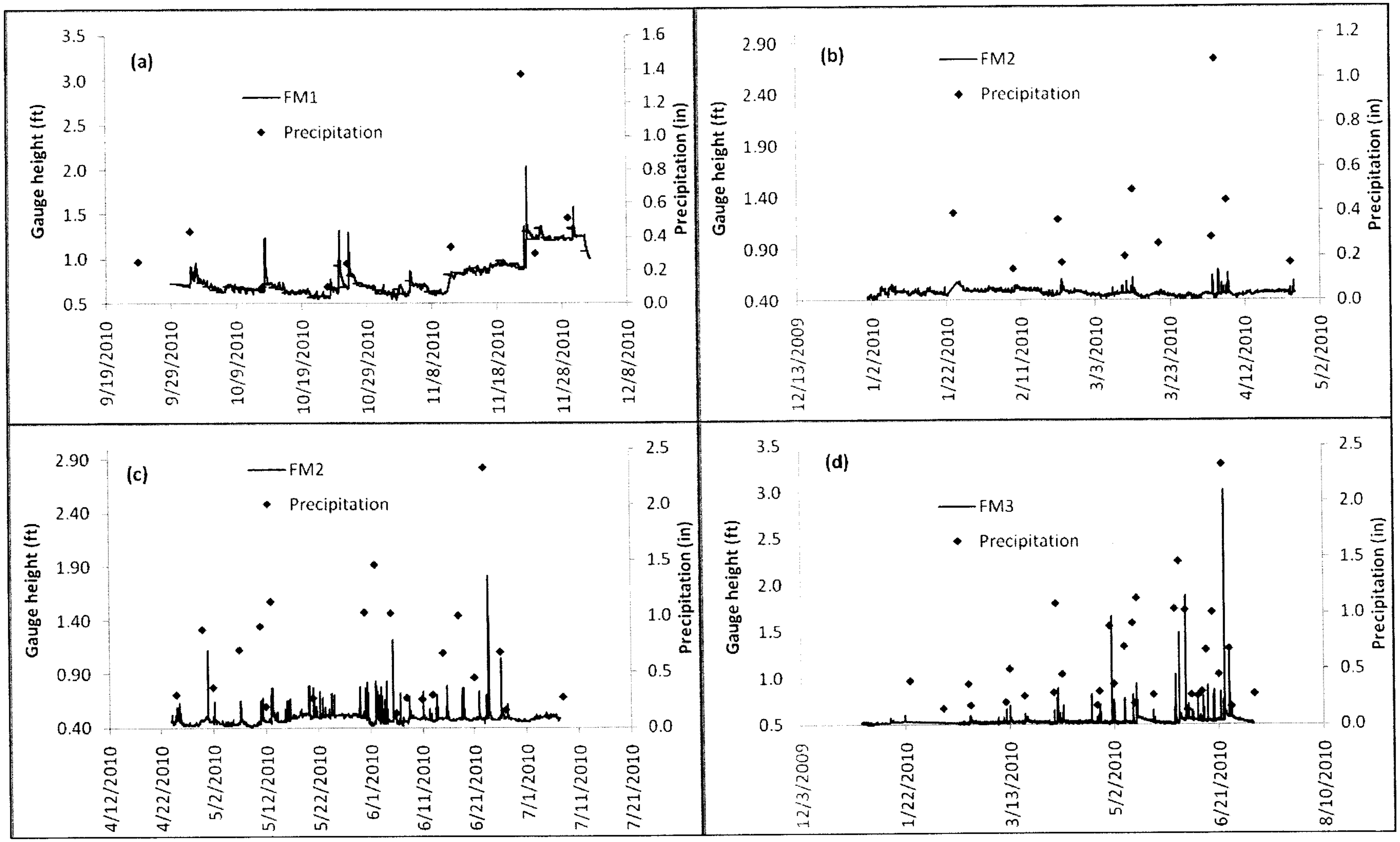
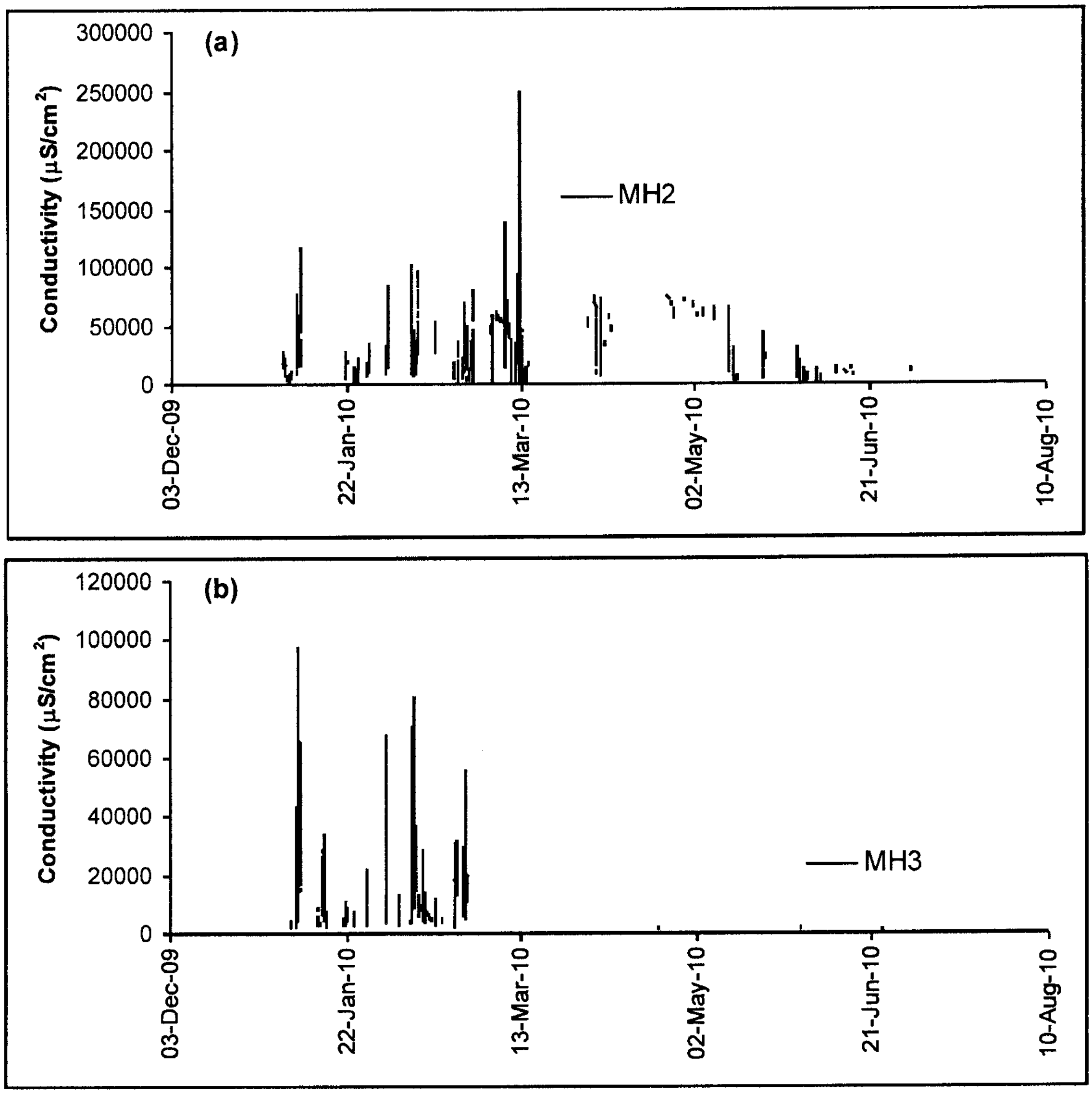


FIGURE II-22: PLOT OF 2010 SEWER WATER CONDUCTIVITIES AT
(a) MANHOLE 2 (MH2) AND (b) MANHOLE 3 (MH3)



BIOSOLIDS UTILIZATION AND SOIL SCIENCE SECTION

BIOSOLIDS UTILIZATION AND SOIL SCIENCE SECTION

The role of the Biosolids Utilization and Soil Science Section is to apply science for the continuous improvement in the sustainability and cost effectiveness of District's biosolids management program through:

1. Research, technical assistance, and public outreach;
2. Contribution to formulation of relevant regulations;
3. Compliance with applicable regulatory requirements;
4. National leadership in biosolids management;
5. Assistance on the District's green initiatives.

The long-range goals of the Biosolids Utilization and Soil Science Section are:

1. To conduct environmental monitoring and reporting to comply with permits and regulations governing the District's biosolids management program.
2. To conduct applied research aimed at evaluating the benefits and environmental impacts of the land application of biosolids.
3. To promote the beneficial use of biosolids through dissemination of information, demonstrations, public relations, and technical support to biosolids users.
4. Monitor and review regulations and relevant issues to evaluate the impacts on the District's operations and assist with the development of technically sound regulations.
5. To provide technical support on green initiatives relevant to the District's operations.

Environmental Monitoring and Reporting

The activities conducted under the environmental monitoring and reporting goal include sampling and analysis of biosolids, waters, soils, and plant tissue as required at the biosolids land application sites, landfills, and biosolids drying facilities. The results of this monitoring are reported to the IEPA and the USEPA

Fulton County Environmental Monitoring. The Fulton County Land Reclamation Site is a large tract of land, 6,122.5 hectares (15,264.5 acres), owned by the District in Fulton County, Illinois. Approximately 600 hectares (1,483 acres) were sold through auction in the fall of 2004. The site is used to recycle biosolids for the purpose of reclaiming mine soil and fertilizing agricultural crops. To satisfy the IEPA permit requirements for operation of the site, the District established an environmental monitoring program to ensure that the land application of biosolids would not adversely affect surface water, groundwater, soils, and crops. The M&O staff located at the Fulton County site is responsible for collecting environmental monitoring samples from the site, when needed, and submitting them to the Soil Science Laboratory or Analytical Laboratory Division for analysis.

No supernatant or biosolids were applied to Fulton County fields during 2010. Supernatant was last applied in 1995, and biosolids were last applied in 2004. Termination of monitoring for soil, crop, and surface and groundwater sites was approved by the IEPA in September 2006 and the coal refuse areas in July 2007. Therefore, no environmental monitoring or reporting is required until such time that biosolids application resumes. On a discretionary basis, samples of soil, plant tissue, groundwater, and surface water from a few locations at the site are collected every two years to add soil and plant tissue samples to the repository and add data to the historical database for the site. The water samples are analyzed, but soil and plant tissue samples are stored without analysis. In 2010, water samples were collected from 15 surface water sites and a total of 100 soil samples were collected from 20 fields.

Hanover Park Fischer Farm. The Hanover Park Fischer Farm is a 48-hectare (120 acres) tract of land, which utilizes all biosolids generated at the Hanover Park WRP. The farm, located on the south side of the WRP grounds, has seven gently sloping fields, each surrounded by a berm to control surface runoff. Anaerobically digested biosolids are applied by injection from tank trucks. The IEPA operating permit (No. 2007-SC-2951-1) for the site limits the annual biosolids application rate to 56 dry Mg/ha (25 dry tons/acre). An underground tile drain system collects surface and subsurface drainage, which is returned to the Hanover Park WRP for treatment. Groundwater monitoring is required by the IEPA operating permit. Monitoring wells on the farm have been sampled twice monthly since biosolids applications began in 1979. Following a request to the IEPA in 2009 to reduce the monitoring frequency of the wells, approval was granted to discontinue the monitoring of Well No. 1 and reduce the monitoring frequency of all other wells, except Well No.7, to quarterly. The analytical data for groundwater sampled from these wells were submitted to the IEPA in the quarterly monitoring reports for 2010 (M&R Report Nos. 10-22, 10-44, 10-58, and 11-11).

Groundwater Quality Monitoring at the Solids Management Areas. Groundwater quality is monitored at the Solids Management Areas (SMAs) where paved cells are used for the air-drying of lagoon-aged or centrifuge cake biosolids. Following a request to the IEPA to reduce the monitoring frequency for groundwater quality at the SMAs, beginning January 2010, monitoring frequency was modified to quarterly for all lysimeters, except three, which are monitored monthly. During 2010, the IEPA approved the termination of the monitoring of twelve lysimeters at the various drying sites, which were replaced by new lysimeters.

Groundwater Quality Monitoring at the Calumet Water Reclamation Plant Solids Management Area. The Calumet West and Calumet East SMAs were constructed at the Calumet WRP in 1986 and 1990, respectively. The IEPA operating permit (No. 2010-AO-0265) for both facilities requires quarterly groundwater monitoring Analytical data were submitted to the IEPA in the quarterly reports for water samples in 2010 from lysimeters at the Calumet West SMA (M&R Report Nos. 10-21, 10-43, 10-54, and 11-8) and from lysimeters at the Calumet East SMA (M&R Report Nos. 10-20, 10-42, 10-60, and 11-9).

Groundwater Quality Monitoring at the Lawndale Avenue Solids Management Area. In 1983, the District began biosolids drying operations on clay surface cells at the Lawndale Avenue Solids Management Area. These drying surfaces were paved with asphalt in 1984. The IEPA operating permit for this site (No. 2010-AO-0267) requires quarterly groundwater monitoring, except for lysimeters L-4N and L-6N, which are monitored monthly. The analytical results for lysimeter and well samples collected in 2010 were submitted to the IEPA in quarterly monitoring reports (M&R Report Nos. 10-24, 10-46, 10-59, and 11-12).

Groundwater Quality Monitoring at the Ridgeland Avenue Solids Management Area. The solids drying area at the Ridgeland Avenue Solids Management Area was originally constructed with a clay surface, and drying began in 1987 until the area was paved with asphalt in 1992 and 1993. The IEPA operating permit for this site (No. 2010-AO-0267) requires groundwater monitoring. Based on permit modifications in 2009, monitoring of all lysimeters has been terminated, except lysimeter L-2N, which is monitored monthly. Analytical results for the lysimeter samples collected during 2010 at this site were submitted to the IEPA in quarterly monitoring reports (M&R Report Nos. 10-25, 10-48-, 10-53, and 11-13).

Groundwater Quality Monitoring at the Harlem Avenue Solids Management Area. In 1990, the District began biosolids drying operations at the Harlem Avenue Solids Management Area (HASMA). The IEPA operating permit for this site (No. 2009-AO-2715-1) requires quarterly monitoring of all lysimeters. Analytical data for water sampled from lysimeters in 2010 were submitted in quarterly reports to the IEPA (M&R Report Nos.10-23, 10-45, 10-55, and 11-10).

Groundwater Quality Monitoring at the 122nd and Stony Island Solids Management Area. Commencing in 1980, biosolids have been dried at the SMA located at 122nd Street and Stony Island Avenue on clay surface drying cells. The drying cells were paved in 1992. The IEPA operating permit for this site (No. 2010-AO-0267) requires quarterly monitoring of all lysimeters, except lysimeter L-1, which is monitored monthly. Analytical results for lysimeter samples and collected during 2010 from lysimeters at this drying facility were submitted to the IEPA in quarterly monitoring reports (M&R Report Nos.10-26, 10-49, 10-57, and 11-14).

Biosolids Monitoring Under Process to Further Reduce Pathogens Certification. The Section is responsible for maintaining the District's site-specific certification of process to further reduce pathogens (PFRP) for biosolids processing trains at the Stickney and Calumet WRPs, as awarded by the USEPA. In this certification, the District's air-dried biosolids generated according to a codified operation is designated as Class A according to pathogen standards under the USEPA Code of Federal Regulations Title 40 Part 503 Rule (Part 503). The monitoring program for this certification includes pathogen analysis of biosolids and semi-annual reporting to the USEPA. In 2010, two monitoring reports (as required by the certification) were submitted to the USEPA. The operation of PFRP-codified biosolids processing trains at the Stickney and Calumet WRPs and the Analytical Microbiology Laboratory, which conducts the pathogen analysis, were audited in 2010.

Biosolids Management Regulatory Reporting. In 2010, the Section prepared the 2009 biosolids management report (M&R Report No.10-05) for submittal to the USEPA. This report was prepared to satisfy the reporting requirements of the USEPA's Part 503 regulation.

In addition, 12 monthly reports for the District's Controlled Solids Distribution permit were submitted to the IEPA (M&R Report Nos.10-16, 10-18, 10-19, 10-35, 10-38, 10-41, 10-51, 10-52, 11-02, 11-03, 11-04, and 11-05). The Controlled Solids Distribution (CSD) Program is the District's urban land application program, and the reports prepared by the Section document the biosolids users, project descriptions and locations, and biosolids analyses.

Applied Research

Applied research is conducted in the Monitoring and Research laboratories and greenhouse, the District's Fulton County land reclamation site, and at other field sites in the Chicago area. Some of the research projects are conducted in collaboration with other institutions.

Corn Fertility Experiment on Calcareous Mine Spoil. Since 1973, the District has been conducting a corn fertility experiment on calcareous mine spoil at the Fulton County site. The purpose of this experiment is to evaluate the effect of long-term applications of anaerobically digested biosolids on crop yields, crop chemical composition, and mine spoil chemical composition. The experiment was designed to simulate biosolids application to fields at the site at agronomic and reclamation rates and to provide information that can be used for the management of biosolids and crops.

This is the longest running continuous biosolids research experiment in the country. Data on metal uptake in corn tissues from these plots were used in the risk assessments conducted by the USEPA to develop the Part 503 biosolids regulation, which was promulgated in 1993. All 38 years of soil and plant tissue samples are available in the sample repository at the Fulton County site.

The study consists of four treatments of biosolids or commercial fertilizer applied to the plots each year. The annual and cumulative (1973 – 2010) amounts of biosolids or commercial fertilizer applied in each treatment are listed in Table III-1. Table III-2 shows a four-year comparison (2007 to 2010) of soil data from the experimental plots. Table III-3 shows the nutrient and metal concentrations in corn grain for the four treatments. Table III-4 shows the comparison of the corn grain and stover yields for 2007 through 2010. The results show that although biosolids applications increased the concentration of some metals in the soil, the concentrations of metals in corn grain in the biosolids-amended plots were similar to those in the control plots. In addition, corn yield increased as the biosolids application rate increased. Over time, the quality of the data collected from the plots has been decreasing, mostly because of cross contamination between the plots. Therefore, the operation of these plots was discontinued at the end of 2010, and establishment of new plots is scheduled for 2011.

Effect of Moisture and Storage on Biosolids Odor. Air-dried biosolids produced by the District's solids processing trains are utilized as a fertilizer and soil amendment under the CSD program. These air-dried biosolids often develop odor when stockpiled (or stored) for more than one week. The potential for odor has a negative impact on the cost-effectiveness of biosolids management because it limits the acceptability of stockpiled biosolids and year-round availability of dried biosolids. An understanding of the factors that contribute to the development of odors when air-dried biosolids are stored in stockpiles will help in identifying methods that can be used to produce air-dried biosolids to increase public acceptance, year-round availability, and the overall market value of biosolids under the CSD program. For this study, we speculated that a major cause of odor in the District's stockpiled, air-dried biosolids is the residual moisture (20 – 40 percent) which facilitates increased microbial activity and results in the emission of odorous organic and sulfur-containing compounds when biosolids are stockpiled. Therefore, we hypothesized that there is a critical moisture level at which microbial activity in stockpiled biosolids is significantly reduced with minimal potential for odor emissions and that this can be achieved with little modification to current operations.

In July 2010, a batch of biosolids was air-dried to produce six 40 cubic yard units of six different solids content (55 – 80 percent solids). Each of the six biosolids units were stockpiled separately inside a garage at HASMA. The stockpiles were scheduled for sampling biweekly during the first two months and after 8 and 12 months of stockpiling. The samples were tested for odor emissions and chemical and physical properties to evaluate changes in biological stability over time. The data in Table III-5 show that odor (ED50) in the six stockpiles increased during the first 15 days and fluctuated on a decreasing trend thereafter. At 60 days after stockpiling, odor levels were much lower than those observed at 15 days. During the sampling conducted in 2010 (first two months), ammonium nitrogen (N) in the biosolids increased while the nitrate-N concentrations decreased over time, which suggests transformation of different N species in the biosolids. The data suggest that during storage, transformation of N species and a short-term increase in odor of stockpiled biosolids occur irrespective of the solids contents, but the odor potential decreases over time.

Potential Nitrogen Mineralization from Centrifuge Cake and Lagoon-Aged, Air-Dried Biosolids. Utilization of the District's biosolids in the Farmland Application Program and for turfgrass under the CSD program is based primarily on their fertilizer nitrogen (N) value. The rate of mineralization and release of the organic fraction of biosolids N governs the N value of biosolids and land application rates. A study was conducted to determine the N mineralization rates in soils amended with District biosolids. A silty clay loam and a sandy soil collected from experimental plots located in Will and Kankakee Counties, IL, respectively, were adjusted to 80 percent field capacity moisture content. The soils were amended with centrifuge cake biosolids from the Stickney WRP and the Calumet WRP, lagoon-aged, air-dried biosolids from the Calumet WRP, and Millorganite (as a control) at two rates of 12.5 and 25 Mg/ha. A non-amended control for each soil was also included. The soils were incubated at $20\pm2^{o}C$ for 100 days. In a complementary experiment, centrifuge cake biosolids from the Stickney WRP and aged, air-dried biosolids from the Calumet WRP were also incubated with a soil previously labeled with ^{15}N. The incubated soils were sampled periodically and analyzed for mineral N (NH_4^+-N and NO_3^--N) and ^{15}N enrichment of mineral-N (where applicable). Nitrogen mineralization in both control soils and biosolids- amended soils followed first-order kinetics. The data in Table III-6 show that the average percent biosolids-N mineralized varied among biosolids and followed the order: Millorganite (44 percent) > Stickney WRP centrifuge cake (35 percent) > Calumet WRP centrifuge cake (31 percent) > lagoon aged, air-dried biosolids (13 percent). The percent N mineralized in the Stickney WRP cake and the Calumet WRP aged, air-dried biosolids determined from the ^{15}N study were 32 percent and 12 percent, respectively, which are similar to the values determined from the non-labeled study.

Biosolids Phosphorus Studies. Many states are implementing regulations to minimize phosphorus contamination of water bodies due to runoff from the land application of biosolids. This project was started in 2003 in collaboration with the IEPA and University of Florida to address the potential for the environmental impacts associated with the application of District biosolids to cropland and to minimize the impact of future biosolids phosphorus regulations on District operations. The project included greenhouse and field studies to evaluate plant availability of biosolids and laboratory and field studies to evaluate the potential for phosphorus runoff from farm fields on which District biosolids are applied. The studies were completed in 2010. Journal articles and a white paper assessing the potential impact of biosolids phosphorus regulations on the District's farmland application program are being prepared.

Farmland Application of Class B Biosolids Project. The practice of Class B biosolids application to farmland has met with public concern and opposition in some regions of the United States. Most of the concerns stem from misinformation about the potential human health and environmental risks from pathogens and trace metals in the Class B biosolids applied to farmland. In the fall of 2004, the District began a research and demonstration project on farmers' fields in Will and Kankakee Counties to demonstrate the safety of the farmland application of Class B centrifuge cake biosolids and to improve the overall public perception and the understanding of communities residing in the vicinities of biosolids-amended farmlands. The field project sites were used by the District and farmland application contractor to host field days. The data collection component of this project was concluded in 2007. A journal article and final report are being prepared.

Fate and Transport of Biosolids-Borne Triclosan and Triclorban. Triclosan (TCS) and triclorban (TCC) are the active ingredients widely used in the personal care product market, and these compounds are discharged from industries and households to wastewater treatment plants. In 2008, the District began a study in collaboration with the University of Florida to conduct laboratory and bench scale tests on samples of District biosolids to determine the levels of TCS and TCC in the biosolids and the fate of these compounds in biosolids-amended soil.

Investigation of Stabilization of Dewatered Biosolids in Lagoon. The District's exceptional quality air-dried biosolids, which are produced by lagoon-aging and air-drying, are utilized under the CSD program in the Chicago metropolitan area on golf courses, parks, and athletic fields. The odor potential of the dried biosolids is a major factor controlling the cost of managing the biosolids, public acceptance, and the economic value of the product. In 2009, the District initiated a project to investigate mechanisms of biosolids stability and the factors controlling odor potential during the processing of District air-dried biosolids. The study was done in collaboration with the Illinois Institute of Technology and was focused on the determination of indices of biosolids stability during lagoon-aging. This project was completed in 2010, and a paper reporting the results of the study has been submitted for journal publication.

Greenhouse Gas Accounting of Biosolids Management Program. The use of biosolids is known to directly or indirectly affect the generation of methane and nitrous oxides and soil carbon sequestration, which can be translated into carbon debits and credits in greenhouse gas accounting. In collaboration with the University of Washington, the District conducted a study to evaluate the carbon credits and debits for each of the District's end-uses of biosolids for both 2001 and 2008. The end-uses evaluated were centrifuge cake landfill disposal, centrifuge cake as fertilizer on farmland, and air-dried biosolids utilization as landfill final cover, on urban recreational areas, and for the reclamation of mineland at Fulton County. A report on this project was prepared in 2010.

Use of Biosolids in Ecological Restoration. As part of its efforts to promote the use of biosolids in the City of Chicago, this project was initiated in 2009 to address issues raised by the United States Fish and Wildlife Service and other stakeholders regarding the suitability of biosolids for ecological restoration in Chicago's Calumet region. The project is being conducted in collaboration with The Ohio State University. The study consists of evaluating field plots in which biosolids and other recyclable materials are used as a soil amendment to determine the impact of these treatments on soil biology. The concentrations of various contaminants in runoff water are also being evaluated.

Promotion and Technical Support to Biosolids Beneficial Reuse Program

The section provides technical support to projects under the Controlled Solids Distribution Program in which exceptional quality air-dried biosolids are used in the Chicago Metropolitan Area and to the Class B Biosolids Farmland Application Program. The technical support is done to help biosolids users maximize the benefits they receive from the programs and to ensure that the District and the users comply with applicable regulations and permits. In addition, the section conducts marketing activities to promote the use of biosolids under the Controlled Solids Distribution Program.

Controlled Solids Distribution Program. The activities the Section conducted in 2010 to promote and support the CSD program include:

1. Technical support on projects where biosolids were used as a soil conditioner or fertilizer topdressing by 13 schools, 17 park districts and suburban villages, five golf courses, two landscaping companies, one athletic club, four cemeteries, and two District properties.

2. Established demonstration plots at the Stickney WRP grounds to display the benefits of biosolids for turf grass fertilization.

3. Collaborated with the City of Chicago to evaluate and promote the use of biosolids for the development of parks and recreational areas in Chicago.

4. Preparation of biosolids information pamphlets.

5. Conducted one field day at which attendees toured the Stickney WRP, biosolids demonstration plots, and biosolids processing facilities.

6. Hosted a biosolids exhibition booth at the Illinois Association of Park Districts/Illinois Parks and Recreation Association annual exhibition.

Class B Biosolids Farmland Application Program. The activities the Section conducted in 2010 to support the program include:

1. Reviewed 215 field information packets for potential application of biosolids to fields. This includes reviewing field location, soil pH and liming levels, ensuring buffers are established for surface water protection. Inform neighbors and public officials near each application site of the biosolids application. Approval or disqualification of the proposed fields is recommended to M&O.

2. Conducted field inspections and meetings with individuals and community groups in response to public concerns regarding the program.

Regulatory Review

The Section conducts regulatory reviews in response to proposed regulations that can potentially affect District operations. Some of these reviews are requested by professional affiliations or organizations. In 2010, the Section conducted the following regulatory reviews:

1. At the request of National Association of Clean Water Agencies, comments were provided on USEPA's proposal to include sewage sludge destined for incineration in "Solid Waste" definition.

2. Illinois House Bill, HB 4936, proposal to amend the Illinois Fertilizer Act of 1961 to prohibit application of fertilizer containing phosphorus to turf grass.

Support to Green Initiatives

Stickney Permeable Pavement Project. In this project, the District is evaluating porous pavement technology for stormwater management in the Chicago Metropolitan Area. In 2010, the Section assisted in conducting evaluations of the permeable pavements. The Section also assisted in designing the monitoring plan to assess the performance of the pavement.

Native Landscaping. During 2010, the Section provided technical support for maintenance of the conventional and native prairie landscaping at the District's facilities.

Native Prairie Research and Demonstration Plots. The Section established long-term native prairie research and demonstration plots at the Stickney WRP in November 2008 in collaboration with M&O. These plots are maintained for the long term and no data will be collected until the native prairie landscaping vegetation develops sufficiently to begin evaluation of the performance of the treatments.

TABLE III-1: BIOSOLIDS APPLICATION RATES AT THE CORN FERTILITY EXPERIMENTAL PLOTS AT THE FULTON COUNTY RECLAMATION SITE FOR 2010

Treatment[1]	Biosolids Application Rate (Dry Weight Basis)			
	Annual		Cumulative	
	Mg/ha	tons/acre	Mg/ha	tons/acre
Control	0.0	0.0	0.0	0.0
¼-Max	16.8	7.5	605	271
½-Max	33.6	15.0	1,210	540
Max	67.2	30.0	2,419	1,080

[1]Control plots receive 336-224-112 kg/ha of N-P-K annually and biosolids amended plots receive 112 kg K/ha annually.

TABLE III-2: MEAN pH, ELECTRICAL CONDUCTIVITY, AND CONCENTRATIONS OF ORGANIC CARBON, NUTRIENTS AND METALS IN THE SURFACE SOIL[1] FROM THE CORN FERTILITY EXPERIMENTAL PLOTS AT THE FULTON COUNTY RECLAMATION SITE FOR 2007 – 2010

				Organic	0.1N HCl Extracted[3]						Concentrated HNO_3 Extracted							
Plot[2]	Year	pH	EC	Carbon	Zn	Cd	Cu	Cr	Ni	Pb	Zn	Cd	Cu	Cr	Ni	Pb	TKN	Tot-P
			dS/m	%	--------	--------	--------	--------	--------	--------	mg/kg	--------	--------	--------	--------	--------	--------	--------
Check	2007	6.9	0.31	1.27	74.1	6.8	7.0	0.60	4.2	0.05	270	14.3	123	181	47.5	58.1	1,739	3,026
	2008	7.1	0.51	0.86	66.7	6.2	16.0	1.7	5.1	0.42	178	10.7	90.3	149	42.3	44.5	1,329	2,531
	2009	7.2	0.37	1.03	76.1	6.7	11.4	1.4	5.1	0.18	219	11.9	97.3	164	42.8	50.1	1,654	3,283
	2010	7.1	0.24	0.87	73.6	6.9	11.3	0.75	5.4	0.02	213	11.9	105	183	45.1	53.4	1,253	3,134
1/4	2007	6.8	0.31	2.12	115	9.9	7.0	0.50	5.4	0.01	500	26.4	231	336	61.8	106	2,846	4,904
	2008	7.5	0.47	1.35	89.6	8.0	6.4	0.67	4.4	0.01	320	16.8	153	226	50.8	70.0	1,864	3,205
	2009	7.3	0.33	2.68	121	8.9	6.0	0.75	5.0	0.01	530	24.5	234	323	59.7	106	3,446	6,662
	2010	7.2	0.25	1.49	86.9	7.5	5.1	0.43	3.9	0.02	375	17.5	173	254	52.0	79.4	2,078	4,055
1/2	2007	6.7	0.39	2.29	109	8.9	12.6	1.2	6.4	0.30	484	25.9	230	320	62.8	104	2,781	5,583
	2008	7.2	0.70	2.07	135	10.9	8.5	0.68	6.0	0.012	510	26.5	248	350	65.3	109	2,724	5,090
	2009	6.8	0.42	2.97	159	11.9	14.0	1.3	7.5	0.11	646	32.8	289	422	70.3	135	3,684	7,935
	2010	7.0	0.29	2.25	118	9.1	5.8	0.34	5.4	0.02	627	30.0	298	413	69.2	132	3,428	6,962
Max	2007	6.7	0.46	2.96	151	11.9	13.6	0.98	8.0	0.15	663	35.6	315	448	74.1	141	3,668	6,905
	2008	6.8	1.15	3.97	144	10.5	7.3	0.45	7.0	0.016	789	39.9	398	517	80.6	165	4,456	8,808
	2009	6.7	0.53	4.62	119	7.7	5.5	0.4	5.4	0.001	835	35.8	372	452	71.9	155	5,618	11,692
	2010	6.8	0.40	4.04	106	6.0	4.4	0.13	4.9	0.02	849	34.6	394	462	73.7	162	5,346	10,631

[1]Sampling depth = 0-15 cm.
[2]Check = No biosolids application - inorganic fertilizer. 1/4, 1/2, and Max = 16.8, 33.6, and 67.2 Mg/ha/yr biosolids loading rates, respectively.
[3]Beginning in 2007, 0.1N HCl extractable metals were done by using a single extraction instead of three sequential extractions in previous years.

TABLE III-3: MEAN CONCENTRATIONS OF TOTAL KJELDAHL NITROGEN, PHOSPHORUS, AND METALS IN 33P69 HYBRID CORN GRAIN COLLECTED FROM THE CORN FERTILITY EXPERIMENTAL PLOTS AT THE FULTON COUNTY RECLAMATION SITE IN 2010

Analyte[2]	Treatment[1]			
	Control	1/4-Max	1/2-Max	Max
	----------mg/kg----------			
TKN	13,883	12,586	12,836	12,989
P	2,926	2,992	3,029	2,892
Zn	19.2	25.1	23.2	20.6
Cd	<0.03	<0.03	<0.03	<0.03
Cu	1.02	1.22	1.12	1.10
Cr	0.18	0.25	0.21	0.21
Ni	1.01	1.84	1.37	0.63
Pb	0.21	0.21	<0.20	<0.20
K	4,083	4,146	4,161	4,015
Ca	27.1	29.5	23.7	19.0
Mg	1,185	1,284	1,224	1,087

[1]Control = No biosolids application - inorganic fertilizer. 1/4-Max, 1/2-Max, and Max represent biosolids application rates of 16.8, 33.6, and 67.2 Mg/ha/yr, respectively.

[2]Tissue digested with HNO_3 for metals.

TKN = Total Kjeldahl-N.

TABLE III-4: AVERAGE GRAIN AND STOVER YIELDS FOR HYBRID CORN 33P69 GROWN AT THE CORN FERTILITY EXPERIMENTAL PLOTS FROM 2008 - 2010

		Treatment[1]											
		Control			1/4-Max			1/2-Max			Max		
Harvested Tissue	Unit	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Grain	bu/acre	77	163	69.2	92	48.2	14.6	188	147	51.3	207	208	138
	Mg/ha	4.8	10.3	4.3	5.8	3.0	0.92	11.8	9.2	3.2	13.0	13.1	8.6
Stover	tons/acre	2.3	3.4	1.9	2.8	3.1	1.4	5.1	3.5	2.0	5.3	3.9	2.9
	Mg/ha	5.2	7.6	4.2	6.3	6.9	3.2	11.5	7.8	4.5	11.8	8.7	6.5

[1]Control = No biosolids application - inorganic fertilizer. 1/4-Max, 1/2-Max, and Max represent biosolids application rates of approximately 16.8, 33.6, and 67.2 Mg/ha/yr, respectively.

TABLE III-5: ODOR OVER TIME IN SIX STOCKPILES OF AIR-DRIED BIOSOLIDS AT VARIOUS SOLIDS CONTENT

Treatment (Solids Content)	Stockpiling Period (Days)				
	0	15	30	45	60
	Odor (ED50)				
Stockpile 1 (55%)	52	559	73	94	1
Stockpile 2 (60%)	36	122	81	110	63
Stockpile 3 (65%)	75	321	215	292	29
Stockpile 4 (70%)	27	199	71	205	93
Stockpile 5 (75%)	24	376	125	441	129
Stockpile 6 (80%)	28	205	113	113	79

[1] ED_{50} = Odor detection threshold: The dilution ratio (ambient air:sample air) that has a 50 percent detection probability by an odor panel.

TABLE III-6: MINERALIZATION OF BIOSOLIDS NITROGEN IN TWO SOILS AMENDED WITH TWO RATES OF STICKNEY AND CALUMET WATER RECLAMATION PLANT BIOSOLIDS DURING 100 DAYS INCUBATION

Biosolids Rate	Biosolids	Silty Clay Loam	Fine Sand	Mean
Mg/ha		------------ N Mineralized (%)[1] ------------		
12.5	SWRP - Cake	42.6	28.5	
	CWRP - Cake	38.1	28.7	
	CWRP - Air-dried	12.7	11.0	
	Millorganite	45.8	38.7	
	Mean	**34.8**	**26.7**	**30.8**
25	SWRP - Cake	36.1	33.2	
	CWRP - Cake	27.7	28.9	
	CWRP - Air-dried	18.2	9.2	
	Millorganite	48.9	42.4	
	Mean	**32.6**	**28.4**	**30.5**

[1]Percent N mineralized calculated from potential soil N mineralized (PSN min) using equation: Percent N mineralized = (PSN min. in biosolids-amended soil – PSN min. in unamended control) x 100/Biosolids Organic N.

ANALYTICAL MICROBIOLOGY AND BIOMONITORING SECTION

ANALYTICAL MICROBIOLOGY AND BIOMONITORING SECTION

Section Mission, Goals and Objectives

The Analytical Microbiology and Biomonitoring Section's (AMBS) primary mission is to provide on-time, quality-assured microbiological and biomonitoring assessment to support the District's treatment process operations and environmental stewardship efforts dedicated to the improvement, and/or sustainable optimization of the wastewater treatment; protection of the CAWS water quality; and public health.

To accomplish this mission, the AMBS has the following goals:

- Microbiological and biomonitoring assessment of the District's final effluent (FE) and biosolids, and area rivers, lakes, and canals, to document the treatment effectiveness, improvements, and/or sustainable optimization of the wastewater treatment process.

- Conduct applied research to generate scientific data and up-to-date information on public health concerns (e.g. microbial risk assessment, public health epidemiology, biosolids for land application), emerging chemicals of concern (e.g. endocrine active compounds, antibiotic-resistant bacteria), optimization of the existing processes or potential changes in District operations (high flow, digester mixing, effluent disinfection, nutrient reduction, filament problems) to inform permit compliance, policy, support/guide/assess regulatory development, and support or improve operations.

- Participate in local and national regulatory review of microbial water quality criteria and standards.

- Collaborate with universities and other agencies, including the National Association of Clean Water Agencies, WERF, USEPA, etc., to share scientific information and knowledge about wastewater treatment processes and public health protection.

- Provide outreach activities to promote education, awareness and acceptance of the District's operations.

Specific objectives identified for attaining the Section's first goal of assessing the treatment process, end products and their environmental impact are:

- Maintain Illinois Department of Public Health certification of the Analytical Microbiology Laboratory (AML).

- Employ test methods capable of meeting Quality Assurance/Quality Control (QA/QC) standards for precision, sensitivity and specificity. The test methods for detecting and enumerating indicators and pathogens in biosolids, wastewater and receiving water are those approved by the USEPA.

- Ensure that all staff members receive training in sufficient depth by completing the demonstration of capability which enables them to carry out the analyses as required by the laboratory Standard Operating Procedures (SOPs) and Quality Assurance Program (QAP).

- Establish a baseline quality for the laboratory's routine analytical performance by developing control chart(s) against which to measure the effectiveness of quality improvement efforts.

- Monitor the routine operational performance of the laboratory through participation in appropriate performance evaluation and/or inter-laboratory testing programs and to provide for corrective actions as necessary.

- Update SOPs and QAP, and implement all QA policies along with essential applicable QC procedures.

- Increase the number of analyses that can be performed to more efficiently support the District's research and operations programs.

- Replace obsolete equipment and upgrade facilities by finding the most cost-effective ways to meet the regulatory requirements.

- Foster a "zero defects" commitment or course of action for all staff members. This commitment will seek to produce data and services of the highest quality attainable.

The secondary and tertiary goals are to conduct applied research to support the emerging public health and regulatory issues facing the District. Specific objectives identified for attaining these goals include:

- Develop research strategies for addressing microbial risk assessment and public health epidemiology.

- Collaborate with municipal, state, federal agencies and non-government organizations, including academic institutions and public utilities in developing public health research projects that enhance the understanding of wastewater processes and microbes in the environment.

- Conduct research to support the PFRP, land application of biosolids program, disinfection technologies evaluation, identification of wastewater operation problems and removal of emerging microconstituents such as antibiotics, endocrine active compounds, etc.

- Participate in and assist with the District's public relations programs, such as District website, public meetings, specialty conferences, exhibits, newsletters, factsheets and press releases.

- Participation in the IPCB rulemaking pertinent to District operations.

- Develop and/or update wastewater microbiology monitoring program.

- Establish and foster cooperative relationships with scientific societies and organizations, to learn and share information about wastewater treatment processes and research.

Overview of Section Activities

There are four professional personnel, one principal office support staff, and twelve technical personnel in AMBS, who are organized into four dedicated state-of-the-art laboratories to perform specialized monitoring and/or research activities. The construction of an additional fifth laboratory, the Molecular Microbiology Laboratory, was completed in 2010.

These five specialized laboratories are:

I. Analytical Microbiology

II. Biomonitoring/Wastewater Microbiology

III. Parasitology

IV. Virology

V. Molecular Microbiology

Recognizing the need for AMBS program reorganization, the Biomonitoring program is to be transferred to the Aquatic Ecology and Water Quality (AEWQ) Section by the end of 2011. The Biomonitoring program will be replaced with the Wastewater Microbiology program (WWM) currently under development. The goal of the WWM Laboratory is to develop a comprehensive microbiological assessment program using both traditional microscopy and advance molecular gene probe methods. The routine microbiological microscopic assessment results will be available to the District's M&O staff as a diagnostic monitoring tool to assist in the prevention and control of WRP operational problems.

The AMBS personnel are often involved in studies of wastewater treatment, biosolids assessment and environmental monitoring, which require the application of specific microbiological disciplines and expertise. The areas of study in which the personnel can be involved during the course of a given year include, but are not limited to:

- Public health risk assessment.
- Ecological risk assessment.
- Water quality monitoring.
- Ecotoxicology and biomonitoring.
- Bioassay - Whole Effluent Toxicity (WET) methodology.
- Microbial processes.
- Enumeration of indicator bacteria, viruses, parasites, and pathogens.
- Research on emerging pathogens and methods.
- The microbiology of specific wastewater or biosolids treatment options.
- Risk assessment and epidemiological study of recreational use of the CAWS.
- Emerging microconstituents, including endocrine disruptors, pharmaceuticals, and antibiotics.

Use Attainability Analysis Research Projects

The AMBS staff coordinated research studies to ensure that the District is effectively dealing with emerging public health and regulatory issues such as microbial water quality, non-point sources of pollution, and public health impact assessment of District operations on the CAWS. Listed below are brief summaries of important research studies coordinated by the AMBS.

Dry and Wet Weather Risk Assessment of Human Health Impacts of Disinfection Versus No Disinfection of the Chicago Area Waterway System. Quantitative microbial risk assessment (QMRA) methods were used to model health risks based on measured concentrations of microorganisms, exposure and microbial dose data. The risk assessment reports are available on the District's website (www.mwrd.org).

The USEPA Office of Research and Development (R&D) and the Office of Water Science and Technology (S&T) reviewed the interim and final QMRA reports, and submitted comments to the District. USEPA comments on the interim QMRA report were discussed during a meeting at the Chicago USEPA Region 5 office with District staff; the Geosyntec team; USEPA Region 5 (in person); and staff from the USEPA S&T and R&D (via conference call). Itemized responses addressing the USEPA comments were forwarded to USEPA.

The QMRA study results indicate that the indicator bacteria such as fecal coliform (FC), *Escherichia coli* (EC) and enterococci which are not pathogens are present in high concentrations in the CAWS and effluents from the North Side, Stickney, and Calumet WRPs; however they are not accompanied by correspondingly high concentrations of pathogens in District effluents or the CAWS. As a result, the QMRA study projected that under current conditions without effluent disinfection, the risk of gastrointestinal illness resulting from secondary contact recreation on the CAWS is low and is less than the risk considered acceptable for primary contact recreation. The report was filed with the IPCB and made available to state (IEPA) and federal (USEPA Region 5, USEPA S&T and R&D) regulators, and other organizations.

The findings of the QMRA study have been published in two peer-reviewed scientific journals (Water Science & Technology[1] and Journal of Water and Health[2]). Furthermore, the study received the American Academy of Environmental Engineers (AAEE) Excellence in Environmental Engineering Research Honor Award (http://www.aaee.net/Website/E32010Honor Research. htm). Figure IV-1 shows the AAEE award ceremony photograph taken on April 28, 2010, in Washington, D.C.

Epidemiological Research Study of Recreational Use of the Chicago Area Waterway System. The study known as the Chicago Health, Environmental Exposure, and Recreation Study (CHEERS) conducted in collaboration with a multidisciplinary team at the University of Illinois at Chicago (UIC) School of Public Health was completed in 2010 (Figure IV-2). Prior USEPA epidemiology studies of water recreation and public health have focused on the health risks of primary contact recreation. CHEERS is the first study in the United States to address the health of individuals who engaged in incidental contact water recreational activities such as boating, fishing and rowing.

CHEERS was independently peer-reviewed under the administration of WERF, which assembled an expert panel of national public health scientists from USEPA, Centers for Disease Control and Prevention, academia and private organizations. The WERF-organized experts reviewed and endorsed the designs and protocols of the research, and monitored the quality of the data collected and its analysis and interpretation. The peer review experts expressed confidence in the research team, study design, methodologies, and the study results. CHEERS used the gold standard of observational epidemiological studies—the prospective cohort design—and followed the study format used for the USEPA's National Epidemiological and Environmental Assessment of Recreational Water.

The CHEERS final report, prepared by the UIC research team, is posted on the District website:

http://www.mwrd.org/irj/portal/anonymous?NavigationTarget=navurl://0d93fcecef2dbf71a94c87efbf804bc.

[1] Rijal et al. 2009. Dry and wet weather microbial characterization of the Chicago area waterway system. Water Science & Technology—WST, Vol. 60 No. 7 p. 1847-1855©IWA Publishing 2009 doi:10.2166/wst.2009.598.

[2] Rijal et al. 2011. Microbial risk assessment for recreational use of the Chicago Area Waterway System. Journal of Water and Health Vol 9 No 1 pp 169–186.

Illinois Pollution Control Board Rulemaking Concerning the Chicago Area Waterway System Water Quality Standards and Effluent Limits. The AMBS staff participated in the IPCB rulemaking on the "Effluent Bacteria Standard" for the District WRPs that discharge to the CAWS. Responsibilities in this administrative process included the review of testimony and preparation of position statements, along with providing questions and comments.

Research Collaboration

The AMBS staff collaborates with other agencies and research organizations by providing support to their research request proposals as follows:

- Development of a microbial sampling strategy for wastewater, storm water, CSOs and the local receiving waters.
- Microbial analyses of samples from the District's wastewater treatment processes.
- Participation in and providing technical support to pilot and full-scale wastewater operation studies.

Water Environment Research Foundation Research Projects. The AMBS was involved in the WERF Issue Area Team (IAT) research in the fields related to microconstituents, biosolids risk assessment, and critical research and scientific needs for the development of recreational water quality criteria. As members of WERF's Science and Regulatory Advisory Panel and pathogen IAT, staff provided technical review of the research projects and regulatory documents, attended project related meetings and teleconference calls, and evaluated the following WERF project proposals and the final report:

- Experts Scientific Workshop on Critical Research and Science Needs for the Development of Recreational Water Quality Criteria in Inland Waters.
- Measuring Water Ingestion Among Water Recreators.
- Creating the Tools for Site-specific Microbial Risk Assessment and Communication Plans for Biosolids Land Application.
- Developing Better Indicators for Pathogen Presence in Biosolids.
- Investigating Molecular Tools for Freshwater.
- Quantification of Pathogens and Sources of Microbial Indicators for QMRA in Recreational Waters.

University/Federal Research Projects. The AMBS staff collaborated with universities and provided review of thesis, grant proposals and research as follows:

- University of Illinois at Chicago- Ph.D. Candidate Thesis Review: *Evaluation of Indicator Microbe Sampling and Enumeration Methods for Chicago Area Surface Waters.*

- Lake Michigan Total Maximum Daily Load for Illinois Beaches, USEPA Region 5 and IEPA.

- Michigan State University, Great Lake Research Proposal titled, "Forecasting Beach and Near Shore Health Effects Using QMRA."

Outreach Activities

The AMBS provides outreach support to promote public awareness and acceptance of District operations. The intent is to inform the public about the District's monitoring and research programs. On a regular basis, the AMBS staff attends meetings to present results of research and to promote the District's public health studies and wastewater microbiology research programs. Some of the outreach activities include:

- Science Fair Participation: Staff participated and judged middle school and high school science fairs. Staff offered encouragement to the students and provided insight on research, report writing and the scientific process.

- Environmental Outreach: Staff participated in the USEPA Women in Science and Engineering conference which is a regional platform for women in the fields of science, technology, engineering and mathematics to discuss collaboration, and educate others on environmental issues.

- Laboratory Tours. Laboratory tours are encouraged and conducted upon request to any person or group wishing to learn about the District microbiology laboratory. Individual and group tours were provided in 2010.

Analytical Microbiology Laboratory Mission and Activities

The mission of the AML is to provide high quality and timely bacteria detection, enumeration and identification services for the District's permit requirements, treatment process operations, monitoring the bacterial quality of waterways within the District's jurisdiction, and to support research investigation of emerging wastewater, public health, regulatory and treatment process issues. The AML staff includes a Supervising Environmental Microbiologist, an Associate Environmental Microbiologist, two Laboratory Technicians II, a Laboratory Technician I, and a Laboratory Assistant. Personnel in this group participated in a variety of monitoring and research activities. Listed below are the most important of these activities:

- WRP Quality Control: Monitoring WRP effluent for the presence and density of FC bacteria for disinfection control.

- CAWS: Monitoring District waterways in Cook County upstream and downstream of the Calumet, North Side, Stickney and Lemont WRPs.

- Groundwater Monitoring Wells – TARP: Monitoring FC presence and density in groundwater monitoring wells near TARP tunnels, as required by IEPA operational permits.

- Groundwater Monitoring Wells – Land Reclamation: Monitoring the presence and density of FC in groundwater monitoring wells around biosolids processing and land application sites in Cook County.

- Part 503 Compliance Monitoring: Analysis of Class A and B biosolids for FC.

- Potable Water Analysis: Monitoring drinking water at District WRP*s* and other locations.

- Disinfection Study: Bacterial density monitoring for FC and EC to evaluate the effectiveness of Disinfection Technology.

- Reviews: Review of the USEPA Water Quality Criteria for Bacteria. Review research reports, proposed regulations, and federal register microbial analytical methods to determine the impact on District operations.

- Participation in the matter of IPCB and IEPA's rulemaking for the CAWS water quality and effluent limitation standards.

- Microconstituents of emerging concern including endocrine disrupters, pharmaceuticals, and antibiotics.

Illinois Department of Public Health Certification. The AML is certified by the IDPH, Registry #17508, for the following laboratory examinations:

- Heterotrophic bacteria, heterotrophic plate count (HPC) for water.

- TC with EC broth verification examination of water from public water supplies and their sources (membrane filtration [MF] and multiple tube fermentation [MTF]).

- FC examination of water from public water sources (MF and MTF).

- Total Coliform (TC) and EC examination of samples of water from public water supplies and their sources (minimal medium, orthonitro-phenyl-β-D-galactopyranoside-4-methylumbelliferyl-β-D-glucuronide [MMO-MUG]).

The AML has been certified for the bacterial analysis of water since 1979. Monitoring the densities of FC bacteria in WRP effluents was first mandated by NPDES permits in 1972.

The AML facility, equipment, and procedures were the subject of the biennial on-site evaluation for certification by the IDPH on October 28, 2010, and were found to be in general compliance with the provisions of the 18th Edition of *Standard Methods for the Examination of Water and Wastewater* (SM 18th ed.) and the Illinois Rules for Certification and Operation of Environmental Laboratories, Title 77, Part 465 (Figure IV-3). The AML collects and analyzes potable water samples from District facilities as required.

Water Reclamation Plant Operation Monitoring and Research Support. The AML supported a variety of programs for the EM&RD and the Industrial Waste Division in 2010: special request effluent analysis, District waterway surveys, Lake Michigan monitoring, WRP monitoring, TARP monitoring, research support, industrial waste surveys, the Illinois waterway survey, and other miscellaneous samples. Table IV-1 shows a summary of the major programs receiving support for the year 2010, and the number of analyses for each program.

The AML is responsible for bacteria monitoring in WRP effluent and area waterway systems. Monitoring of Chicago's harbors is conducted when river reversals to Lake Michigan occur due to heavy rainfall in the Chicagoland area. In 2010, there was one reversal to Lake Michigan as a result of an exceptionally large volume of rainfall. Samples were collected and analyzed for FC and EC. The report titled, "Microbiological Report of Backflow Samples in 2010" describes the results of microbiological sampling for bacteria during storm water and combined sewage discharged by the District to Lake Michigan (M&R Report No. 11-19).

Bacterial indicator analyses for TC, FC and EC are used by the District as indicators of the sanitary quality of water. The indicator bacteria types and number of analyses performed in 2010 are presented in Table IV-2. Coliform bacteria are identified to species (ID-CONF) using specific biochemical metabolic characteristics. Isolated colonies from culture plates are selected and inoculated to the B-D Crystal ID Systems (BBL Crystal ID System and BBL Crystal MIND Software V5.02E [Becton, Dickson and Company, Sparks, Maryland]). HPC is a procedure for estimating the number of viable heterotrophic bacteria in water. The HPC, TC and EC analyses are used to monitor the bacteriological quality of drinking water.

National Pollutant Discharge Elimination System Compliance Monitoring. Results of FC analysis of disinfected effluents are made available to the Hanover Park, Kirie and Egan WRPs within 24 hours. These data are used as a guide in maintaining proper disinfection at these District WRPs and for reporting compliance with NPDES permit regulations. All District WRPs with NPDES disinfection requirements have a seasonal exemption from November 1 through April 30 of each year and are not subject to effluent disinfection during this period.

NPDES permits also require additional monitoring when increased flow due to storms exceeds the design maximum treatment capacities of the WRPs. These storms can cause the WRPs to discharge a portion of influent to the receiving streams. These storm-related excess flow discharges must be monitored for FC bacteria levels. In 2010, the AML performed analyses of FC bacteria on storm-related excess flow discharge events at the District WRPs. The storm-related excess flow samples were analyzed from the Egan WRP on May 13 and July 24, 2010. One storm related excess flow sample from the Hanover Park WRP was analyzed on July 24, 2010.

Part 503 Compliance Monitoring. The 40 CFR Part 503 regulations require that biosolids applied to land meet specific pollution limits, site restrictions, management practices, and/or pathogen and vector reduction process. Biosolids at the District are processed to meet Class A (PFRP) or Class B standards. The AML analyzes biosolids for the detection and enumeration of FC bacteria. An internal audit of the AML was conducted on June 8, 2010. The audit report indicated that the AML's analytical methods, chain of custody, data/record archiving and retrieval, and quality assurance protocols are operating in compliance with Part 503 methodology requirements for pathogen analysis.

In 2010, the laboratory analyzed 36 biosolids samples from 27 batches of biosolids. Samples were analyzed to determine site specific PRFP equivalency monitoring or for compliance with Part 503 biosolids bacteria limitations (Table IV-3). The analytical results for the 27 batches demonstrate that biosolids generated by the District's solids process train during the 2010 period met the Class A criteria for bacteria prior to any beneficial land use application.

Excess Flow Disinfection Improvement Study. The AML continued to provide analytical support for a study that commenced in 2009, to improve the chlorine disinfection effectiveness of excess flow discharges at the Egan WRP. The excess flow discharge is the result of influent flow level that exceeds the plant's maximum treatment capacity. Such discharges are the result of extreme rainfall events during which primary effluent from the plant is discharged at the 004 outfall of the Egan WRP. FC analyses were performed on 209 samples that were part of a laboratory scale research. Results of this work will be used to optimize treatment strategies at the Egan WRP. Additional information on this project is in the WTPR Section of this report.

Biomonitoring Laboratory Mission and Activities

The mission of the Biomonitoring Laboratory (BL) is to provide high quality whole effluent toxicity testing services for the District's treatment process operations and compliance with permit requirements, and to conduct research to support emerging public health and regulatory issues. This group is composed of three professionals: Supervising Environmental Microbiologist, Senior Environmental Microbiologist, Assistant Environmental Microbiologist; and three laboratory staff (Laboratory Technician II, I, and Laboratory Assistant). Personnel in this group participated in the following biomonitoring and research activities:

- WET Testing for NPDES Permits. Use of *Pimephales promelas* (fathead minnows) and *Ceriodaphnia dubia* (daphnids or "water fleas") to assess acute and chronic toxicity of effluents from District WRPs.

- Reviews. Review research reports, NPDES permits and proposed regulations for any impact on District operations.

National Pollutant Discharge Elimination System Compliance Biomonitoring. Under the NPDES program (Section 402 of the Clean Water Act), the BL (Figure IV-4) conducts WET tests to monitor and evaluate the District's WRP treated final effluents for any adverse effects (toxicity) to aquatic life.

WET is defined as the aggregate toxic effect of an effluent or receiving water as measured with a toxicity test. In WET testing, organisms are exposed to effluent samples for a specific time period. Test treatments consist of five different concentrations of effluent. The fathead minnow and water fleas are the organisms used in the WET tests (Figure IV-5). Two types of WET tests are conducted in the BL: acute and chronic. Acute tests typically last 48-96 hours, and the objective is to determine the concentration of the effluent that causes organisms to die during a short-term exposure under the controlled conditions. The chronic test lasts about 7 days. Chronic tests provide estimates of effluent concentration that interferes with the normal growth or reproductive potential of test organisms.

In 2010, the BL conducted one chronic WET test on Hanover Park WRP effluent for NPDES permit compliance. No acute or chronic toxicity was observed. The results are shown in Table IV-4.

Quality Assurance/Quality Control. All laboratory procedures are conducted in accordance with an approved QAP. SOPs are prepared for each test method and laboratory procedure. A control treatment (an exposure of the test organisms to dilution water with no effluent added) is used to measure the acceptability of the test by showing the quality of the organisms and the suitability of the dilution water, test conditions, and handling procedures. For each test type performed, ongoing laboratory performance is continually evaluated by performing reference toxicant tests (RTT) using sodium chloride (NaCl). All RTTs are performed using the laboratory's control water under test conditions identical to NPDES permit required tests. Laboratory staff maintains quality control charts using RTT data from the most recent twenty tests. The results of the RTTs are shown in Table IV-4.

The acute and chronic WET test methods and procedures are conducted in accordance with the following USEPA established protocols:

- Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, EPA/821-R-02-012, Fifth Edition, October 2002.

- Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, EPA/821-R-02-013, Fourth Edition, October 2002.

The laboratory assesses and evaluates the results of all quality control procedures on an ongoing basis and will not release any test results without verification that test criteria have been met for all quality control procedures. On an annual basis, the laboratory participates in the Discharge Monitoring Report Quality Assurance (DMR-QA) Program established by USEPA, to conduct toxicity tests on unknown samples and demonstrate that the results are within the acceptable ranges. The results of the DMR-QA tests are shown in Table IV-5.

Whole Effluent Toxicity Tests Training. In preparation for the transition of the BL to the AEWQ section, BL staff presented a brief overview of WET testing regulations and procedures. A detailed and more formal BL training of AEWQ staff is planned for 2011.

Parasitology Laboratory Mission and Activities

The mission of the Parasitology Laboratory (PL) is to provide high quality *Ascaris* ova testing services for the District's biosolids treatment process operations and compliance with permit requirements, and to conduct research to support emerging public health and regulatory issues. This group is composed of two professionals: a Supervising Environmental Microbiologist and a Senior Environmental Microbiologist; and two laboratory staff (Laboratory Technician II and I.) Personnel in this laboratory participated in the following monitoring and research activities:

- Part 503 Compliance Monitoring. Analysis of biosolids for viable *Ascaris* ova to demonstrate that the District's codified PFRP treatment processes consistently produce Class A biosolids as defined in the Part 503 Regulations.

- Monitoring of Biosolids for Coliphages (somatic and F^+ specific). Research on the use of coliphages as indicators for enteric viruses in biosolids.

- Reviews. Review research reports and proposed regulations for any impact on District operations.

- Technical Support to the WTPR Section. Microbiological evaluation to solve operation problems.

Part 503 Compliance Monitoring. The 40 CFR Part 503 regulations require that biosolids applied to land meet specific pollutant limits, site restrictions, management practices, and/or pathogen concentrations and vector attraction reduction processes. Biosolids at the District are processed to meet either Class A or B standards. The PL analyzes biosolids for the detection, enumeration and the determination of viability of *Ascaris* ova. An internal audit of the PL was conducted on June 8, 2010, and it was found to be in full compliance with all USEPA requirements for analysis to determine compliance with the Part 503 Class A pathogen standards.

In 2010, the laboratory analyzed 15 biosolids samples for site-specific PFRP equivalency monitoring and for compliance with the Part 503 biosolids regulations (Table IV-6). USEPA Region 5 has approved the practice of analyzing 50g dry weight samples of biosolids for the determination of *Ascaris* ova densities with every sixth sample being 300g dry weight as required in the District's site-specific PFRP compliance monitoring. Two 300g and thirteen 50g samples were analyzed in 2010. Viable *Ascaris* ova densities were determined to be below the detectable limit, which is less than one viable *Ascaris* ovum per four grams of total solids (dry weight basis). The results for the 15 samples demonstrate that biosolids generated by the processing train during the 2010 period met the Class A criteria for the helminth ova pathogen.

Microscopic Image Analysis. The PL uses a state-of-the-art microscopic image analysis (MIA) system as an aid to monitor and document viable *Ascaris* ova in biosolids. The MIA system, mounted on a Nikon Eclipse E600 phase contrast microscope includes a digital camera with a video image acquisition mode to transmit microscopic images from a slide to the computer workstation (Figure IV-6). The video imaging allows staff to record and document images of viable *Ascaris* ova (Figure IV-7). Digital images are stored and analyzed using the MetaMorph™ imaging software. For each digital image, the length and width of the ovum, the date and time the image is recorded and the sample identification number is recorded. In 2010, the PL purchased an additional Nikon Eclipse 80*i* digital imaging system which includes a research level microscope that is optimized for digital imaging.

Quality Assurance/Quality Control. The laboratory maintains a high standard for QA and QC. All laboratory procedures are conducted in accordance with an approved QAP and SOP. Accuracy and precision tests are performed annually. Replicate samples are examined for precision and replicate samples spiked with a known number of Ascaris ova are analyzed for accuracy. The analytical method used for enumerating viable *Ascaris* ova in biosolids are followed in accordance with the USEPA established protocol (EPA/625/R-92/013, July 2003).

Monitoring of Biosolids for Coliphages (F^+ Specific and Somatic). The PL is currently conducting research to evaluate the usefulness of coliphages as an alternative indicator for the presence of enteric viruses in biosolids. Coliphages are viruses that infect EC via receptors on the cell wall. There are two main groups of coliphages: F^+ specific phages (FP) and somatic phages (SP). The USEPA coliphage method 1602: Male-specific (F^+) and Somatic Coliphage in Water by a Single Agar Layer (SAL) method was modified and adapted in the District to determine coliphage concentrations in Class A and B biosolids.

The coliphage (SP and FP) concentrations ranged between less than 1 to 7 plaque forming units (PFU) per gram dry weight biosolid samples from Calumet WRP. Higher coliphage (SP and FP) concentrations (67-13,600 PFU per gram dry weight) were recovered from Stickney WRP biosolid samples. Results of these analyses are shown in Table IV-7. Higher coliphage concentrations in the biosolids generated at the Stickney WRP may be due to low percent total solids (<60%) content. The Stickney WRP biosolids were not PRFP-compliant with the digester holding time criteria specified in the codified operating parameters.

Microscopic Evaluation of Water Reclamation Plant Activated Sludge. A total of 103 activated sludge samples were analyzed in 2010. Samples were analyzed to determine dominant filamentous bacteria types, the health and dominance of protozoa and metazoan types and the structure and density of the floc (Figure IV-8). The microscopic assessment of sludge quality for each WRP were summarized in a report and made available to M&O and the WTPR Section.

The monitoring frequency for North Side, Calumet and Egan WRPs were increased during the winter months in order to closely monitor plant performance during the critical winter operations. The total number of samples analyzed for each WRP is summarized in Table IV-8. The microscopic assessment results for the Egan WRP aeration tanks comparison allowed M&O to improve the settle-ability of solids in the North Aeration Battery considerably.

Virology Laboratory Mission and Activities

The mission of the Virology Laboratory (VL) is to provide high quality enteric virus testing services for the District's biosolids treatment process operations and compliance with permit requirements and to conduct research to support emerging public health and regulatory issues. This group is composed of one professional, a Supervising Environmental Microbiologist, and two laboratory staff (Laboratory Technicians I and II). Personnel in this laboratory participated in the following monitoring and research activities:

- Part 503 Compliance Monitoring. Analysis of biosolids for culturable enteric viruses.
- Process Certification for Class A Biosolids. Analysis of biosolids for enteric viruses to demonstrate that the District's codified PFRP treatment processes consistently produce Class A biosolids as defined in the Part 503 Regulations.
- Evaluation of the USEPA's Manual of Methods for Virology.
- Reviews. Review research reports and proposed regulations for any impact on District operations.

Part 503 Compliance Monitoring. The 40 CFR Part 503 regulations require that biosolids applied to land meet specific pollutant limits, site restrictions, management practices, and/or pathogen vector attraction reduction processes. Biosolids at the District are processed to meet either Class A or B standards. The VL analyzes biosolids for the detection, enumeration and the determination of enteric viruses. An internal audit of the VL was conducted on June 8, 2010, and it was found to be in full compliance with all USEPA requirements for analysis to determine compliance with the Part 503 Class A pathogen standards.

In 2010, the laboratory analyzed 15 biosolids samples for site-specific PFRP equivalency monitoring and for compliance with the Part 503 biosolids regulations. Results of these analyses are found in Table IV-9. Enteric virus densities in all samples of biosolids produced by the District's codified PFRP processing trains were determined to be below the detectable limit, which is less than PFU per four grams total solids (dry weight basis). The results for the 15 samples demonstrate that biosolids generated by the processing train during the 2010 period met the Class A criteria for enteric virus pathogen.

Quality Assurance/Quality Control. The laboratory maintains a high standard for QA & QC. All laboratory procedures are conducted in accordance with an approved QAP and SOP for determining the density of enteric viruses in biosolids. The analytical method for enteric viruses involves the elution of viruses from solids, concentration of the eluates, and an assay for plaque forming viruses using BGM-K cells. The test methods and procedures are followed in accordance with the USEPA established protocol (EPA/625/R-92/013, July 2003). Positive recovery studies were performed on all samples for quality assurance purposes. The mean recovery of spiked viruses was 44 percent. Recoveries ranged from 5.4 – 78.2 percent and were dependent upon the sample spiked (Table IV-10).

Molecular Microbiology Laboratory Mission and Activities

The mission of the Molecular Microbiology Laboratory (MML) is to develop the capability for rapid identification of fecal indicator bacteria, filamentous microorganisms, and pathogen source tracking by employing state-of-the-art molecular microbiology (Polymerase Chain Reaction [PCR]) analytical tools to comply with the regulatory advancement and to address emerging public health issues facing the District. Specific activities identified for attaining the mission of this group are:

- Development of rapid quantitative PCR technology capability to meet the future demands for microbial source tracking, pathogen monitoring, wastewater microorganisms, and genetic analysis.

- Conduct diagnostic research to identify wastewater process microorganisms using culture and molecular methods.

- Recruit and train laboratory staff to develop the capability of diagnostic molecular microbiology research to assist WRP operations.

Establishment of Molecular Microbiology Laboratory. The District completed its plan to construct a molecular microbiology research laboratory at the Cecil Lue-Hing R&D Complex. The laboratory construction was completed in 2010.

TABLE IV-1: INDICATOR BACTERIA ANALYSES PERFORMED BY THE ANALYTICAL MICROBIOLOGY LABORATORY FOR VARIOUS DISTRICT PROGRAMS IN 2010

Program	Total Coliform	Fecal Coliform	*Escherichia coli*
Effluent Analysis	-[a]	682	-
Land Reclamation	-	52	-
Biosolids Indicator Organism Density	-	42	-
District Waterway Surveys	-	641	202
Industrial Waste Surveys	1	9	1
Research – Support[1]	2	209	9
Lake Michigan Monitoring[2]	51	51	51
Major Treatment Facility Monitoring	2	2	2
Illinois Waterway	-	-	-
TARP	-	485	-
Other[3,4]	30	21	20
Total	86	2,194	285

[a] No samples analyzed.
[1] Includes disinfection study and support to plant operations.
[2] Includes festivals and District bypasses to Lake Michigan.
[3] Includes drinking water.
[4] Includes annual performance evaluation sample testing.

TABLE IV-2: ANALYTICAL MICROBIOLOGY LABORATORY SAMPLES AND ANALYSES IN 2010

		Analysis or Test Performed[1]						
Year	Samples	TC	FC	HPC	EC	IQC	ID-CONF	Total
2010	2,210	86	2,194	2	265	9,727	16	12,290

[1] TC = Total Coliform; FC = Fecal Coliform; HPC = Heterotrophic Plate Count; EC = *Escherichia coli*; IQC = Internal Quality Control Testing (reported as the number of procedures performed); ID-CONF = Organism Identification using specific multiple biochemical metabolic characteristics.

TABLE IV-3: BACTERIOLOGICAL ANALYSIS[1] OF BIOSOLIDS GENERATED BY THE DISTRICT'S WATER RECLAMATION PLANTS SOLIDS PROCESSING TRAINS IN COMPLIANCE WITH PART 503 CLASS A BIOSOLIDS REQUIREMENTS, JANUARY THROUGH DECEMBER 2010

Biosolids Source	Total Number of Samples Collected for Analyses	Total Dry Solids Range (%)[2]	Number of Biosolids Samples Meeting Class A Criteria[3]
Calumet WRP[4]	17	64.15 to 88.69	11
Stickney WRP[5]	19	46.61 to 90.47	16

[1] Fecal coliform most probable number per dry weight of 1 gram as received biosolids determined using USEPA Method 1681.
[2] Percent total solids per dry gram.
[3] Fecal coliform bacteria ≤ 1000 MPN per dry weight of 1 gram as received biosolids determined using USEPA Method 1681.
[4] Site producing biosolids compliant with codified operations designated as being equivalent to Procedure to Further Reduce Pathogens.
[5] Site producing biosolids managed according to the appropriate requirements of 40 CFR Parts 503.32a6.

TABLE IV-4: SUMMARY OF WHOLE EFFLUENT TOXICITY TESTS AND REFERENCE TOXICANT TESTS CONDUCTED IN 2010

Test Description	Date	WET Test[1]	Results [2, 3]
Reference Toxicant	Feb 23-27	Acute *P. promelas*	VT[3]
Reference Toxicant	March 23-25	Acute *C. dubia*	VT[3]
Reference Toxicant	April 6-13	Chronic *C. dubia*	VT[3]
Reference Toxicant	April 6-13	Chronic *P. promelas*	VT[3]
Reference Toxicant	April 20-22	Acute *P. promelas*	VT[3]
Reference Toxicant	April 20-22	Acute *C. dubia*	VT[3]
Reference Toxicant	May 4-11	Chronic *P. promelas*	VT[3]
Hanover Park WRP	June 9-16	Chronic *P. promelas*	NTE[2]
Reference Toxicant	June 9-16	Chronic *P. promelas*	VT[3]
Hanover Park WRP	June 9-16	Chronic *C. dubia*	NTE[2]
Reference Toxicant	June 9-16	Chronic *C. dubia*	VT[3]
Reference Toxicant	June 21-28	Chronic *C. dubia*	VT[3]
Reference Toxicant	August 3-5	Acute *C. dubia*	VT[3]
Reference Toxicant	August 30-Sep 1	Acute *C. dubia*	VT[3]
Reference Toxicant	August 31-Sep 2	Acute *C. dubia*	VT[3]
Reference Toxicant	Oct. 18-22	Acute *P. promelas*	VT[3]
Reference Toxicant	Nov. 30- Dec. 2	Acute *C. dubia*	VT[3]
Reference Toxicant	Dec. 13-17	Acute *P. promelas*	VT[3]

[1] WET Tests = Chronic *Pimephales promelas* (survival, growth) and Chronic *Ceriodaphnia dubia* (survival, reproduction), EPA 821/R-02013, (Fourth Edition) 2002: Acute *Pimephales promelas* (survival) and Acute *Ceriodaphnia dubia* (survival),EPA 821/R-02/012, (Fifth Edition) 2002.
[2] Results: NTE= No Toxic Effect.
[3] VT = Valid Test.

TABLE IV-5: DISCHARGE MONITORING REPORT QUALITY ASSURANCE TESTS CONDUCTED IN 2010

Test Description	Date	WET Test[1]	Results [2, 3]
DMR-QA-30	April 20-22	Acute *P. promelas*	AT[3]
DMR-QA-30	April 20-22	Acute *C. dubia*	AT[3]
DMR-QA-30	May 4-11	Chronic *P. promelas*	AT[3]
DMR-QA-30	June 21-28	Chronic *C. dubia*	AT[3]

[1]WET Tests = Chronic *Pimephales promelas* (survival, growth) and Chronic *Ceriodaphnia dubia* (survival, reproduction), EPA 821/R-02013, (Fourth Edition) 2002: Acute *Pimephales promelas* (survival) and Acute C*eriodaphnia dubia* (survival),EPA 821/R-02/012, (Fifth Edition) 2002.
[2]Results: NTE= No Toxic Effect.
[3]AT = Acceptable Test.

TABLE IV-6: PARASITOLOGICAL ANALYSIS OF BIOSOLIDS GENERATED BY THE DISTRICT'S WATER RECLAMATION PLANT SOLIDS PROCESSING TRAINS IN COMPLIANCE WITH PART 503 PROCESS TO FURTHER REDUCE PATHOGENS – EQUIVALENT REQUIREMENTS, JANUARY THROUGH DECEMBER 2010 MONITORING PERIOD

Date Sampled	Location	Viable Helminth Ova[1,2] - No./4g -
03/02/10	Vulcan	<0.0800
03/02/10	HASMA	<0.0800
03/16/10	Marathon	<0.0800
03/16/10	Marathon	<0.0800
04/20/10	Calumet East	<0.0800
04/20/10	Calumet East[3]	<0.0133
04/20/10	Calumet East	<0.0800
06/01/10	LASMA	<0.0800
06/15/10	LASMA	<0.0800
08/24/10	Calumet East	<0.0800
09/21/10	Calumet West	<0.0800
09/21/10	Marathon	<0.0800
10/21/10	Calumet West[3]	<0.0133
11/16/10	HASMA	<0.0800
11/30/10	Vulcan	<0.0800

[1] Number of viable *Ascaris* ova per dry weight of 4 gram of as-received biosolids.
[2] Failure to detect viable helminth ova in samples is recorded as less than (<) the limit of test sensitivity.
[3] For helminth ova analysis, sample weight = 300g. For other samples, sample weight = 50g.

TABLE IV-7: COLIPHAGE (SOMATIC AND F+ SPECIFIC) ANALYSIS OF BIOSOLIDS IN 2010[1]

WRP/Sample Location	Total Solids (TS)[2]	Coliphage MPN/Gram Dry Wt [3,4]	
		Somatic	Male Specific (F^+)
Calumet[5] East and West	64.15 – 86.66	<0.1154 - 6	<0.1154 - 7
Stickney[6]			
HASMA[7]	17.22 – 19.94	1,500 – 13,600	190 – 200
LASMA[8]	20.59 – 30.65	65 – 110	67 - 150
Vulcan	26.88 – 39.78	82 – 67	77 – 95
Marathon	19.36 – 21.41	820 – 1,400	230 – 560

[1]The coliphages were enumerated according to the USEPA Method 1601: Male-specific (F+) and Somatic Coliphage in Water by Two-step Enrichment Procedure (EPA/821-R-01-030). The method was modified to increase the sensitivity of the method for biosolids monitoring.
[2]TS=Percent Total Solids.
[3]Most Probable Number of FP and SP Based on Dry Weight of 1gram of as-received biosolids.
[4]Failure to detect coliphages in biosolids is recorded as less than (<) the limit of test sensitivity.
[5]PFRP compliant as specified in the codified operating parameters.
[6]PFRP non-compliant as specified in the codified operating parameters.
[7]Harlem Avenue Solids Management Area.
[8]Lawndale Avenue Solids Management Area.

TABLE IV-8: NUMBER OF ACTIVATED SLUDGE SAMPLES ANALYZED FOR MICROSCOPIC ASSESSMENT

Water Reclamation Plant	Number of Samples Analyzed
North Side	16
Calumet	55
Egan	24
Lemont	6
Stickney	2

TABLE IV-9: VIROLOGICAL ANALYSIS OF BIOSOLIDS GENERATED BY THE DISTRICT'S WATER RECLAMATION PLANT SOLIDS PROCESSING TRAINS IN COMPLIANCE WITH PART 503 PROCESS TO FURTHER REDUCE PATHOGENS – EQUIVALENT REQUIREMENTS, JANUARY THROUGH DECEMBER 2010 MONITORING PERIOD

Date Sampled	Location	Enteric Virus[1,2] - PFU/4g -
03/02/2010	Vulcan	<0.8000[3]
03/02/2010	HASMA[4]	<0.8000
03/16/2010	Marathon	<0.8000
03/16/2010	Marathon	<0.8000
04/20/2010	Calumet East	<0.8000
04/20/2010	Calumet East	<0.8000
04/20/2010	Calumet East	<0.8000
06/01/2010	LASMA[5]	<0.8000
06/15/2010	LASMA	<0.8000
08/24/2010	Calumet East	<0.8000
09/21/2010	Calumet West	<0.8000
09/21/2010	Marathon	<0.8000
10/21/2010	Calumet West	<0.8000
11/16/2010	HASMA	<0.8000
11/30/2010	Vulcan	<0.8000

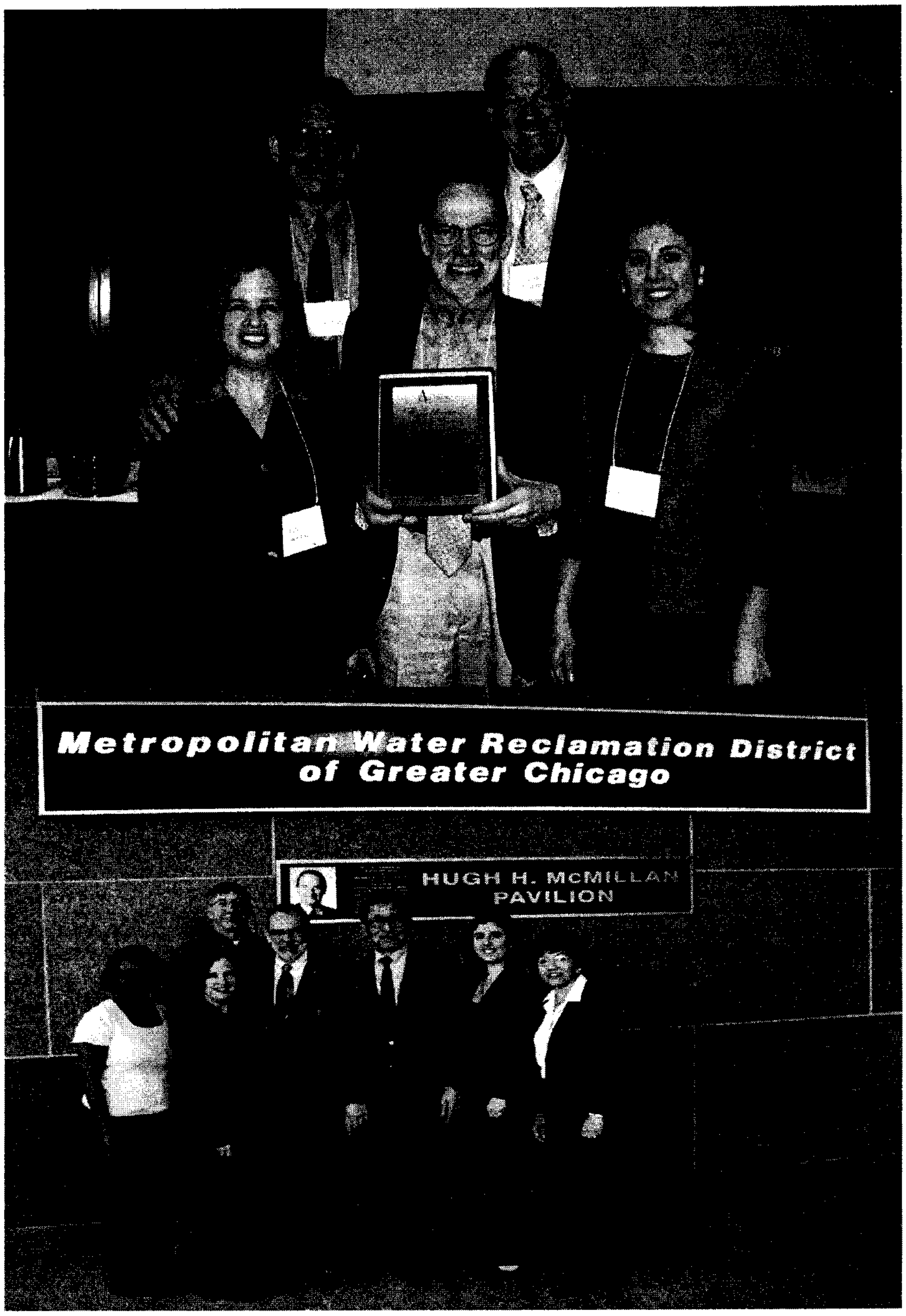
[1]Results of enteric virus analyses performed for site specific PFRP equivalency monitoring.
[2]Total culturable enteric viruses are less that 1 plaque-forming units (PFU) per 4 grams total dry solids.
[3]Failure to detect viruses in solids eluates are recorded as less than (<) the unit of test sensitivity.
[4]Harlem Avenue Solids Management Area.
[5]Lawndale Avenue Solids Management Area.

TABLE IV-10: SUMMARY OF VIROLOGICAL ANALYSIS OF CLASS A BIOSOLIDS IN COMPLIANCE WITH PART 503 PROCESS TO FURTHER REDUCE PATHOGENS, JANUARY THROUGH DECEMBER 2010 MONITORING PERIOD[1]

WRP Sample Location	Total Number of Samples Collected	Total Number of Samples Meeting Class A Pathogen Requirement[2]	PFU/4 g dry wt Range [3,4]	Quality Control Results Percent Recovery of Seeded Viruses[5] Range
Calumet	6	6	<0.8000	05.4 – 77.6
Marathon	3	3	<0.8000	14.6 – 45.6
LASMA[6]	2	2	<0.8000	39.7 – 45.2
Vulcan	2	2	<0.8000	42.3 – 78.2
HASMA[7]	2	2	<0.8000	55.8 – 59.2

[1]Results of analyses performed in the District's Virology Laboratory for site-specific PFRP equivalency monitoring.
[2]Total Culturable Enteric Viruses are less than 1 plaque forming units (PFU) per 4 grams total dry solids.
[3]Confirmed PFU/4 grams total dry solids.
[4]Failure to detect viruses in solids eluates are recorded as less than (<) the limit of test sensitivity.
[5]Positive recovery controls: percent recovery of 400 plaque forming units of poliovirus 1 Sabin seeded into a 4 g (dry wt) aliquot of sample. A positive recovery control was performed for each sample analyzed.
[6]Lawndale Avenue Solids Management Area.
[7]Harlem Avenue Solids Management Area.

FIGURE IV-1: 2010 AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS RESEARCH HONOR AWARD FOR THE MICROBIAL RISK ASSESSMENT STUDY



Top: AAEE Award Ceremony in Washington, DC (L to R): C. Lue-Hing, K. Tolson; M. DeFlaun, R. Lanyon, C. Petropoulou.

Bottom: Project Team Photograph Taken at the District's Downtown Office (L to R): A. Glymph; M. DeFlaun; R. Gore (back), R. Lanyon; C. Lue-Hing; C. Petropoulou; G. Rijal.

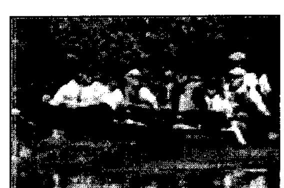
FIGURE IV-2: CHICAGO HEALTH, ENVIRONMENTAL EXPOSURE, AND RECREATION STUDY

CHEERS

WATER CHICAGO SPORTS

Unexposed recreators

General use recreators



CAWS recreators

FIGURE IV-3: ILLINOIS DEPARTMENT OF PUBLIC HEALTH CERTIFICATE OF APPROVAL FOR PUBLIC HEALTH LABORATORY SERVICE

ILLINOIS DEPARTMENT OF PUBLIC HEALTH

Awards this certificate of approval
for public health laboratory service to

Metropolitan Water Reclamation District

6001 West Pershing Road
Cicero, Illinois 60804

for the following laboratory examinations:

Heterotrophic Plate Count for Water (9215B)
Total Coliform Examination of Water from Public Water Supplies and their Sources (9222B, 9221B)
Fecal Coliform Verification with EC Broth (9221E)
Fecal Coliform Examination of Water from Public Water Supply Sources (9222D)
Total Coliform and E. Coli Examination of Water from Public Water Supplies and their Sources (9223B,Colilert P/A,Quantitray)

Rick Gore, Kathleen Jackowski, Andrea Maka, David Roberts, and Geeta Rijal are approved for the procedures listed above.

SEAL OF THE STATE OF ILLINOIS AUG 26th 1818

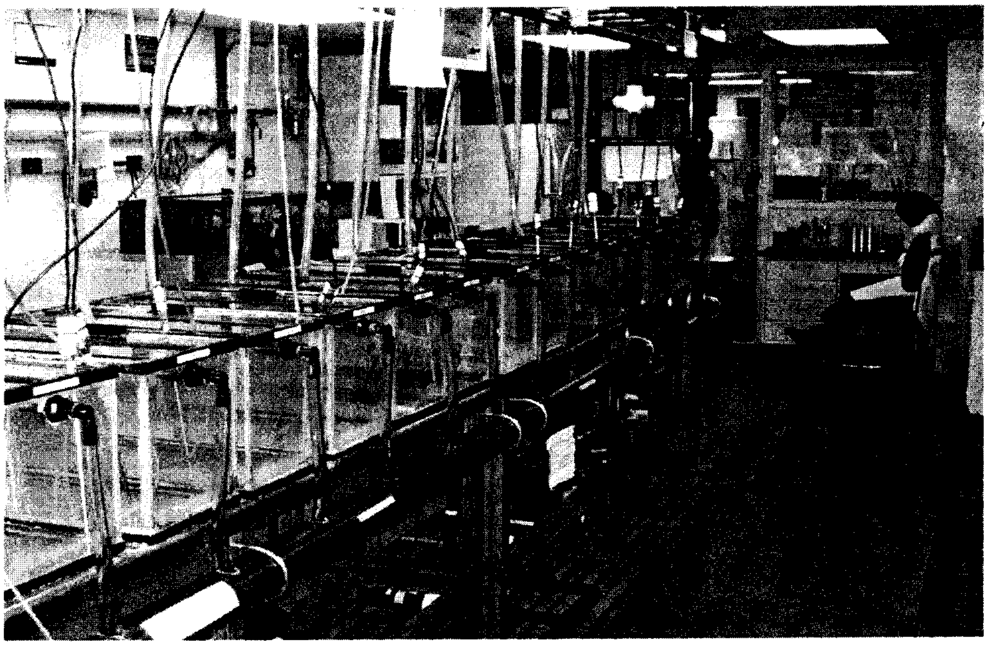
Registry no. 17508

Date October 27, 2010

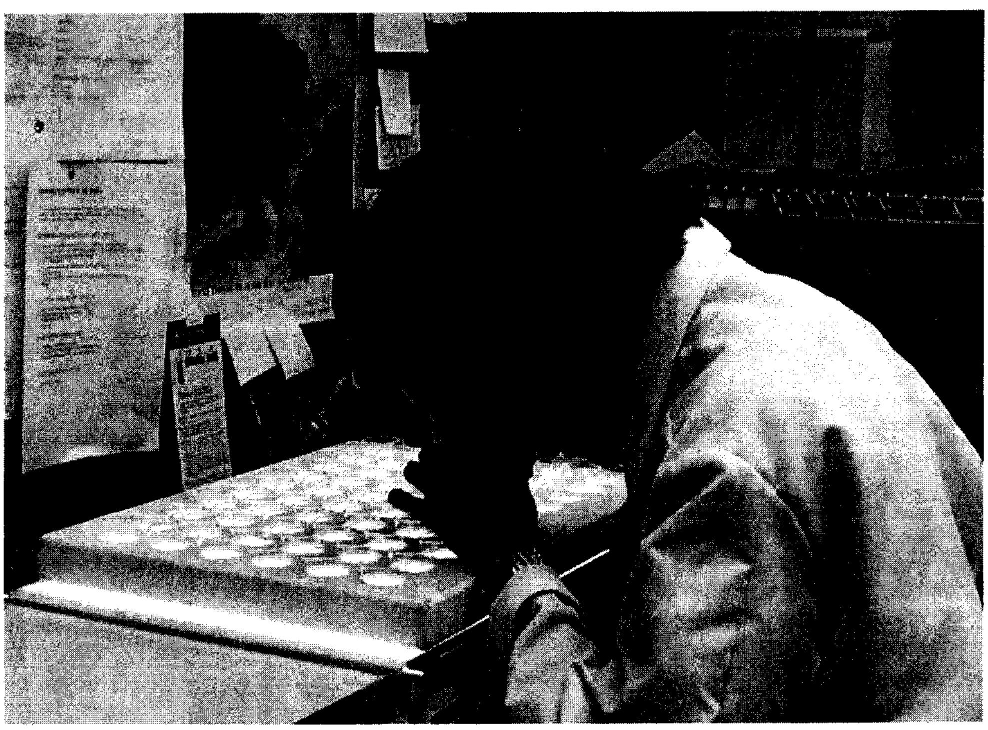
For the period ending October 27, 2012

Damon T. Arnold, M.D., M.P.H., Director
Illinois Department of Public Health

FIGURE IV-4: BIOMONITORING LABORATORY



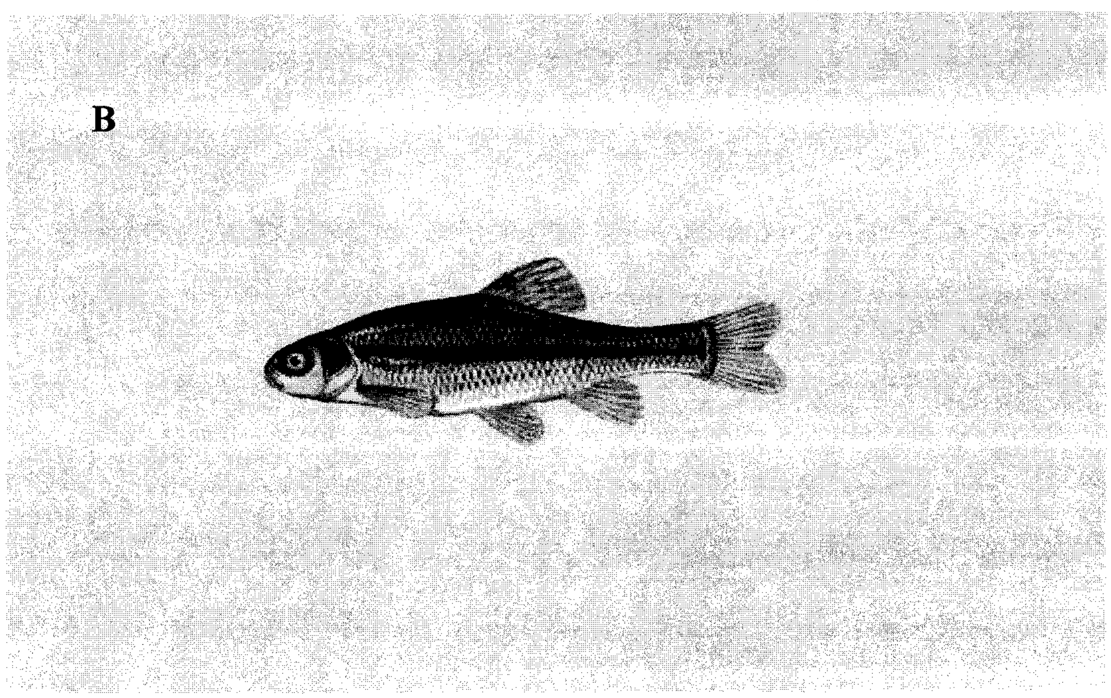
A. Biomonitoring Lab fish spawning tanks



B. Staff viewing *C. dubia* culture trays for neonate production

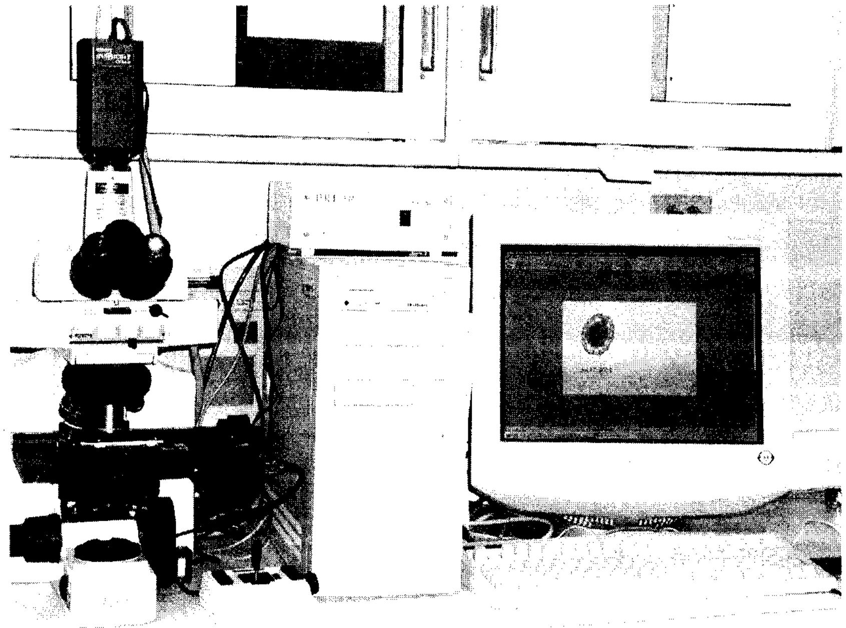
FIGURE IV-5: WHOLE EFFLUENT TOXICITY TEST ORGANISMS

A. *Ceriodaphnia dubia* (Water Flea)

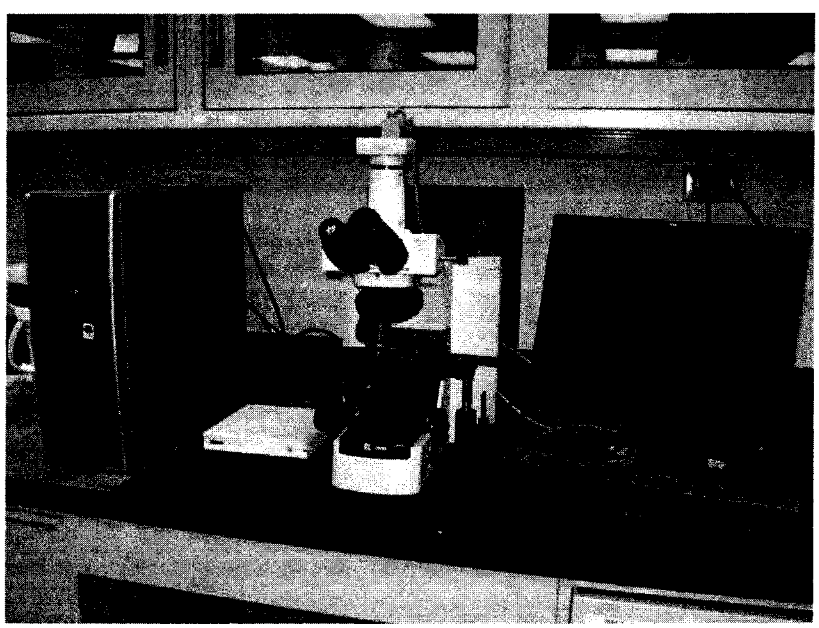


B. *Pimephales promelas* (Fathead Minnow)

FIGURE IV-6: MICROSCOPIC IMAGE ANALYSIS SYSTEM



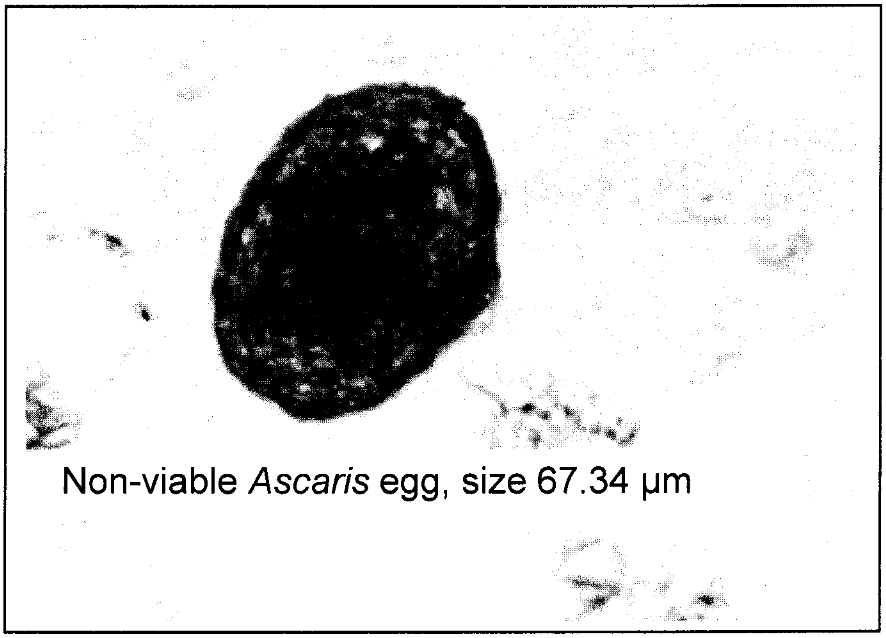
A. Nikon E600 Research Phase Contrast Microscope with a Digital Snap Video Camera Transmitting Microscopic Images from Slide to a Computer Workstation with a Metamorph Software Program.



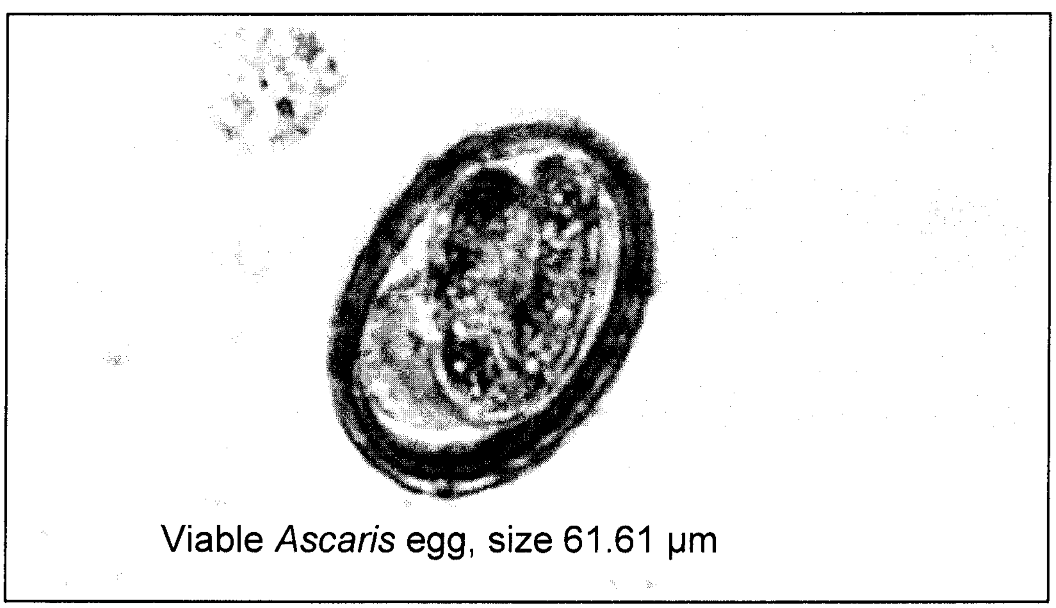
B. Nikon Eclipse 80*i* digital imaging system which includes a research-microscope that is optimized for digital imaging.

FIGURE IV-7: DIGITAL IMAGES OF *ASCARIS LUMBRICOIDES*

A

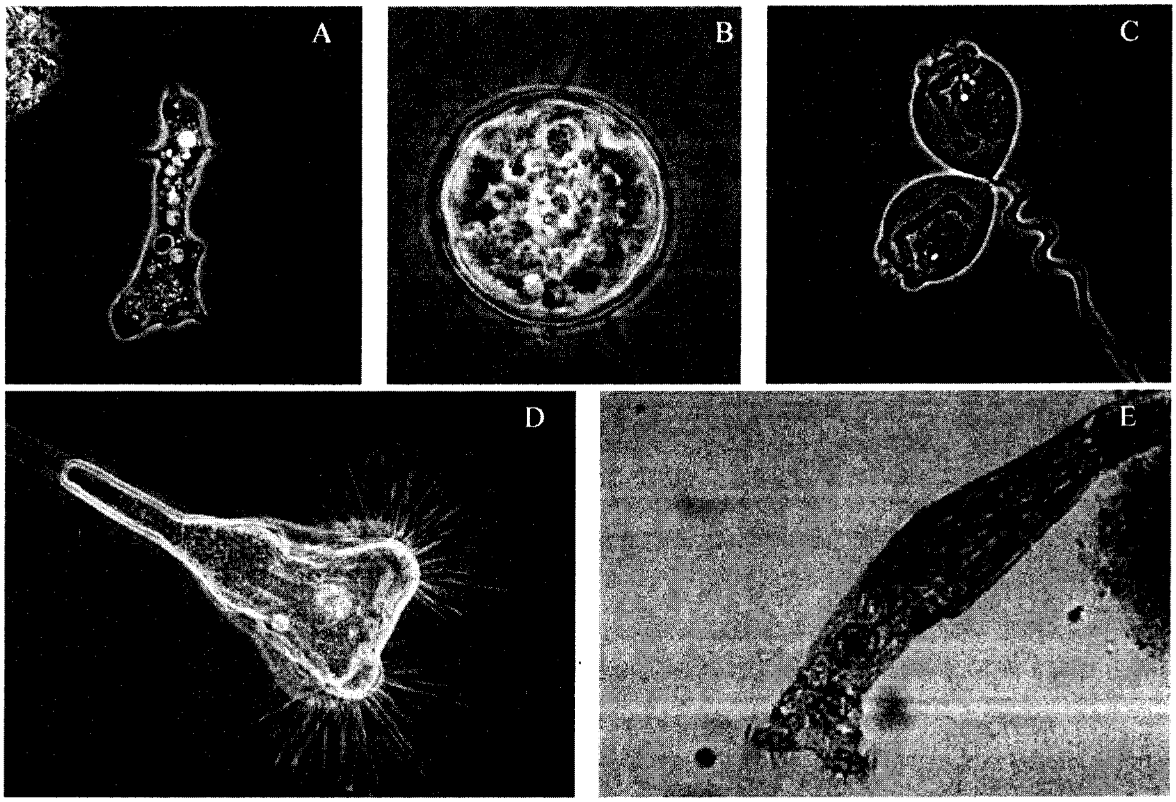


B

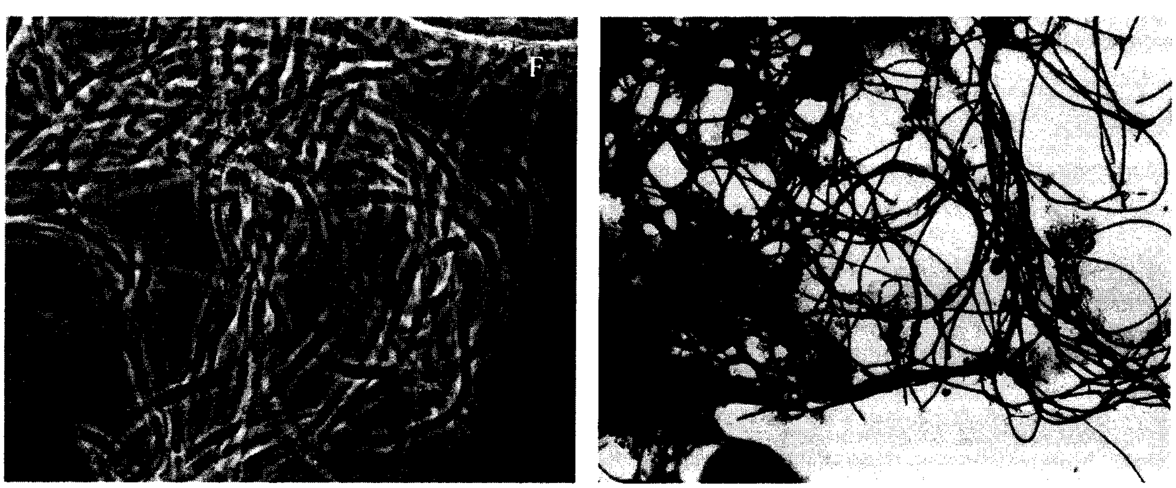


A. Non viable ovum; 67.34 µm long
B. Viable, fertile ovum; 61.61 µm long.

FIGURE IV-8: MICROSCOPIC OBSERVATIONS – RESULTS FROM THE DISTRICT WATER RECLAMATION PLANTS ACTIVATED SLUDGE SAMPLES



Microorganisms commonly observed in the District's activated sludge. (A) *Amoeba proteus,* 40x phase contrast. (B) A shelled amoebae *Arcella,* 100x, oil immersion, phase contrast. (C) A stalked ciliate dividing *Vorticella,* 40x phase contrast. (D) *Suctoria,* 40x phase contrast. (E) A rotifer, *Rotaria* 40x phase contrast.



Filamentous bacteria Type 021N (F) and *Microthrix parvicella* (G) were observed most often in the WRPs during winter monitoring.

AQUATIC ECOLOGY AND WATER QUALITY SECTION

AQUATIC ECOLOGY AND WATER QUALITY SECTION

Section Mission and Goals

The mission of the section is to provide scientific and technical support to assess the waterways impacted by the District's wastewater treatment operations. The goals of the Aquatic Ecology and Water Quality (AEWQ) Section are to:

1. Assess the water and sediment quality in waterways in the District's service area and in other waterways impacted by flow from this service area in order to inform policy, guide and assess regulatory developments, and support and improve operations.

2. Conduct fish, benthic invertebrate, and physical habitat monitoring in order to evaluate the biological health of waterways and assess changes in waterway conditions over time especially as it may be associated with District operations.

3. Perform laboratory analysis of chlorophyll in accordance with the Standard Operating Procedure.

4. Design and conduct research projects to address potential changes in District operations, such as effluent disinfection and phosphorus removal.

5. Design and conduct research projects to explore emerging issues in water quality and treatment as they arise, such as assessing the impact of endocrine-disrupting compounds.

6. Participate in regulatory review of water quality related standards and documents, including attendance at regulatory hearings and stakeholder meetings that concern District operations.

7. Cooperate with other governmental and non-governmental agencies and academic institutions to develop water quality and aquatic ecology research projects.

8. Promote public awareness and acceptance of District operations by communicating monitoring and research results through our website, public meetings and presentations, and assisting the Public Affairs Section in preparing fact sheets and press releases.

Ambient Water Quality Monitoring Program

The biological monitoring program, which runs in conjunction with the Ambient Water Quality Monitoring (AWQM) Program, includes chlorophyll monitoring, the study of the benthic invertebrate and fish communities, characterization of the physical habitat, and assessment of sediment toxicity and sediment chemistry. The primary objective of the monitoring program is to provide scientific data to the District and the IEPA regarding the biological condition of the CAWS and Chicago Area General Use waterways. The IEPA uses the data to assess the biological integrity, physical habitat, and sediment quality in waterways in the District's service area. These assessments are summarized in the IEPA's Integrated Water Quality Report and Section 303 (d) Lists. Results are used by the IEPA to prepare a list of impaired waters through the 303 (d) listing process.

The biological portion of the AWQM Program began in 2001 and is conducted from June through September at 59 stations in the CAWS (Figure V-1). Fifteen of the 59 sampling stations are assessed annually, with the remaining 44 stations assessed once every four years.

Fish Monitoring

From June through September of 2010, fish were collected by electrofishing and seining at 23 biological monitoring stations on the CAWS. In 2010, 4,845 fish, comprised of 41 species and 3 hybrids, were identified, weighed, and measured for length. The fish were also examined for parasites and disease.

Data from these collections are shown in Table V-1 for the deep-draft waterways and in Table V-2 for the wadeable waterways. The most abundant species in the deep-draft waterways included gizzard shad, western mosquitofish, carp, largemouth bass, spotfin shiner, and bluntnose minnow. In the wadeable waterways, green sunfish, yellow bullhead, fathead minnow, largemouth bass, bluegill, and bluntnose minnow were the most abundant.

Benthic Invertebrate Monitoring

Benthic invertebrates were collected from side and center locations using a petite ponar grab and Hester Dendy larval plate samplers at 23 AWQM stations during 2010. Invertebrates other than worms were sent to a consultant to be identified and examined for head capsule deformities. A comprehensive report of the benthic invertebrate sampling results will be available at www.mwrd.org in early 2012.

Chlorophyll Monitoring

As a photosynthetic component of all algae cells, chlorophyll *a* is a surrogate for quantifying algal biomass in lakes and streams. Chlorophyll *a* values are of interest to regulatory agencies since it is also widely accepted that high algae concentrations may indicate nutrient impairment of a water body. The IEPA is cooperating with other state and local agencies to propose regional water quality criteria for nutrients and possibly chlorophyll. In light of this consideration, the District began monitoring chlorophyll on a monthly basis in August 2001 as part of the AWQM Program. Results from 2010 are shown in Table V-3. The highest mean values of chlorophyll *a* were 76 µg/L at Burnham Avenue on the Grand Calumet River, 26 µg/L at Material Service Road on the Des Plaines River, and 26 µg/L at Higgins Road on Salt Creek.

Illinois Waterway Monitoring

In 1984, M&R established a long-term water and sediment monitoring program along the Illinois Waterway from the Lockport Lock to the Peoria Lock, a distance of approximately 133 miles. The purpose of the monitoring program is to assess the chemical and microbiological quality of the water and to characterize the chemical quality of the sediments.

In 2010, water samples were collected during May, August, and October from each of the 49 sampling stations (Figures V-2 and V-3). During October, sediment samples were collected at 14 selected stations. Data for these sampling events were compiled in M&R Report No. 11-42 entitled, "Water Quality Along the Illinois Waterway from the Lockport Lock to the Peoria Lock During 2010."

Continuous Dissolved Oxygen Monitoring

In order to gain a better understanding of the oxygen dynamics in deep-draft sections of the CAWS, the AEWQ Section developed a comprehensive Continuous Dissolved Oxygen Monitoring program beginning in August 1998 in the Chicago River System, July 2001 in the Calumet River System, and in the Des Plaines River System in July 2005.

The DO is measured hourly using remote (in-situ) water quality monitors deployed in protective stainless steel housing enclosures. As shown in Figure V-1, in the Chicago River System the monitors are located at 14 stations on the North Shore Channel, North Branch of the Chicago River, Chicago River, South Branch of the Chicago River, Bubbly Creek, and the Chicago Sanitary and Ship Canal. In the Calumet River System, the monitors are located at eight stations on the Calumet River, Grand Calumet River, Little Calumet River, and the Calumet-Sag Channel. Nine stations are located in the Des Plaines River System on the Des Plaines River and Salt Creek.

The DO results for 2010 can be found in the reports entitled, "Continuous Dissolved Oxygen Monitoring in the Deep-Draft Chicago Waterway System During 2010" (M&R Report No. 11-41) and "Continuous Dissolved Oxygen Monitoring in Chicago Area Wadeable Streams During 2010" (M&R Report No. 11-30).

Investigation of Endocrine Disruption in the Chicago Area Waterway System

A three-year study began in March 2009 to conduct a comprehensive assessment of the potential for endocrine disrupting compounds (EDCs) to impact the reproductive potential of fish populations in the CAWS. The objectives of this study are to determine (1) the spatial and temporal occurrence of EDCs; (2) the occurrence of endocrine disruption in wild fish populations; and (3) the likely sources contributing to any occurrence of endocrine disruption. The study included analysis of waterway and WRP effluent samples, deployment of caged fish, collection of wild fish, and deployment of a mobile exposure laboratory.

Monthly waterway samples were collected from 38 AWQM stations and monthly final effluent samples were obtained from all seven District treatment plants. These water samples were analyzed each quarter for total estrogenicity and a subset of common estrogenic compounds. Some samples were not analyzed but have been archived for future analysis as needed.

Caged fish were deployed in selected CAWS reaches for at least two weeks during two periods in 2010 (April/May and September/October). Wild fish were also collected in May. Wild and caged fish were examined for endocrine disruption using histopathology and plasma vitellogenin analysis.

Two successful deployments of the mobile exposure laboratory trailer (MELT) occurred in August and September of 2010. MELT will establish a relationship between a specific water source and observed endocrine disruption and identify the likely compounds responsible.

Analysis of the 2009-2010 data collected from the CAWS informed the direction of the 2011 study as follows:

1. The presence of estrogenicity in sites upstream of the WRPs indicated other sources, such as road runoff, urban runoff, and combined sewer overflows. In 2011, additional estrogenicity sources will be identified by sampling multiple stormwater events and locations in the CAWS and exposing fathead minnows to the collected water using MELT to induce and measure vitellogenin induction.

2. The North Shore Channel exhibited unique characteristics in regard to endocrine activity that require further in-depth analysis. MELT will be employed within the North Side WRP and at a location downstream on the North Shore Channel in an attempt to further elucidate the effects of this effluent on the fish populations in the channel.

3. The success of the last three caged-fish deployments confirmed the utility of this procedure to investigate estrogenic pollution. The first deployment of caged sunfish in May/June 2009 suffered from several shortcomings, so an additional caging event will be performed in 2011.

4. Another MELT deployment will be scheduled at the Stickney WRP in 2011 to examine whether the effects observed during the fall 2010 MELT experiment at the Stickney WRP exhibit temporal stability.

Final results will be published at the conclusion of this study in 2012.

Wet Weather Fish Movement Study

A collaborative study with LimnoTech Inc. and the Illinois Natural History Survey (INHS), funded by WERF, began in 2010. The purpose of this pilot study is to assess the effect of wet weather driven DO sags on CAWS fish. During the summer of 2010, fourteen acoustic hydrophone receivers were installed in Bubbly Creek, the South Branch Chicago River, the Chicago Sanitary and Ship Canal, and two off-channel slips. Electronic tags were surgically implanted in 20 largemouth bass that were collected in or near Bubbly Creek. Twenty common carp were also tagged by INHS within the study area in cooperation with Asian carp monitoring activities occurring in the CAWS. The District provided DO data from five continuous DO monitoring stations to determine whether tagged fish avoided low DO areas during wet weather events and, if so, where they relocated.

In 2010, the DO profiles differed within the study area during and after wet weather discharges. Therefore, the study area was delineated into four zones, each exhibiting different DO characteristics. While each zone displayed a minimum of three hours of hypoxia (DO < 2 mg/l) following wet weather events, the duration and magnitude of DO sags differed across zones. Preliminary results indicated that largemouth bass occupied all four zones during periods of DO below 2 mg/l. Following wet weather discharges that resulted in hypoxia, there was a general trend of fish movement away from hypoxic areas. However, not all fish avoided hypoxic areas, suggesting that fish may tolerate the hypoxic conditions for a short time or that the fish are able to find refuge in local areas of higher DO that may not be observed by the study design. The second phase of the study, to be conducted in 2011, was designed to explore these initial findings. A final report will be published on this research by early 2012.

TABLE V-1: FISH COLLECTED FROM DEEP-DRAFT WATERWAYS DURING 2010

Station No.	Location	Number of Fish Collected	Weight (kg) of Total Catch	Number of Fish Species	Number of Game Fish Species	Most Abundant Fish Species
			NORTH SHORE CHANNEL			
36	Touhy Avenue	118	56.3	13	4	Spotfin shiner
			NORTH BRANCH CHICAGO RIVER			
46	Grand Avenue	365	33.4	13	5	Gizzard shad
			CHICAGO RIVER			
74	Lake Shore Drive	168	19.9	12	7	Gizzard shad
100	Wells Street	136	63.6	14	7	Gizzard shad
			CHICAGO SANITARY AND SHIP CANAL			
40	Damen Avenue	136	115.9	12	6	Bluegill
75	Cicero Avenue	589	61.4	14	6	Gizzard shad
41	Harlem Avenue	1103	19.4	15	7	Mosquitofish
42	Route 83	14	0.2	3	1	Gizzard shad
48	Stephen Street	5	1.7	5	1	Gizzard shad
92	16th St., Lockport	103	2.8	3	2	Gizzard shad
			SOUTH BRANCH CHICAGO RIVER			
39	Madison Street	176	23.1	9	4	Spotfin shiner
108	Loomis Street	117	96.1	8	4	Bluegill
			SOUTH FORK SOUTH BRANCH CHICAGO RIVER			
99	Archer Avenue	29	3.0	5	3	Gizzard shad
			CALUMET RIVER			
55	130th Street	320	57.4	18	8	Smallmouth bass
			LITTLE CALUMET RIVER			
76	Halsted Street	538	101.8	19	8	Gizzard shad
			CALUMET-SAG CHANNEL			
59	Cicero Avenue	181	65.1	15	7	Gizzard shad

TABLE V-2: FISH COLLECTED FROM WADEABLE WATERWAYS DURING 2010

Station No.	Location	Number of Fish Collected	Weight (g) of Total Catch	Number of Fish Species	Number of Game Fish Species	Most Abundant Fish Species
			NORTH BRANCH CHICAGO RIVER			
96	Albany Avenue	73	231.2	5	2	Green sunfish
			HIGGINS CREEK			
78	Wille Road	235	152.4	3	0	Fathead minnow
			DES PLAINES RIVER			
13	Lake-Cook Road	122	817.4	11	6	Spotfin shiner
22	Ogden Avenue	61	473.4	16	5	Green sunfish
91	Material Services Rd.	30	171.7	10	4	Yellow bullhead
			SALT CREEK			
18	Devon Avenue	31	281.1	7	4	Largemouth bass
			WEST BRANCH DUPAGE RIVER			
64	Lake Street	31	5745.0	6	5	Green sunfish

TABLE V-3: MEAN AND RANGE OF CHLOROPHYLL *a* VALUES FROM THE CHICAGO AREA WATERWAY SYSTEM AND CHICAGO AREA GENERAL USE WATERWAYS DURING 2010

Station No.	Location	Number of Samples	Mean (µg/L)	Minimum (µg/L)	Maximum (µg/L)	Standard Deviation (µg/L)
	WEST FORK NORTH BRANCH CHICAGO RIVER					
106	Dundee Road	10	8	1	28	8
103	Golf Road	10	14	2	47	14
	MIDDLE FORK NORTH BRANCH CHICAGO RIVER					
31	Lake-Cook Road	9	5	1	17	5
	SKOKIE RIVER					
32	Lake-Cook Road	9	7	2	15	5
105	Frontage Road	12	10	1	21	6
	NORTH BRANCH CHICAGO RIVER (Wadeable Portion)					
104	Glenview Road	9	7	1	15	5
34	Dempster Street	8	8	<1	16	6
96	Albany Avenue	11	9	1	40	12
	NORTHSHORE CHANNEL					
35	Central Street	8	18	1	122	42
102	Oakton Street	11	17	1	96	28
36	Touhy Avenue	11	2	<1	10	3
101	Foster Avenue	12	2	1	4	1
	NORTH BRANCH CHICAGO RIVER (Deep-Draft Portion)					
37	Wilson Avenue	12	3	1	7	2
73	Diversey Avenue	12	3	1	8	2
46	Grand Avenue	12	3	1	5	1
	CHICAGO RIVER					
74	Lake Shore Drive	11	1	1	3	1
100	Wells Street	12	2	1	5	1

TABLE V-3 (Continued): MEAN AND RANGE OF CHLOROPHYLL *a* VALUES FROM THE CHICAGO AREA WATERWAY SYSTEM AND CHICAGO AREA GENERAL USE WATERWAYS DURING 2010

Station No.	Location	Number of Samples	Mean (µg/L)	Minimum (µg/L)	Maximum (µg/L)	Standard Deviation (µg/L)
	SOUTH BRANCH CHICAGO RIVER					
39	Madison Street	12	4	1	18	5
108	Loomis Street	11	2	1	5	1
	BUBBLY CREEK (South Fork South Branch Chicago River)					
99	Archer Avenue	10	13	2	52	16
	CHICAGO SANITARY AND SHIP CANAL					
40	Damen Avenue	12	6	1	28	7
75	Cicero Avenue	12	5	1	11	3
41	Harlem Avenue	9	4	1	11	4
42	Route 83	12	5	1	23	8
48	Stephen Street	12	5	1	16	5
92	Lockport	51	5	<1	33	5
	CALUMET RIVER					
49	Ewing Avenue	6	1	1	1	<1
55	130th Street	10	4	1	8	3
	WOLF LAKE					
50	Burnham Avenue	11	4	2	9	2
	GRAND CALUMET RIVER					
86	Burnham Avenue	7	76	5	447	164
	LITTLE CALUMET RIVER					
56	Indiana Avenue	10	14	1	65	20
76	Halsted Street	10	4	1	10	4
52	Wentworth Avenue	12	5	1	23	8
57	Ashland Avenue	10	8	3	15	4

TABLE V-3 (Continued): MEAN AND RANGE OF CHLOROPHYLL *a* VALUES FROM THE CHICAGO AREA WATERWAY SYSTEM AND CHICAGO AREA GENERAL USE WATERWAYS DURING 2010

Station No.	Location	Number of Samples	Mean (μg/L)	Minimum (μg/L)	Maximum (μg/L)	Standard Deviation (μg/L)
		THORN CREEK				
54	Joe Orr Road	9	5	1	10	3
97	170th Street	11	11	4	25	6
		CALUMET-SAG CHANNEL				
58	Ashland Avenue	10	7	1	28	8
59	Cicero Avenue	10	4	2	9	2
43	Route 83	11	5	1	10	3
		BUFFALO CREEK				
12	Lake-Cook Road	7	14	3	28	9
		HIGGINS CREEK				
77	Elmhurst Road*	1	28	28	28	0
78	Wille Road	9	3	<1	8	2
		DES PLAINES RIVER				
13	Lake-Cook Road	11	12	<1	39	13
17	Oakton Street	11	14	0	53	17
19	Belmont Avenue	11	14	1	59	18
20	Roosevelt Road	11	13	1	42	15
22	Ogden Avenue	12	12	1	52	15
23	Willow Springs Road	11	13	1	45	14
29	Stephen Street	12	17	2	49	18
91	Material Service Road	12	26	2	86	30
		SALT CREEK				
79	Higgins Road	8	26	17	52	11
80	Arlington Heights Road	12	16	1	50	16
18	Devon Avenue	10	14	3	55	16
24	Wolf Road	10	9	1	23	8
109	Brookfield Avenue	11	8	1	29	8

TABLE V-3 (Continued): MEAN AND RANGE OF CHLOROPHYLL *a* VALUES FROM THE CHICAGO AREA WATERWAY SYSTEM AND CHICAGO AREA GENERAL USE WATERWAYS DURING 2010

Station No.	Location	Number of Samples	Mean (μg/L)	Minimum (μg/L)	Maximum (μg/L)	Standard Deviation (μg/L)
		WEST BRANCH DUPAGE RIVER				
110	Springinsguth Road	8	17	1	59	21
89	Walnut Lane	12	5	1	18	6
64	Lake Street	6	16	4	37	12
		POPLAR CREEK				
90	Route 19	10	10	1	19	6

* Statistics are based on only one value.

FIGURE V-1: AMBIENT WATER QUALITY MONITORING AND CONTINUOUS DISSOLVED OXYGEN MONITORING SAMPLE STATIONS

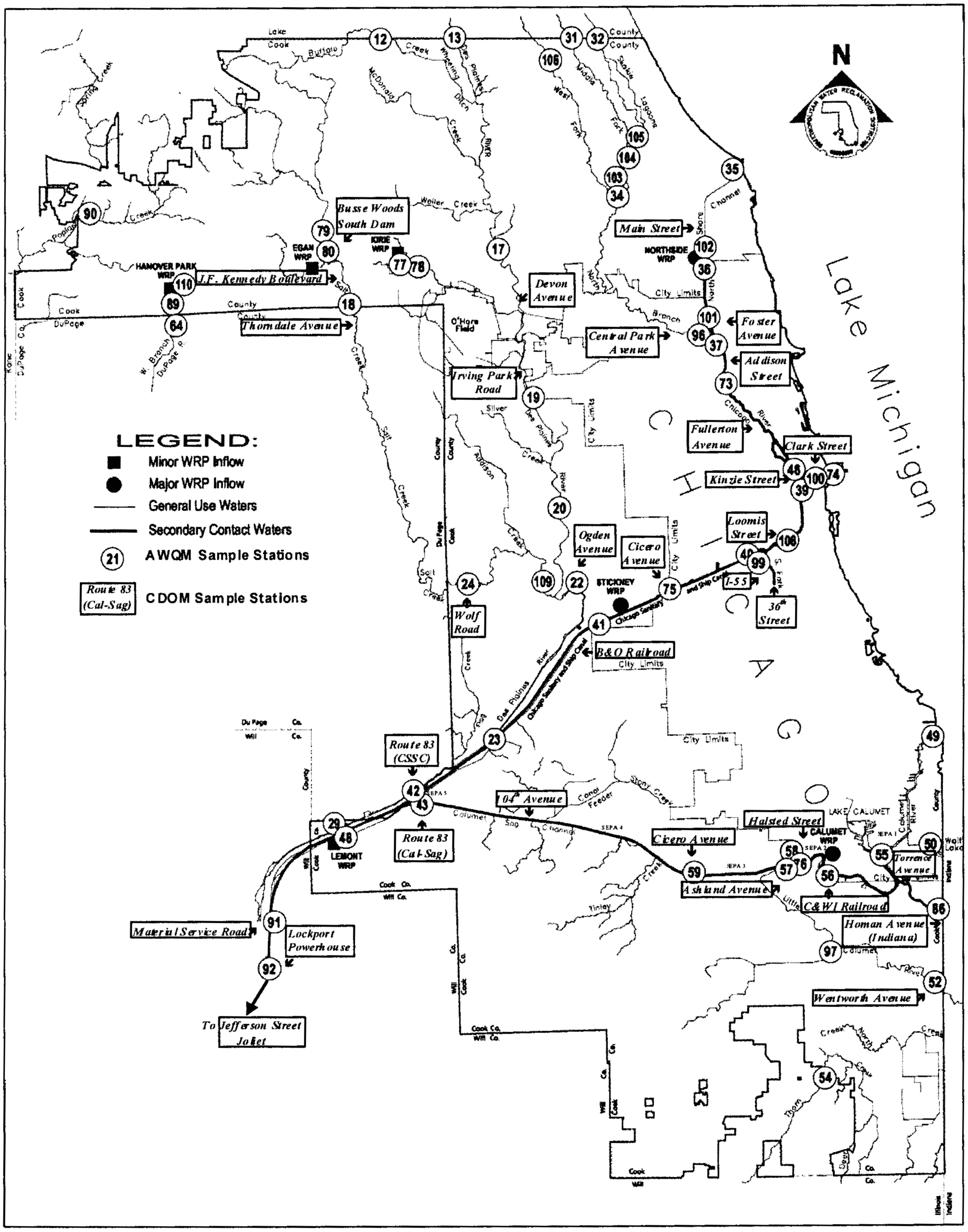


FIGURE V-2: MAP OF THE ILLINOIS WATERWAY FROM LOCKPORT TO MARSEILLES SHOWING SAMPLING STATIONS 1 TO 21

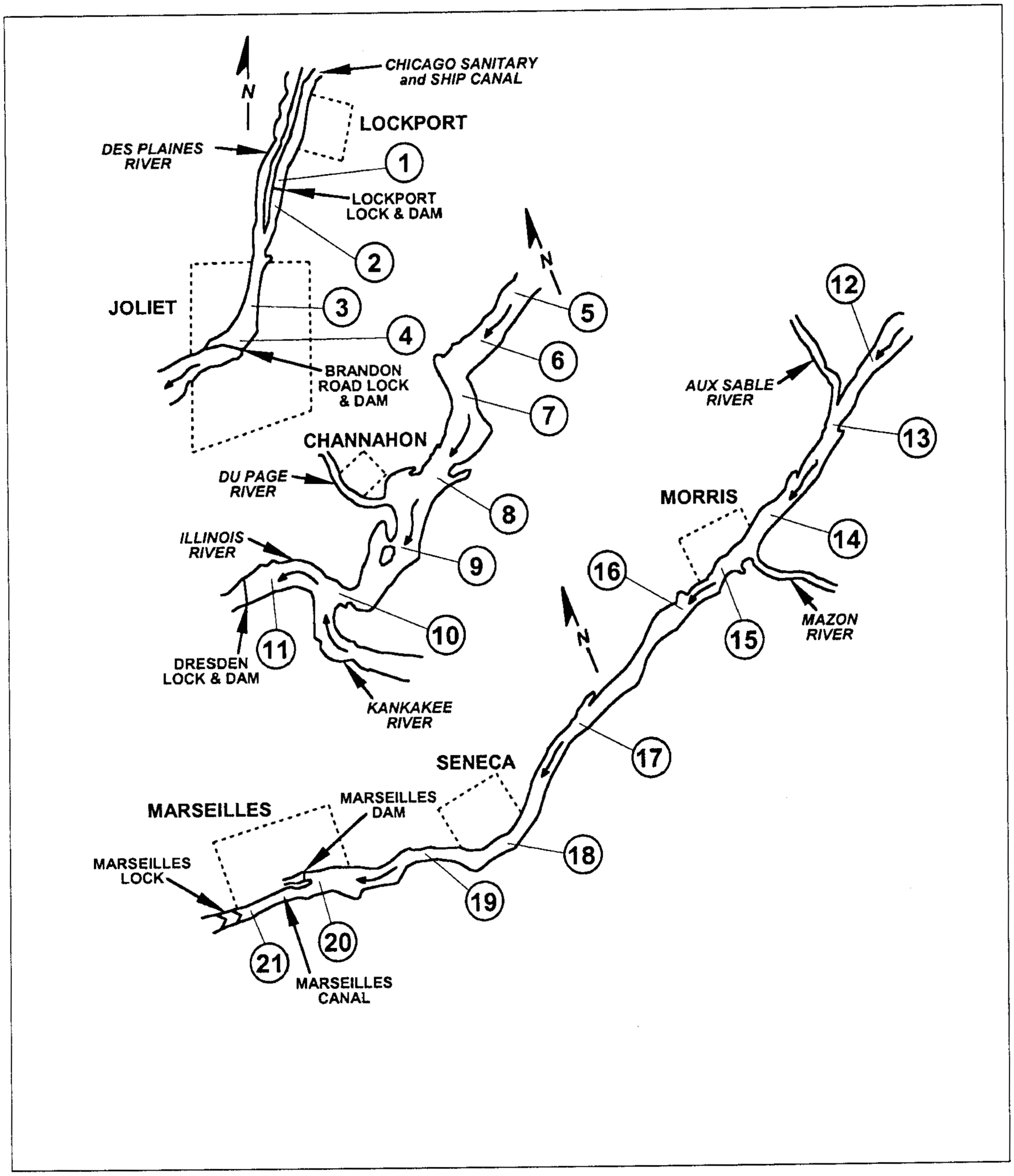
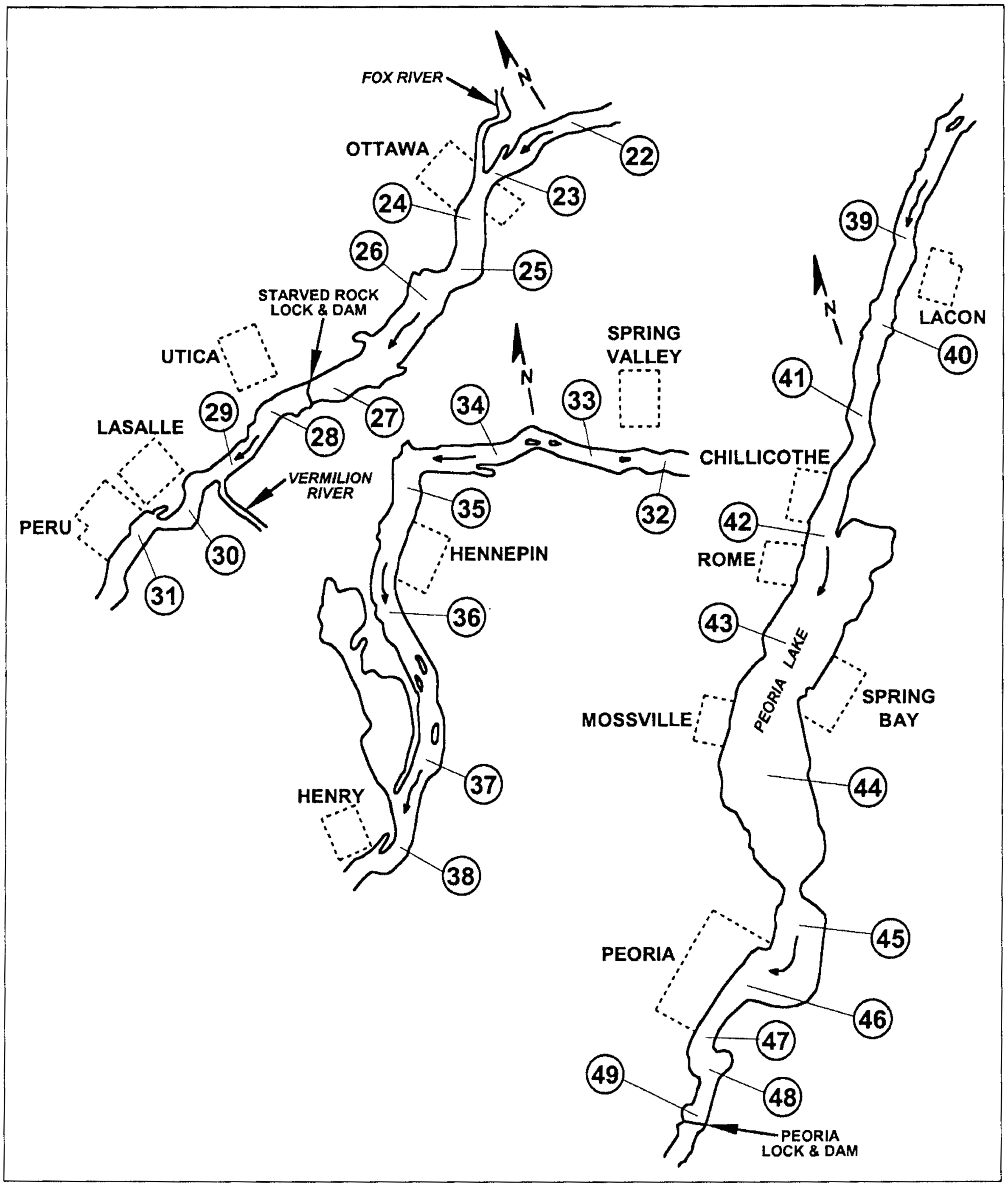


FIGURE V-3: MAP OF THE ILLINOIS WATERWAY FROM OTTAWA TO PEORIA SHOWING SAMPLING STATIONS 22 TO 49



APPENDIX I

APPENDIX I

MEETINGS AND SEMINARS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

1. DuPage River, Salt Creek Watershed Workgroup Meeting (and follow-up meetings throughout the year), Downers Grove, Illinois, *January 2010.*

2. Illinois Association of Park Districts/Illinois Parks and Recreation Association Conference, Chicago, Illinois, *January 2010.*

3. Illinois Pollution Control Board, Use Attainability Analysis Hearings (and follow-up hearings throughout the year), Chicago, Illinois, *January 2010.*

4. Illinois Water Environment Association and Central States Water Environment Association, Government Affairs in Water Pollution Control Conference, Willowbrook, Illinois, *January 2010.*

5. Midwest Water Analysts Association, Winter Expo 2010 (and follow-up committee meetings throughout the year), Kenosha, Wisconsin, *January 2010.*

6. Publicly Owned Treatment Works Nutrient Reduction and Efficiency Conference, Evansville, Indiana, *January 2010.*

7. United States Army Corp of Engineers, Bubbly Creek Feasibility Study (and follow up meetings throughout the year), Chicago, Illinois, *January 2010.*

8. United States Fish and Wildlife Service, Hines Emerald Dragonfly Critical Habitat Planning (and follow-up meetings throughout the year), Chicago, Illinois, *January 2010.*

9. Illinois Chapter of the American Fisheries Society, Annual Meeting, Whittington, Illinois, *February 2010.*

10. Illinois Water Environment Association, 31st Annual Conference & Exhibition (and follow-up committee meetings throughout the year), East Peoria, Illinois, *March 2010.*

11. United States Environmental Protection Agency, Greenhouse Gas Mandatory Reporting Rule Region 5 and 7 Training Session, Chicago, Illinois, *March 2010.*

12. United States Environmental Protection Agency, Region 5, BeWISE (Women in Science and Engineering) 2010 Conference, Chicago, Illinois, *March 2010.*

13. Water Environment Federation/Air & Waste Management Association, Odors and Air Pollutants 2010, Charlotte, North Carolina, *March 2010.*

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MEETINGS AND SEMINARS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

14. Water Environment Federation, Urban River Restoration Conference, Boston, Massachusetts, *March 2010.*

15. Central States Water Environment Association, Managing Biosolids in Our Energy Conscious Era Education Seminar, Madison, Wisconsin, *April 2010.*

16. Chicago Department of the Environment, Calumet Summit, Hammond, Indiana, *April 2010.*

17. Illinois Institute of Technology, Advanced Wastewater Treatment Technology: Conventional and Micropollutants Workshop, Chicago Illinois, *April 2010.*

18. National Association of Clean Water Agencies, National Perspectives, Developments, and Advanced Urban Wet Weather Solutions Workshop, Chicago, Illinois, *April 2010.*

19. Water Environment Research Foundation, Regional Conference, Alexandria, Virginia, *April 2010.*

20. Commonwealth Edison, Energy Efficiency Expo, Rosemont, Illinois, *May 2010.*

21. Illinois Association of Wastewater Agencies, Technical Committee Meeting (and follow-up committee meetings throughout the year), Utica, Illinois, *May 2010.*

22. Pesticide Training and Certification Clinics, DesPlaines, Illinois, *May 2010.*

23. United States Environmental Protection Agency, Technology Transfer Seminar on Nutrient Control at Municipal Wastewater Treatment Plants, Rosemont, Illinois, *May 2010.*

24. Water Environment Federation, Residuals and Biosolids Conference, Savannah, Georgia, *May 2010.*

25. Friends of the Chicago River, Chicago River Summit, Chicago, Illinois, *June 2010.*

26. Midwest Water Analysts Association, 2010 Spring Meeting, Lisle, Illinois, *June 2010.*

27. United States Department of Agriculture, Regional Research Committee 2-2170, Annual Meeting, Willow Springs, Illinois, *June 2010.*

28. Water Environment Research Foundation, The Johnson Foundation at Wingspread Conference, Racine, Wisconsin, *July, 2010.*

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MEETINGS AND SEMINARS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

29. American Fisheries Society, Annual Meeting, Pittsburgh Pennsylvania, *September 2010.*

30. American Institute of Chemical Engineers, Midwest Regional Conference, Chicago, Illinois, *September 2010.*

31. Illinois Environmental Protection Agency, Nutrient Science Summit, Springfield, Illinois, *September 2010.*

32. Mississippi Nutrient/Hypoxia Task Force Meeting and Summit, Robinsonville and Tunica, Mississippi, *September 2010.*

33. National Association of Clean Water Agencies, Nutrient Summit, Chicago, Illinois, *September 2010.*

34. Northwest Biosolids Management Association Conference, Lake Chelan, Washington, *September 2010.*

35. Great Lakes Beach Association, 2010 Conference, Preque Isle, Pennsylvania, *October 2010.*

36. Illinois Environmental Protection Agency, Nutrient Standard Roundtable Meeting, Springfield, Illinois, *October 2010.*

37. Illinois Water Conference 2010, Champaign, Illinois, *October 2010.*

38. Midwest Water Analysts Association, Fall Meeting, Racine Wisconsin, *October 2010.*

39. Water Environmental Federation, 83rd Annual Technical Exhibition and Conference, New Orleans, Louisiana, *October 2010.*

40. Water Environment Research Foundation, Pathogen Program Issue Area Team Challenge, Wastewater Microbes and Public Health Meeting, Alexandria, Virginia, *October 2010.*

41. Air and Waste Management Association, 2010 Air Quality Management Conference, Glen Ellyn, Illinois, *November 2010.*

42. American Society of Agronomy, Annual Meeting, Long Beach, California, *November 2010.*

APPENDIX I

MEETINGS AND SEMINARS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

43. National Science Foundation, Industry and University Cooperative Research Center for Water Equipment and Policy, Milwaukee, Wisconsin, *November 2010.*

44. Society of Environmental Toxicology and Chemistry, North America 31^{st} Annual Meeting, Portland Oregon, *November 2010.*

45. Illinois Emergency Management Agency and Central Midwest Interstate Low-Level Radioactive Waste Commission, Low-Level Radioactive Waste Generators/Radioactive Material License Conference, Chicago, Illinois, *December 2010.*

46. Midwest Association of Fish and Wildlife Agency, Midwest Fish and Wildlife 71^{st} Conference, Minneapolis, Minnesota, *December 2010.*

47. Ohio Water Environment Association, Annual Conference, Columbus, Ohio, *December 2010.*

APPENDIX II

APPENDIX II

PRESENTATIONS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

1. "Determining Plant Capacity for Future Expansion Assessment Using Plant Performance Data." Presented at the Midwest Water Association, Winter Expo 2010, Kenosha, Wisconsin, by J. Moran. *January 2010.* PP

2. "Energy and Carbon Footprint of Water Reclamation and Water Management in Greater Chicago and Chicago's Sustainable Streetscape." Presented at DePaul University, Sustainable Cities Class, Chicago, Illinois, by J. A. Kozak. *February 2010.* PP

3. "Can the New Water Quality Criteria be Applied to POTW Permit Compliance Monitoring?" Presented at the Illinois Water Environment Association, 31st Annual Conference and Exhibition, East Peoria, Illinois, by G. Rijal. *March 2010.* PP

4. "Effects of Mechanical Mixing on Full-scale Digester Performance at the Calumet Water Reclamation Plant." Presented at the Illinois Water Environment Association, 31st Annual Conference and Exhibition, East Peoria, Illinois, by K. Patel. *March 2010.* PP

5. "Farmland Application of Biosolids by the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Illinois Water Environment Association, 31st Annual Conference and Exhibition, East Peoria, Illinois, by A. Cox, D. Collins, K. Kumar, G. Tian, and T. C. Granato. *March 2010.* PP

6. "Protozoa as Indicators of Activated Sludge Treatment System Conditions." Presented at the Illinois Water Environment Association, 31st Annual Conference and Exhibition, East Peoria, Illinois, by A. Glymph. *March 2010.* PP

7. "The Effect of Ferric Chloride Addition and Filtration on UV Disinfection." Presented at the Illinois Water Environment Association, 31st Annual Conference and Exhibition, East Peoria, Illinois, by J. A. Kozak. *March 2010.* PP

8. "Assessing the Potential for Endocrine Disruption in Urbanized Aquatic Environments: Study Design, Findings and Impacts for the Calumet Region," Presented at the Chicago Department of the Environment, Calumet Summit, Hammond, Indiana, by T. Minarik. *April 2010.* PP

9. "Greening More than the Chicago River." Presented at the National Association of Clean Water Agencies, National Perspectives, Developments, and Advanced Urban Wet Weather Solutions Workshop, Chicago, Illinois, by J. A. Kozak. *April 2010.* PP

APPENDIX II

PRESENTATIONS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

10. "Heat Recovery at a Water Reclamation Plant in Greater Chicago." Presented at the American Institute of Chemical Engineers, Midwest Regional Conference, Chicago, Illinois, by A. Oskouie. *September 2010.* PP

11. "Occurrence and Fate of Emerging Contaminants in Biosolids and Biosolids-Amended Soils – An Overview." Presented at the Northwest Management Association Conference, Lake Chelan, Washington, by L. S. Hundal. *September 2010.* PP

12. "The Energy and Carbon Footprint of Water Treatment, Water Reclamation, and Waterway Management in Greater Chicago." Presented at the American Institute of Chemical Engineers, Midwest Regional Conference, Chicago, Illinois, by J. A. Kozak, and P. Mulvaney. *September 2010.* PP

13. "Assessing the Potential for Endocrine Disruption in Urbanized Aquatic Environments: Study Design and Preliminary Findings." Presented at the Illinois Water Conference 2010, Champaign, Illinois by T. Minarik. *October 2010.* PP

14. "Continuous Dissolved Oxygen Monitoring of Illinois Streams: An Assessment of Practicality, Sustainability, and Necessity." Illinois Water Conference 2010, Champaign, Illinois, by T. C. Granato, T. Minarik, and J. Wasik. *October 2010.* PP

15. "Greenhouse Gas Emissions from Three Chicago Wastewater Treatment Plants." Presented at the Water Environment Federation, 83rd Annual Technical Exhibition and Conference, New Orleans, Louisiana, by F. Bellucci, J.A. Kozak, L. Hearaty, J. Carbone, N. C. Sturchio, C. O'Connor, L. Kollias and R. Lanyon. *October 2010.* PP

16. "Operating the Sidestream Elevated Pool Aeration Stations to Meet the Proposed Water Quality Standards on the Calumet-Sag Channel." Presented at the Illinois Water Conference 2010, Champaign, Illinois, by J. Moran. *October 2010.* PP

17. "Stream Response to Phosphorus Reduction at the Metropolitan Water Reclamation District of Greater Chicago." Presented at the Illinois Water Conference 2010, Champaign, Illinois by J. Wasik. *October 2010.* PP

18. "A Framework to Predict Uptake of Pharmaceutical and Personal Care Products by Plants: Potential Mechanisms." Presented at the American Society of Agronomy, Annual Meeting, Long Beach, California, by K. Kumar, L. S. Hundal, S. C. Gupta, A. Cox, and T. C. Granato. *November 2010.* PP.

APPENDIX II

PRESENTATIONS 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

19. "Assessing the Potential for Endocrine Disruption in Urbanized Aquatic Environments: Study Design, Finding, and Impacts for the Calumet Region," Presented at the Society of Environmental Toxicology and Chemistry, North America 31st Annual Meeting, Portland Oregon, by T. Minarik. *November 2010.* PP

20. "Effect of Long-Term Application of Biosolids on Biological Soil Quality: SOC Pools." Presented at the American Society of Agronomy, Annual Meeting, Long Beach, California, by G. Tian, A. J. Franzluebbers, T. C. Granato, A. Cox, and C. O'Connor. *November 2010.* PP

21. "Microconstituents in Biosolids – What Does it Mean for the Future of Land Application of Biosolids?" Presented at the Ohio Water Environment Association, Annual Conference, Columbus, Ohio, by L. S. Hundal. *December 2010.* PP

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* P = Available as a paper
B = Available as both a paper and PowerPoint Presentation
PP = Available as PowerPoint Presentation
PS = Poster Presentation

APPENDIX III

APPENDIX III

PAPERS PUBLISHED 2010
ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

1. Apul, D. S, M. Diaz, J. P. Gustafsson, and L. S. Hundal. 2010. "Geochemical Modeling of Trace Element Release from Biosolids," *Environmental Engineering and Science.* 27(9):743 -755. *2010.*

2. Bellucci, F., J. A. Kozak, L. Heraty, J. Carbone, N. C. Sturchio, C. O'Connor, L. Kollias, and R. Lanyon. "Greenhouse Gas Emissions from Three Chicago Wastewater Treatment Plants." Proceedings of the Water Environment Federation, 83nd Annual Technical Exhibition and Conference, New Orleans, Louisiana. *2010.*

3. Higgins, C. P., Z. J. Paesani, T. E. A. Chalew, R. U. Halden, L. S. Hundal. "Persistence of TCS and TCC in Soils After Land Application of Biosolids and Bioaccumulation in *Eisenia foetida,*" *Journal of Environmental Toxicology and Chemistry*, 30:556-563. *2010*

4. Kozak, J., D. T. Lordi, Z. Abedin, C. O'Connor, T. C. Granato, and L. Kollias. "The Effect of Ferric Chloride Addition for Phosphorus Removal on Ultraviolet Radiation Disinfection of Wastewater." *Environmental Practice,* Vol. 12, No. 4: 275-284. *2010.*

5. Kozak, J., K. Patel, Z. Abedin, D. Lordi, C. O'Connor, T. C. Granato, and L. Kollias. "Effect of Ferric Chloride Addition and Holding Time on Gravity Belt Thickening of Waste Activated Sludge." *Water Environment Research*, 82: n.p. *2010.*

6. **Rijal**, G. K., **J. K. Tolson,** C. **Petropoulou,** T. C. **Granato, A. Glymph, C. Gerba,** M. F. **Deflaun,** C. **O'Connor,** L. **Kollias, and** R. **Lanyon. "Microbial Risk Assessment for Recreational Use of the Chicago Area Waterway System."** ***Journal of Water and Health,*** **© IWA Publishing.** ***2010.***

7. Xia, K., L. S. Hundal, K. Kumar, A. E. Cox, T. C. Granato, and K. Armbrust. "TCC, TCS, PBDEs, and 4-NP in Biosolids and in Soil Receiving 33-year Biosolids Application," *Journal of Environmental Toxicology and Chemistry,* 29:597-605. *2010.*

APPENDIX IV

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO
MONITORING AND RESEARCH DEPARTMENT 2010 SEMINAR SERIES

January 29, 2010	***Incorporating Microbiology in Wastewater Process Control*** Ms. Auralene Glymph, Senior Environmental Microbiologist, Monitoring and Research Department, Metropolitan Water Reclamation District of Greater Chicago (District), Chicago, IL
February 26, 2010	***Environmental and Sustainability Factors Associated With Next-Generation Biofuels in the United States: What Do We Really Know?*** Dr. Pamela Williams, E Risk Sciences, Boulder, CO
March 19, 2010	***Uptake of Emerging Contaminants in Plants*** Dr. Kuldip Kumar, Associate Environmental Soil Scientist, Monitoring and Research Department, District, Cicero, IL
April 30, 2010	***The Emerald Forest – An Integrated Approach for Sustainable Community Development and Bio-Derived Energy Generation*** Dr. Fouad Teymour, Illinois Institute of Technology, Chicago, IL
May 21, 2010	***Status of Implementing the Tunnel and Reservoir Plan at the District*** Mr. Kevin Fitzpatrick, Principal Civil Engineer, Engineering Department, District, Chicago, IL
June 18, 2010	***Management of the Chicago Area Waterway System from the Locks to Lockport*** Mr. Edward Staudacher, Supervising Civil Engineer, and Mr. James Yurik, Principal Civil Engineer, Maintenance and Operations Department, District, Chicago, IL
July 30, 2010	***Greenhouse Gas Accounting for District Biosolids Management Program*** Dr. Sally Brown, University of Washington, Seattle, WA, and Dr. Guanglong Tian, Senior Environmental Soil Scientist, Monitoring and Research Department, District, Cicero, IL
August 27, 2010	***Pharmaceuticals in the Environment: Is the Problem Here or Just Around the Corner?*** Dr. Cecil Lue-Hing, Cecil Lue-Hing & Associates, Burr Ridge, IL
September 24, 2010	***Plant Availability and Environmental Significance of Phosphorus in Land-Applied District Biosolids*** Dr. Guanglong Tian, Senior Environmental Soil Scientist, and Dr. Kuldip Kumar, Associate Environmental Soil Scientist, Monitoring and Research Department, District, Cicero, IL
October 29, 2010	***Chicago Health, Environmental Exposure, and Recreational Study*** Dr. Samuel Dorevitch, University of Illinois at Chicago, Chicago, IL
November 19, 2010	***Feasibility of Traditional and Emerging Technologies for Treatment and Resource Recovery of Recycle Streams*** Mr. Kamlesh Patel, Senior Environmental Research Scientist, Monitoring and Research Department, District, Cicero, IL
December 17, 2010	***Bubbly Creek Sediment Oxygen Demand Study and Implications for Water Quality Improvement*** Dr. Marcelo Garcia, University of Illinois at Urbana-Champaign, Urbana, IL

RESERVATIONS REQUIRED (at least 24 hours in advance); PICTURE ID REQUIRED FOR PLANT ENTRY
CONTACT: Dr. Catherine O'Connor, Assistant Director of Monitoring and Research, EM&R Division, (708) 588-4264 or (708) 588-4059
LOCATION: Stickney Water Reclamation Plant, Lue-Hing R&D Complex, 6001 West Pershing Road, Cicero, IL 60804; TIME: 10:00 A.M.
NOTE: These seminars are eligible for Professional Development Credits/CEUs

APPENDIX V

ENVIRONMENTAL MONITORING AND RESEARCH DIVISION

Section 121 - Administrative Section

O'Connor, Catherine, Assistant Director of Monitoring and Research
Vacant, Environmental Monitoring and Research Manager
Abedin, Zainul, Biostatistician
Khalique, Abdul, Radiation Chemist
Gregor, Bettina, Secretary
Urlacher, Nancy, Administrative Assistant

Section 122 - Wastewater Treatment Process Research

Zhang, Heng, Supv. Env. Research Scientist
Lordi, Dave, Supv. Env. Research Scientist
Franklin, Laura, Prin. Office Support Spec.
Oskouie, Ali, Senior Env. Research Scientist
Patel, Kamlesh, Senior Env. Research Scientist
Bernstein, Doris, Assoc. Env. Research Scientist
Kozak, Joseph, Assoc. Env. Research Scientist
MacDonald, Dale, Assoc. Env. Research Scientist
Moran, Judith, Assoc. Env. Research Scientist
Haizel, Anthony, Lab Technician 2
Reddy, Thota, Lab Technician 2
Bodnar, Robert, Lab Technician 1
Byrnes, Marc, Lab Technician 1
Iu, Kim, Lab Technician 1
Kowalski, Shawn, Lab Technician 1
Robinson, Harold, Lab Technician 1

Section 123 - Biosolids Utilization and Soil Science

Cox, Albert, Supv. Env. Soil Scientist
Quinlan, Kathleen, Prin. Office Support Spec.
Hundal, Lakhwinder, Senior Env. Soil Scientist
Tian, Guanglong, Senior Env. Soil Scientist
Kumar, Kuldip, Assoc. Env. Soil Scientist
Lindo, Pauline, Assoc. Env. Soil Scientist
Oladeji, Olawale, Assoc. Env. Soil Scientist
Patel, Minaxi, Assist. Env. Chemist
Mackoff, Ilyse, Lab Technician 2
Tate, Tiffany, Lab Technician 2
Adams, Richard, Lab Technician 1
Vacant, Lab Technician 1
Holic, Larry, Lab Assistant
Horvath, Beverly, Lab Assistant

Section 124-Analytical Microbiology and Biomonitoring

Rijal, Geeta, Supv. Env. Microbiologist
Slaby, Pamela, Prin. Office Support Spec.
Glymph, Auralene, Senior Env. Microbiologist
Gore, Richard, Assoc. Env. Microbiologist
Shukla, Hemangini, Assist. Env. Microbiologist
Billet, Vince, Lab Technician 2
Jackowski, Kathleen, Lab Technician 2
Kaehn, James, Lab Technician 2
Maka, Andrea, Lab Technician 2
Rahman, Shafiq, Lab Technician 2
DeGutes, Mathew, Lab Technician 1
Hussaini, Syed, Lab Technician 1
Mehta, Atulkumar, Lab Technician 1
Vacant, Lab Technician 1
Roberts, David, Lab Technician 1
Qureshi, Farhan, Lab Assistant
Saverson, Amanda, Lab Assistant

Section 126 - Aquatic Ecology and Water Quality

Wasik, Jennifer, Supv. Aquatic Biologist
Maurovich, Coleen, Prin. Office Support Spec.
Minarik, Thomas, Senior Aquatic Biologist
Gallagher, Dustin, Assoc. Aquatic Biologist
Vick, Justin, Assoc. Aquatic Biologist
Kollias, Nick, Assist. Aquatic Biologist
Burke, Michael, Lab Technician 2
Joyce, Colleen, Lab Technician 2
Schackart, Richard, Lab Technician 2
Whitington, Angel, Lab Technician 2
Lansiri, Panu, Lab Technician 1
Schipma, Jane, Lab Technician 1