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Project Summary

Assessment and Remediation of Contaminated Sediments (ARCS) Program—Quality Assurance Program Plan

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The quality assurance (QA) policy of the U.S. Environmental Protection Agency (USEPA) requires every monitoring and measurement project to have a written and approved quality assurance program and project plan. The purpose of this quality assurance program plan is to specify the policies, organization, objectives, and the quality evaluation and quality control (QC) activities needed to achieve the data quality requirements of the Assessment and Remediation of Contaminated Sediments (ARCS) Program. These specifications are used to assess and control measurement errors that may enter the system at various phases of the program, (during sampling, preparation, and analysis).

This Project Summary was developed by EPA's Environmental Monitoring and Systems Laboratory, Las Vegas, NV, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Project Description

The 1987 amendments to the Clean Water Act, Section 118(c)(3), authorize the USEPA Great Lakes National Program Office (GLNPO) to coordinate and conduct a 5-year study and demonstration project relating to the control and removal of toxic pollutants in the Great Lakes, with emphasis on removal of toxic pollutants from bottom sediments. Five areas were specified in the Clean Water Act as requiring priority consideration in locating and conducting demonstration projects: Saginaw Bay, MI; Sheboygan Harbor, WI; Grand Calumet River, IN; Ashtabula River, OH; and Buffalo River, NY. In response, GLNPO has initiated the ARCS Program. ARCS is an integrated program for the development and testing of assessment and remedial action alternatives for contaminated sediments.

The overall objectives of the ARCS program are to: (1) assess the nature and extent of bottom sediment contamination at selected Great Lakes Areas of Concern (AOCs), (2) evaluate and demonstrate remedial options, including removal, immobilization, and advanced treatment technologies, as well as the "no action" alternative, and (3) provide guidance on the assessment of contaminated sediments and the selection and implementation of necessary remedial actions in the AOCs and other locations in the Great Lakes.

To accomplish the objectives of the ARCS program, two committees, one nontechnical workgroup, and three technical workgroups were established. The names of the individual workgroups and their basic responsibilities are:

Management Advisory Committee: Advises the GLNPO Director on their perceptions of the overall progress of the ARCS program and reviews annual work and funding plans for the ARCS program.

Activities Integration Committee: Oversees the ARCS program, including the technical activities of each of the

workgroups, develops and coordinates the QA/QC program, and coordinates the data management activities of the ARCS program.

Toxicity/Chemistry Workgroup: Assesses the current nature and extent of contaminated sediment problems by studying the chemical, physical, and biological characteristics of contaminated sediments and their biotic communities, demonstrates cost-effective assessment techniques at the priority consideration areas that can be used at other Great Lakes AOCs, and produces three-dimensional maps showing the distribution of contaminated sediments in the priority areas.

Risk Assessment/Modeling Workgroup: Assesses the current and future hazards presented by the contaminated sediments to all biota (aquatic, terrestrial, and human) under the "no action" alternative and other remedial alternatives at the priority consideration areas, as well as develops a ranking scheme for site comparison.

Engineering/Technology Workgroup: Evaluates and tests available removal and remedial technologies for contaminated sediments, selects promising technologies for further testing, and performs field demonstrations on as many of the promising technologies as possible.

Communication/Liaison Workgroup: Facilitates the flow of information from the technical workgroups and the overall ARCS program to the interested public and provides feedback from the public to the ARCS program on needs, expectations, and perceived problems.

Expertise for the three technical workgroups (toxicity/chemistry, risk assessment/modeling, and engineering/technology) was sought from numerous federal and state government agencies (USEPA, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Oceanographic and Atmospheric Administration, Bureau Of Mines, Illinois Natural History Survey, New York State Department of Environmental Conservation), universities and colleges (Wright State University, Michigan State University, University of Michigan, State University College of New York at Buffalo, Memphis State University, University of Minnesota, Saginaw Valley State College, University of California at Santa Barbara, and private industry (Lockheed Engineering & Sciences Company, Science Applications International Corporation, and Battelle-Marine Sciences Laboratory).

Further discussion of the primary responsibilities, including sampling and analyses, to be performed by the three technical workgroups is presented in the following text.

Toxicity/Chemistry Workgroup

Four different types of sampling stations were established for the sediment toxicity testing by the Toxicity/Chemistry (T/C) workgroup: reconnaissance stations, master stations, priority master stations, and extended priority master stations. A brief description of the site selection criteria, sampling process, and analyses performed on each station type follows.

Sampling locations for the reconnaissance stations were selected to give the greatest possible coverage of the entire AOC and to obtain a zone of intensive sampling around a known "hot spot". Site coordinates were obtained using the Loran C navigation or the global positioning system. Samples were obtained using a Vibra-core* unit. Observations of sediment color, texture, smell, and layering were performed on-site. Subsamples of approximately 61-cm (2-ft) intervals were collected, placed in 4 L polyethylene bottles, kept on ice in the field, and stored at the laboratory at 4°C. Indicator parameters, including ammonia, conductivity, metals, Microtox™ bioluminescence assay, organohalogens, pH, sediment grain size fractions, solvent extractable residue, total solids, volatile solids, and total organic carbon (TOC), were analyzed in various media (pore water, elutriate, and/or solids).

In principle, the indicator parameters correlate with other measurements of contamination and toxicity. Therefore, use of the indicator parameters allow the detailed analyses from the few master stations to be extrapolated throughout the site, based on correlations between reconnaissance and master station data. Information from these analyses and from profiling data obtained during the reconnaissance survey will be used to prepare three-dimensional contamination maps during the post-survey phase.

The locations of the master stations (including the priority and extended priority master stations) were selected based on the availability of historical sediment contaminant concentration data and contaminant maps from each AOC, input from local authorities, and a desire to provide some degree of complete geographic coverage in each AOC. Stations were usually positioned along the sides of the dredged shipping channel since these shallow areas are usually the location of sediment deposition zones. Collection of the bulk sediment sample was performed using either a Van Veen or Ponar grab sampler. Approximately 15 L of sediment at master stations and approximately 120 L of sediment at priority master stations was collected. The sediment from the grabs was transferred and composited in 5-gal plastic bag-lined buckets.

Upon completion of the sampling effort, the sediments were transported to shore and homogenized. Homogenization consisted of mixing the sediments in a cement mixer for 15 min. Once the sediment was determined to be visually homogeneous, the sample was transferred to labeled, high-density polyethylene bottles. A 5-cm headspace was left in each bottle to allow for later sample homogenization at the analytical laboratories. The bottles were stored on ice in the field and in walk-in coolers at 4 ± 2° C in the dark at the analytical laboratories.

Chemical analyses for all master station (including priority and extended priority master stations) samples included: metals, pH, acid volatile sulfides, methylmercury, tributyltin, pesticides, polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), dioxins/furans, and total organic carbon. Analyses were performed using standardized, approved EPA methods. Where standardized EPA methods do not exist, written standard operating procedures or published references for the method were provided by the analytical laboratory.

To examine the toxicity (actual and potential) of the sediments, pore waters, and elutriates to living organisms in the Great Lakes, numerous bioassays were performed on the sediments from the various levels of master stations. At each master station, a tiered testing approach was used to determine the toxicity of the sediments. Tier I testing focuses on acute toxicity testing using *Daphnia magna, Ceriodaphnia dubia, Chironomus riparius, Chironomus tentans, Selenastrum capricornutum*, and Microtox™, benthic community structure, and mutagenicity testing while Tier II focuses on partial life-cycle toxicity employing *Hyalella azteca* assays. Tier III testing focuses primarily on full life-cycle toxicity and bioaccumulation using *Hyalella azteca* and *Pimephales promelas*. Appropriate water quality parameters were monitored.

Priority master stations were selected from the master stations to represent sediments with a wide range in the degree of contamination in each AOC. These stations underwent the same testing as the master stations. Additionally, the following comparative bioassays were performed: Microtox™, *Selenastrum capricornutum, Daphnia magna, Hyalella azteca, Lemna minor, Pimephales promelas, Hydrilla*

* Mention of trade names or commericial products does not constitute endorsement or recommendation for use.

verticillata, Diaporeia sp, Hexagenia limbata, Panagrellus redivivus, and indigenous bacterial enzyme function. This additional suite of bioassays was used to assist in the selection of optimal sediment toxicity test assays for a given contaminant group (PAHs), provide comparisons with the International Joint Commission recommended test battery, and aid in the determination of biologically significant contaminant levels in "grey" areas where contaminants are likely to produce some acute and chronic toxicity effects.

Most, if not all, of the sediments selected as priority master stations underwent a bioaccumulation assay using *Pimephales promelas*. If the potential exists for the bioaccumulation of a contaminant or suite of contaminants identified in the sediment, the priority master station was designated as an extended priority master station and the fish tissue underwent analysis for the suspected bioaccumulated contaminants. The extended priority master station sediments were areas of high contaminant levels (a "hot spot") in each AOC.

Fish tumor and abnormality identification on the brown bullhead (*Amelurus nebulosus*) were also performed as part of the T/C workgroup testing program. The brown bullhead has been selected as the primary fish due to its intimate contact with the bottom sediments. Surveys were conducted in the Buffalo, Ashtabula, and Saginaw Rivers to determine the incidence of external abnormalities and internal tumors.

Risk Assessment/Modeling Workgroup

One of the primary objectives of the Risk Assessment and Modeling (RA/M) workgroup is to perform hazard evaluations. The phrase "hazard evaluation" refers to the overall evaluation of impacts to all receptors of concern resulting from exposure to sediment contaminants and consists of several discrete assessments. The ultimate purpose of the hazard evaluation is to determine the existing and future health risks and effects (carcinogenic, reproductive, systemic effects, community structure impacts) presented to human and environmental receptors (aquatic, avian, mammalian) from direct or indirect contact with sediment contaminants under different remedial options. The hazard evaluation is comprised of four assessments: exposure, human health risk, aquatic hazard, and wildlife hazard assessments.

Two levels of evaluation will be examined, baseline and comprehensive hazard evaluations. Baseline human health hazard evaluations will be performed for all five AOCs and will be developed from available site-specific information. The baseline hazard evaluations describe the hazards to receptors under present site conditions or the "no action" alternative. This baseline assessment will examine all potential pathways by which humans may incur risk from exposure to sediments at a given location.

Comprehensive hazard evaluations will be performed for the Buffalo River and Saginaw River AOCs. These evaluations describe the hazards to receptors under different remedial alternatives. The remedial alternatives include examining selective removal or capping of "hot spots", source control, or dredging of an entire river, among others. Additionally, the comprehensive risk assessment will examine risk from losses of selected remedial alternatives.

Sampling consisted predominantly of the collection of samples to support the mini-mass balance/synoptic surveys on the Buffalo and Saginaw Rivers. These efforts included the collection of the water column samples, simultaneous measurements of river discharge and associated water quality parameters, and sampling of fish populations. For the Buffalo River system, sampling of combined sewer outfall (CSO) discharges were performed. Two additional river characterization studies (sediment transport and sediment resuspension potential studies) were conducted on the Buffalo River AOC.

The basic goal in the sampling design for the mini-mass balance/synoptic surveys is to collect information about the river system during several periods of low flow (or quasi-steady state) conditions as well as during at least one high flow event (after a major storm system has passed through the AOC or during the spring snow melt). These data provide information on the relative importance and amplitude of point and non-point pollutant sources to the AOC on both a temporal and a spatial scale. These same data also serve as a primary information source for the mass-balance, near-field dispersion, far-field dispersion, and food chain models to be used by the RA/M workgroup. Samples were collected from fixed stations (six in the Saginaw River AOC and 7 within the Buffalo River AOC) for all sampling events to measure pollutant influxes to the AOC, ambient concentrations within the AOC, and effluxes to the lake, harbor, or bay.

Measurements of the river flow conditions (flow velocity and direction, sediment load, thermal stratification, etc.) and water quality parameters (pH, conductivity, temperature, dissolved oxygen, chlorophyll-a content) were made simultaneously with the collection of the water column samples using a variety of automated measurement systems including: the Sea-Bird® Model SBE-25 Sealogger, Sea-Bird® SEACAT SBE-16® recorder fitted with a Sea Tech Transmissometer, HydroLab Surveyor II®, LI-COR® system, March-McBirney Model 301 Flow Velocity Meter and/or Price and Weathermeasure current meters.

Under both high and low flow conditions, numerous measurements were taken throughout the AOC to determine dissolved contaminant concentrations in the water column and on the suspended sediment. Contaminants measured in the Buffalo River included: total PCBs, DDT, dieldrin, chlordane, benzo(a)pyrene, benzo(a)-anthracene, benzo(b)fluoranthene, benzo-(k)fluoranthene, chrysene, Pb, and Cu. The contaminants analyzed in water and particulate samples collected in the Saginaw River AOC included: total PCBs, Pb, Fe, Cu, and Zn. Conventional water quality parameters of sulfides, alkalinity, hardness, chlorides, TOC, dissolved oxygen content, and total suspended solids were also measured in both AOCs. Analyses were performed using standardized, approved EPA methods. Where standardized EPA methods do not exist, written standard operating procedures or published references for the method were provided by the analytical laboratory.

Fish samples were collected at both the Buffalo and Saginaw River AOCs to support the food chain modeling efforts. Fish were collected throughout the entire AOC. Carp (*Cyprinus carpio*) was collected as the primary fish in the Buffalo River while walleye (*Stizostedion vitreum*) was sampled in the Saginaw River. Carp were chosen to be sampled in the Buffalo River due to their abundance and representativeness of the river's bottom feeders. Walleye were selected in the Saginaw River AOC because of its abundance, the importance of the walleye fishery at the AOC, and past use of the walleye in bioaccumulation studies.

The sediment transport studies involve the determination of the resuspension potential of the bottom sediments. The sampling strategy involves collecting samples and testing resuspension potential throughout the AOC. The primary consideration was to perform tests at sites with muddy bottom sediments since these sediments are most easily resuspended during natural high flow events.

The second river characterization study involves the collection of total suspended solids data and other limnological parameters, such as water temperature, conductivity, and velocity, during high flow

events in the river. These data will be used in the calibration of hydrodynamic and sediment transport models. Collection efforts were performed throughout the Buffalo River AOC during an event large enough to initiate bottom scour of the river bed.

Engineering/Technology Workgroup

Sampling for the Engineering/Technology (E/T) workgroup consisted of gathering enough bulk sediments from one or two locations within an AOC to supply all the bench scale remediation processes with the "same" initial sediment. The sediments collected were grossly contaminated with a given class or classes of contaminants. Site selection was based on historical data, the results of the sediment characterization from the T/C workgroup efforts, and discussions among members of the three technical workgroups.

Site locations were marked on U.S. Army Corps of Engineers sounding charts after determination via triangulation. Bulk samples were collected from the toe of the channel using a crane barge bucket operation. Sediments were then scooped or shoveled from the bucket, working from top to bottom, to fill approximately twenty 5-gallon plastic buckets. Sample compositing and homogenization was performed using a cement mixer. Sediments were deemed homogeneous by visual inspection of texture, color, and water content. After homogeneity has been obtained, samples were stored at 4° C in the dark prior to analysis.

In general, the remedial processes in the ARCS program are aimed at the degradation of organic compounds, such as pesticides, PCBs, and PAHs. However, several remedial processes, such as sieving and cycloning, froth flotation, gravity separation, and magnetics, were used to demonstrate remediation possibilities for sediments contaminated with heavy metals. To select the remedial processes for the organic contaminants, a literature review was performed of existing remediation technologies. Upon completion of the literature review, several remedial processes were selected by the E/T workgroup for two different levels of testing, the bench-scale tests and pilot-scale demonstrations.

To determine if a remediation process has been successful, contaminant concentrations must be determined prior to and after the remediation has been completed. Therefore, testing was performed on both untreated and treated sediments, as well as water and oil fractions (remediation by-products) depending upon the process being tested. Parameters monitored by the E/T workgroup included: metals, pH, pesticides, PCBs, PAHs, oil and grease, total organic carbon, moisture content, conductivity, and total volatile solids. Analyses were performed using standardized, approved EPA methods. Where standardized EPA methods do not exist, written standard operating procedures or published references for the method were provided by the analytical laboratory.

Quality Assurance Program

The data collection criteria provide a balance between constraints of time and cost and the quality of data necessary to achieve the ARCS program research objectives. The ARCS quality assurance program plan (QAPP) is designed to accomplish the following objectives:

- Establish the QA/QC criteria used to control and assess data collection in the ARCS program,
- Provide comparable sampling, preparation, and analytical methods,
- Utilize assessment samples and procedures to verify the quality of the data,
- Perform field and on-site laboratory system audits to ensure that all activities are properly performed and that discrepancies when identified are resolved, and
- Evaluate the data and document the results in a final QA report to GLNPO management.

The raw data for the ARCS program was collected during three major operational phases consisting of sediment mapping, sampling, and analysis. A certain amount of data measurement uncertainty is expected to enter the system at each phase. The sampling population itself is a source of confounded uncertainty that is extremely difficult to quantify.

Generally, the data quality objectives (DQOs) for the ARCS program encompass the overall allowable uncertainty from sample measurement and from the sampling population that the data users are willing to accept in the analytical results. Because of the many confounding sources of uncertainty, overall DQOs for the ARCS program are not described herein. This QAPP focuses on the definition, implementation, and assessment of Measurement Quality Objectives (MQOs) that are specified for the entire sample preparation and analysis phases of data collection as well as for the verification of the field sampling phase. The MQOs are defined according to the following six attributes:

- Detectability - the lowest concentration of an analyte that a specified analytical procedure can reliably detect,
- Precision - the level of agreement among multiple measurements of the same characteristic,
- Accuracy - the difference between an observed value and the "true" value of the parameter being measured,
- Representativeness - the degree to which the data collected accurately represents the population of interest,
- Completeness - the quantity of data that is successfully collected with respect to the amount intended in the experimental design, and
- Comparability - the similarity of data from different sources included within individual or multiple data sets; the similarity of analytical methods and data from related projects across AOCs.

Initial MQOs were established by the principal laboratories performing a given type of measurement (inorganic or organic analyses, bioassays) after discussion and approval by the members of the T/C, and/or E/T workgroups. In most cases, the initial proposed QA program and MQOs are equivalent to the QA program routinely implemented at the analytical laboratory. Upon the initiation of the formal QA program within the ARCS program, the existing MQOs were either accepted or modified with additional requirements to ensure data quality in the ARCS program. The resultant MQOs were then applied to all parameters in the process of being analyzed and to all future analyses.

To produce data of known quality, participating laboratories are required to analyze certain types of QC samples that are known to the laboratory staff and that can be used by the analysts to identify and control analytical measurement uncertainty. Each QC sample has certain specifications that must be met before data for that parameter is considered acceptable. These specifications include acceptance limits and frequency of sample use requirements. The various types of QC samples for the chemical and physical parameters, as well as the water quality parameters run in conjunction with bioassays and fish bioaccumulation studies, included: analytical replicates, field duplicates, reagent blanks, reference materi-

als, matrix spikes, matrix spike duplicates, surrogate spikes for organic analyses, and ongoing calibration check samples. Additionally, acceptance criteria and limits have been established for initial instrument calibration and method detection limits, where appropriate. QC samples that are unique to bioassays, fish bioaccumulation studies, and/or mutagenicity testing included: reference toxicants, reference sediments, pre-exposure sampling, spontaneous reversion rates, and strain integrity testing. Secondary confirmation of organism identification by an independent scientist, analytical replicates, and relative abundance of species comparisons within the AOC and between independent identifications are required as QA/QC checks during benthic community structures determinations.

Quality Assurance Implementation

The quality assurance program is implemented through on-site systems audits of both laboratory and field operations, independent assessments, and other procedures used to control and assure the quality of the data being collected. Verification of these data will be accomplished through a series of manual checks for success in meeting the ARCS program established MQOs. All data will be reviewed for the following items:

- completeness of the submitted dataset in terms of missing data,
- completeness of the submitted data in terms of the completeness quality assurance objective,
- formal submission of the data as indicated by signatures of the PI and laboratory QA officer,
- logbooks, in particular to determine holding time violations,
- raw data including sample weights, extract volumes, dilution or concentration factors, instrument readings (e.g., chromatograms, quantification reports, etc.), and dates of analysis, where appropriate,
- proper frequency of use and successful completion of the established MQOs for QC samples on a dated per batch basis,
- method detection limits and their determinative data and dates of determination,
- calibration data on a per instrument per analyte basis,
- in-house performance audit and other QA reports as specified in the submitted QAPPs, and
- a discrepancy report indicating at what point during the laboratory operations the formal ARCS QA program was initiated and providing a discussion of the QA program at the laboratory prior to the institution of the ARCS overall QA program.

Data Quality Assessment and Reporting

The assessment of detectability (detection limits) is accomplished on a parameter basis at two different levels, compliance with ARCS specified MDLs and calculation of actual IDLs. The final results will be grouped in tabular form to allow comparisons among the values for any parameter of interest.

A statistical evaluation procedure that has been developed by the ARCS QA staff is applied to the data to assess precision as a function of confounded data collection uncertainty. An additive step-function model is used, where an observed value of any sediment, elutriate, or water characteristic is considered as the sum of the "true" accepted value and an error term. Precision is evaluated for each variance segment of the range of concentration for a given analyte.

The assessment of accuracy is based on the ongoing calibration check samples and the use of certified reference materials, standard reference materials, or standards for the inorganic and organic analyses while for the bioassays and fish bioaccumulation studies, the assessment of accuracy rely upon the use of reference toxicants and the reference sediment. The recoveries of matrix and surrogate spikes for the inorganic and organic analyses can also be used in the assessment of accuracy.

One aspect of sampling representativeness is assessed by comparing the individual site locations and AOC coverage with the locations and expected coverage DQOs. Representativeness of the homogenization and subsampling procedures at the analytical laboratories may be assessed using precision estimates for the analytical and field replicate samples.

Upon completion of the ARCS program, a comparison will be made among the laboratories that will focus on method differences, QC sample results, laboratory effects, and other QA features of the program to assess program comparability. Summary statistics will be used to collate individual values into pooled groups that enable the data users to discern trends within the overall ARCS program.

Field sampling completeness is assessed by comparing the actual number of stations collected to the number requested during the design phase of the ARCS program. Completeness of the sample preparation and analytical phases is calculated as the number of analyses passing the QA requirements divided by the number of analyses performed at a given laboratory.

Each participating laboratory is required to produce at least one written report to document their QA/QC activities as well as several oral laboratory updates at the all-hands meetings to be planned throughout the duration of the ARCS program. Communications among the various participants in the ARCS program has been maintained through conference calls, site visits, releases of preliminary draft data, and all-hands and workgroup meetings.

A final written summary of the QA activities and final results is required from each participating ARCS program laboratory, and should accompany the submission of the laboratory QA approved dataset. Other periodic QA reports will be submitted to the ARCS QA officer, workgroup chairs, and GLNPO staff as specified in the laboratory's QAPP.

The ARCS QA staff will produce a documented sample/data tracking system such that hardcopy and electronic forms of the database can be easily located, identified, and collated for use and distribution by the staff at GLNPO.

Quality Assurance/Quality Control of Historical Databases

A QA/QC evaluation scale was developed for the RA/M workgroup to allow for the objective assessment of historical data used in the risk assessments and modeling efforts. Evaluation scales were produced for inorganic and organic chemistry analyses. The verification process will include QA/QC compliance checking for accuracy, precision, spike analyses, blanks, detection limits, calibration (initial and ongoing), and holding times, as well as other QA/QC concerns that can affect the integrity of the sample and resultant data. The final evaluation of a dataset is presented as a combination of a number value and a flag list. The numerical value for a given parameter or suite of parameters is assigned based on the successful completion of each required QA/QC sample or measurement. A list of appropriate flags are attached to each numerical rating to indicate where discrepancies

exist between the laboratory data and the acceptance limits of the required QA program. Two different interpretation can be made using the final ratings. The first interpretation is based upon the formal ARCS QA program while the second interpretation is based upon the "full potential" of the submitted dataset in which differences between the ARCS QA program and the QA program implemented during the generation of the data can be accounted.

Data Management System

The Ocean Data Evaluation System (ODES) has been used as the final database repository for the ARCS program. ODES was designed to support the decision making processes associated with marine/water monitoring programs. Since ODES was originally designed for saltwater systems, some modification of data fields may be required to adapt the system for the fresh water environment analyzed in the ARCS program.

ODES is comprised of three separate components: the ODES database, ODES reporting and graphical tools, and ODES menu system. Through the ODES menu system a user may access information stored in the ODES database and use the ODES tools to produce analytical reports. The ODES database combines source input information with river, harbor, and bay environmental information including biological data, sediment pollutant data, water quality data, and field sampling data.

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The complete report, entitled "Assessment and Remediation of Contaminated Sediments (ARCS) Program—Quality Assurance Program Plan," (Order No. PB94-144581/AS; Cost: $27.00, subject to change) will be available only from:
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