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**ENVIRONMENTAL
RESTORATION
PROGRAM**

**Final Project Report on Arsenic
Biogeochemistry in the Clinch River
and Watts Bar Reservoir**

**Volume 2: Quality Assurance/Quality
Control Summary Report for Arsenic
Biogeochemistry in the Clinch River
and Watts Bar Reservoir**

MANAGED BY
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FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Energy Systems Environmental Restoration Program
Clinch River Environmental Restoration Program

**Final Project Report on Arsenic Biogeochemistry
in the Clinch River and Watts Bar Reservoir**

**Volume 2: Quality Assurance/Quality Control Summary Report for
Arsenic Biogeochemistry in the Clinch River
and Watts Bar Reservoir**

K. A. Newman
C. J. Ford
J. T. Byrd

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Author Affiliations

C. J. Ford is a member of the Environmental Sciences Division of the Oak Ridge National Laboratory, Oak Ridge, Tennessee. J. T. Byrd is employed by the Department of Chemistry and Physics at Armstrong State College, Savannah Georgia. K. A. Newman is employed by Scientific Applications International Corporation, Oak Ridge, Tennessee.

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ABBREVIATIONS

CR/WBR	Clinch River/Watts Bar Reservoir
CR-ERP	Clinch River Environmental Restoration Program
DL	detection limit
EPA	U. S. Environmental Protection Agency
IC	ion chromatography
ICP	inductively coupled plasma
LCS	laboratory control sample
ORNL	Oak Ridge National Laboratory
%R	percent recovery
QA	quality assurance
QC	quality control
RI	remedial investigation
RPD	relative percent difference
SOP	standard operating procedure
SRM	standard reference material
TOC	total organic carbon

PREFACE

This study was conducted as a special project of the Clinch River Remedial Investigation, which is tasked with conducting a remedial investigation of the Clinch River and Watts Bar Reservoir by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The Clinch River Environmental Restoration Program is funded by the U. S. Department of Energy to investigate the possible corrective actions required to rectify the historic releases of hazardous waste and radioactive contaminants into the Clinch River/Watts Bar Reservoir system. The arsenic study was undertaken after preliminary screening of existing data from the Clinch River and Watts Bar Reservoir. As a result of nonconservative screening, arsenic was assigned as a definitely high priority substance for further human health consideration, and the data showed that arsenic concentrations exceeded benchmark criteria for ecological risk assessment. This study investigated the speciation, distribution, and mobility of arsenic in the sediment, pore water, and the water column seasonally over a 3-year period (1990–1992).

EXECUTIVE SUMMARY

Arsenic contamination was studied in the Clinch River/Watts Bar Reservoir (CR/WBR) system downstream from the U. S. Department of Energy's Oak Ridge Reservation (ORR). Arsenic is of particular interest and concern because (1) it occurs commonly in coal-bearing rock and waste products such as fly ash associated with the burning of coal, (2) it is classified as a Class A carcinogen by the U. S. Environmental Protection Agency, and (3) disposal of fly ash, both on and off the ORR, may have contaminated surface water and sediments in the Clinch River and Watts Bar Reservoir. The present study differs from previous reports on arsenic concentrations in the CR/WBR system in the use of much more sensitive and precise processing and analytical techniques to measure arsenic species (arsenate, arsenite, and organic arsenic) at levels well below the ecological and human health risk screening criteria. The absolute detection limits using these techniques are approximately 20 to 40 pmol/L, or 0.0015 to 0.003 $\mu\text{g/L}$.

Four main sites were sampled quarterly over a 3-year period (1990 through 1992). Sites investigated included Lower Watts Bar Reservoir near the Watts Bar Dam (Tennessee River kilometer 849.6), the Kingston area (Clinch River kilometer 1.6), Poplar Creek (Poplar Creek kilometer 1.6), and the McCoy Branch Embayment (McCoy Branch kilometer 0.3). Additional sites were investigated in the vicinity of these main stations to determine the distribution of contamination and to identify possible alternative or additional sources of arsenic.

Detection limits that were a factor of 20 below the minimum risk screening criteria were achieved for 100% of arsenic speciation data. However, 118 samples for inductively coupled plasma metals analysis were not preserved to analytical specifications, and the analytical holding times for 180 ion chromatography samples were not met. More rigorous preservative testing protocols and more tightly defined analytical statements of work will prevent these problems in the future.

Introduction, background, materials and methods, results, discussion, and conclusions are presented in Volume 1. The Quality Assurance/Quality Control Summary Report; the listing of water quality and surface water arsenic speciation data by source and site; and the listing of pore water arsenic speciation and particle-to-water distribution coefficients for As, Fe, and Mn by source, site, and season are presented in Volume 2.

The Clinch River Environmental Restoration Program is currently completing the second phase of the Clinch River Remedial Investigation, with the intent of performing a baseline risk assessment on collected data. The data collected for this report will contribute to the baseline risk assessment for the Clinch River. Many of the goals of the Clinch River Remedial Investigation were refined using the results of this study.

1. INTRODUCTION

The purpose of this section is to present and provide an assessment of the field sampling and analytical laboratory quality assurance (QA) and quality control (QC) activities performed during the Arsenic Biogeochemistry Study of the Clinch River and Watts Bar Reservoir (CR/WBR) system. These QA/QC results are presented in this section to document the quality and usability of the data collected during the 1992 sampling efforts. Limited QA/QC data and/or documentation exists for the data generated during the 1990 and 1991 sampling and analysis efforts; however, consistent sampling protocols and analytical techniques have been used throughout the course of the investigation.

2. QUALITY ASSURANCE/QUALITY CONTROL PROGRAM

The QA program for the Arsenic Biogeochemistry Study was designed to comply with Clinch River remedial investigation (RI) protocols (CRRI 1990; Cook et al. 1993). General QA requirements and the QA objectives of this study are as follows:

- Scientific data generated should withstand scientific scrutiny;
- Controlled systems for sample collection, processing, analysis, and reporting should be used for data gathering; and
- Precision and accuracy of the data should be known.

The data quality requirements that were developed to meet both specific project objectives and these more general goals are found in Sect. 1.3 of the final report (Volume 1).

The QA objective for data collected in support of the Arsenic Biogeochemistry Study was to obtain reproducible, precise, and accurate measurements consistent with the intended use of the data and the limitations of the sampling and analytical procedures used. These objectives were met through the implementation of (1) standard operating procedures (SOPs) and (2) field sampling and analytical laboratory QC requirements.

2.1 STANDARD OPERATING PROCEDURES

Whenever applicable, existing procedures were used to guide and support collection, processing, and reporting activities for the study. Field sampling procedures from the Clinch River Environmental Restoration Program (CR-ERP) procedures manual (Energy Systems 1995) were used. U.S. Environmental Protection Agency (EPA) SW-846 (EPA 1986) analytical procedures were specified where appropriate. Arsenic speciation techniques with an extremely low analytical detection limit (0.02 to 0.04 nM or 1.5 to 3 ng/L) were used (Andreae 1983). Standard CR-ERP procedures (Energy Systems 1995) were used for the following activities: (1) sampling processes, (2) sample handling and custody, (3) calibration of equipment used in obtaining samples and/or data, and (4) analytical processes.

2.2 FIELD QUALITY CONTROL

QC measures for field operations, including selection of sampling locations, recording of field data, and documentation of sample collection and preparation, were implemented to meet the project QA objectives. Methods for field activities included record keeping, establishment and maintenance of sample custody, instrument calibration, and sample identification.

All field activities followed standard record keeping and chain-of-custody procedures, which included recording site-specific information in logbooks. Sample custody was established upon collection by the sampling team, through the use of standard chain-of-custody forms, and was maintained throughout sample processing and delivery to analytical support

laboratories. Field QC samples included field duplicates and equipment rinse blanks. The assessment of duplicates and equipment rinse blanks is summarized in Chap. 4 of this volume.

2.3 LABORATORY QUALITY CONTROL PROGRAM

The laboratory QC program ensured that all data generated and reported were scientifically valid, consistent with acceptable methods, and of known accuracy. Results from laboratory QC samples were used to document data quality and verify that the analytical system was functioning for a given matrix or analyte. The laboratory QC data provided an important indication of how well the project quality objectives were met. The types of laboratory QC samples used included (1) verifications of instrument calibration to check instrument response to standard conditions, used in quantification of accuracy; (2) laboratory blanks to assess the existence and magnitude of contamination introduced through analytical methodology; (3) matrix spikes to assess the effect of the sample matrix on the digestion and measurement methodology, used to assess accuracy; (4) laboratory duplicates and replicates to serve as indicators of the precision of the methods and sample measurements; and (5) laboratory control samples (LCSs) to serve as monitors of the efficiency of the sample processing procedure, also an important component of accuracy.

In addition to the requirements for the performance of method-specific QC analysis was the requirement for complete documentation of the analytical process and results of these QC analyses. Table 1¹ provides the analyses and specific analytical methodologies used in this investigation. For this investigation the 1992 data analytical reporting requirements were consistent with the requirements for Level D deliverables as specified in the *Requirements for Quality Control of Analytical Data for the Environmental Restoration Program* (Energy Systems 1992).

The QA objectives for precision and accuracy in the laboratory were defined by control limits specified in SW-846 (EPA 1986a) and *Requirements for Quality Control of Analytical Data for the Environmental Restoration Program* (Energy Systems 1992). The assessment of laboratory QC samples is summarized in Chap. 4 of this volume.

Charge balance calculations were performed to assess the degree to which analytical chemistry data, specifically inductively coupled plasma (ICP) and ion chromatography (IC) data, adequately accounted for all major ions in the surface water and pore waters of the study sites. In freshwater systems, the major ions, consisting of positively charged (cation) and negatively charged (anion) ions, are balanced in terms of charge equivalence, which is based on molar concentrations and the valence of the ion. For cations Ca, K, and NH_4 , and anions Cl and NO_3 , one equivalent is equal to one mole. Two equivalents are required for each mole of the anion sulfate (SO_4) and the cations Fe, Mg, Mn, and Na. The charge balance is the sum of the cation chemical equivalents (Ca, Fe, Mg, Mn, K, Na, and NH_4) divided by the sum of the anion chemical equivalents (including Cl, NO_3 , SO_4 , alkalinity, and total organic anions). Deviation of this ratio above 1 reflects a surplus of cations in the analytical results; below 1 reflects an over-representation of anions in the analytical results.

¹All tables may be found at the end of the text portion of this volume.

2.4 DATA QUALITY INDICATORS

Both qualitative and quantitative criteria are used as indicators of the quality of the data. In determining data usability, especially in the decision process, the integrity and authenticity of the data must be evaluated, and the analytical uncertainty must be determined. Indicators used to assess data quality for this investigation are precision, accuracy, representativeness, comparability, completeness, and sensitivity.

Precision is the degree of mutual agreement between independent measurements made under identical, specified conditions. Relative percent difference (RPD) is used to express precision. Analysis of laboratory duplicates and replicates provides an assessment of the precision associated with the analytical method. Analysis of field duplicates provides a total assessment of the overall precision of the sample data as they include both the field and laboratory variability. Evaluation of sampling precision may be determined from the difference between overall precision and analytical precision. The usefulness of the precision data is limited to samples that contain contaminants at concentrations above the detection limit (DL). RPD is calculated as follows:

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100 ,$$

where D_1 is the value of the first measurement, and D_2 is the value of the second measurement.

Accuracy is the closeness of agreement between an observed value and an accepted reference value. When applied to a set of observations, accuracy will be a combination of a random component and a common systematic error component (bias). Accuracy will be evaluated by reviewing the percent recovery (%R), which is calculated as follows:

For matrix spike QC analyses,

$$\%R = \frac{SSR - SR}{SA} \times 100 ,$$

where SSR is the spiked sample measurement, SR is the unspiked sample measurement, and SA is the amount of spike added. For QC analyses that use a standard reference material (SRM), the following formula is used:

$$\%R = \frac{C_m}{C_{sr}} \times 100 ,$$

where C_m is the measured concentration of the SRM, and C_{sr} is the true measured concentration of the SRM.

Accuracy is evaluated through the use of LCSs and matrix spike samples. When used correctly, blanks, both in the field and the analytical laboratory, provide a means for checking for bias resulting from contamination. Blanks must be treated the same as the samples. Use of blank results to correct sample results can add more variability to the result because blank results are also subject to analytical error. No blank corrections were performed on this study.

Calibration standards at the required concentrations and frequency are also used to estimate data variability.

Representativeness expresses the degree to which the data accurately reflect the parameter of interest at an environmental site. Several factors may contribute to whether a sample result is representative of the sampling site. SOPs and approved analytical methods must be used both in the field and in the analytical laboratory. Any measures taken to ensure that bias has not been introduced into the sampling and analysis process will contribute to sample representativeness. These measures include (1) proper preservation; (2) use of proper sample containers; (3) use of standard analytical methods; (4) adherence to appropriate holding times; and (5) use of field and laboratory blanks.

Comparability is the confidence with which one data set can be compared with another data set that is generated from a different sampling event or by a different laboratory. Sample collection, preservation, storage, preparation, analysis, and reporting must be consistent for comparability to be achieved.

Completeness is a measure of the amount of valid data obtained from the sampling and analysis process. Analytical completeness is typically expressed as the total number of samples taken for which acceptable analytical data are generated divided by the total number of samples collected.

Sensitivity is the capability of the methodology or instrumentation to discriminate between samples with differing concentrations of analytes. Sensitivity is defined by the limit of detection, the limit of quantitation, the instrument DL, and the method limit of detection. The ability to accurately report a contaminant of concern at or above the DL is a primary concern in evaluating false positives and false negatives. Holding times and sample preservation must also be evaluated for effects on sensitivity.

3. OVERALL DATA ASSESSMENT

This section provides an overall assessment of the CR-ERP arsenic biogeochemistry study water, pore water, and sediment data. This assessment is based on the field and laboratory QC results presented in Chap. 4 of this volume. Sections 3.1 and 3.2 provide an assessment of each matrix in terms of the data quality indicators (precision, accuracy, representativeness, completeness, comparability, and sensitivity). This assessment is quantitative when possible and qualitative when necessary.

Representativeness for this study was ensured by careful site selection, based on historical and process knowledge of plant operations involved in the use and/or disposal of fly ash from coal-fired steam plant operations. Sediment sample collection stations were intentionally biased toward areas of known or suspected deposition areas. These sites included deep-channel areas of the CR/WBR system. Therefore, results from reservoir sediment sampling may not represent the average reservoir conditions, but likely do represent the maximum levels found in the CR/WBR system sediments.

The completeness objective was to determine (1) temporal and spatial changes in arsenic concentrations and (2) seasonal changes in water distribution coefficients (K_D) for arsenic and metals. Sampling was considered complete when sediment samples had been collected from each of the major sampling sites during each season. Using the observational approach to focus sampling efforts, initial investigations were made at secondary sites to identify additional sources or sinks for contamination in the CR/WBR system. Data were collected and analyzed from these secondary sources once, and the data were evaluated relative to the project objectives, particularly considering the potential contribution of the site to better characterizing arsenic distribution in the CR/WBR system. If conditions observed at the site were unique from those at adjacent sites, and sufficient project resources existed to further characterize the site, it was included in future sampling events. If either of the two conditions was not observed for the site, it was not investigated further.

3.1 DATA ASSESSMENT OF SURFACE WATER AND PORE WATER RESULTS

Precision was evaluated through the use of field and laboratory duplicates and replicates. Overall, for all analyses, the objectives for analytical precision of less than 20% RPD have been met. Comparison of field duplicates is presented for major ion analyses in Table 2, ICP metals in Table 3, and arsenic speciation in Table 4. In most cases where the RPD was greater than 20%, either one of the two analytes was not reported for the duplicate-regular pair or one of the two analytes was less than the analytical detection limit for the duplicate-regular pair. The only duplicate pair that consistently showed a poor RPD was for February 1992 in McCoy Branch Embayment.

Accuracy was assessed by reviewing the results of LCSs and matrix spike samples. Overall, the objectives of $\pm 25\%$ recovery for matrix spikes and $\pm 20\%$ for LCSs have been met. As noted in Chap. 5, the few exceptions can be attributed to matrix interference in the sample itself. Overall, objectives for calibration data have also been met.

Quantitative measures of representativeness include the use of SOPs, equipment rinse blanks, analytical method blanks, proper preservation, standard analytical methods, and

adherence to holding times. As identified in Chap. 4, a significant number of samples for ICP analysis (182) are documented as having a potential sample preservation problem, indicated by the laboratory's measurement of the sample pH, which was reported as greater than 2. While all chain-of-custody and request-for-services documentation indicates a hydrochloric acid preservation, either the preservation was not performed or was not performed to the level to reduce the pH to less than 2. Because of the small volumes available from the pore water extraction process, the samples for ICP determination were first used for alkalinity determination, with the 0.1N HCl titrant serving as preservative. Alkalinity documentation indicates that for all samples, the pH was lowered to between 2 and 3 pH units by the titration.

An alternative explanation for this pH failure is that the analysis indicator, which is a part of the sample ID, was truncated by the laboratory in the November 1992 report of June and July data, and because of this action, the bottles for ICP analysis may have been switched with those for IC analysis, which were not acid preserved. This explanation is not likely because of the relatively low levels of chloride in the samples. If the IC bottles had been acidified with HCl by mistake, each sample would have shown an amount of the anion Cl greater than that normally found in freshwater systems. In the absence of other cations to balance the electrical charge, this would be far out of balance with the rest of the system, which would result in charge balance ratios ranging from 0.01 to 0.001, rather than the 1.5 to 0.1 range observed (Table 5).

Also identified in Chap. 4, a significant number of samples (118) are documented as exceeding the regulatory holding time for IC analyses by one to three months. The degree to which the representativeness of these particular IC samples may have been impaired was evaluated by calculation of a chemical charge balance for all samples, as described above. Using the criterion of a $\pm 20\%$ acceptability around environmental data, all of the calculated charge balance for samples exceeding the holding time falls outside of this range. For these samples, the ratio values are below 0.8, indicating that anions (from IC analysis) are overrepresented in the charge balance. The impact on interpretation of arsenic speciation data is limited. Despite the fact that sample preservation did not meet the analytical laboratory QC criterion of $\text{pH} < 2$, holding times for ICP analysis specifically were met. As is discussed in Chap. 2 of the report, the behavior of arsenic is controlled most by the behavior of Fe and Mn ions. Due to the amount of exceedance, great caution should be exercised with the interpretation of these IC data.

Only three equipment rinse blanks were submitted for analysis for the entire 1992 sampling effort. While there are measurable quantities of B, Ca, Fe, Mg, Na, Zn, Mn, and Ni in these equipment rinse blanks (Table 2 and 3), there were also measurable quantities of Ca, Fe, and Mg in the laboratory preparation blank. The other results are similar to the samples, with the exception of sodium, which was generally five times greater in the samples. The results are at such a low level that without results for the rinse water itself, it is difficult to draw any meaningful conclusions. There was no indication of arsenic contamination in the ICP metals analysis rinse blanks. However, detectable levels of arsenic were observed in one rinse blank for arsenic speciation (Table 6), due to either actual contamination or a switching of samples by the arsenic speciation laboratory. Detected arsenic levels were approximately equal to the detection limit (3 nM or 0.2 $\mu\text{g/L}$).

Comparability was ensured by the use of similar methods for sampling and analysis. All analytical methods used in the analyses of water samples for ICP, IC, and total organic carbon

(TOC) analyses were EPA-approved. For the arsenic speciation analyses, all samples were analyzed by the same laboratory, following the same analytical protocols.

Analytical sensitivity was ensured by use of ultra-low arsenic detection methodologies and by consistently using comparable methods for different sampling events. As indicated in the arsenic report that this summary supports, all previous arsenic data were reported with values equal to or less than the DL for each of these sites. The techniques used in this study consistently produced distinctly different values for distinctly different sites. The sensitivity of the arsenic speciation analysis performed has allowed the documentation of seasonal changes in surface and pore water concentrations, as well as identification of sites with elevated levels of arsenic. The between-site variability observed for surface water quality also indicates that the equipment and procedures used were appropriate to the level of sensitivity to distinguish differences observed within the water column at each site and between sites, as required for this project. Spatially separated sites were distinguishable from one another by their different temperature profiles, consistent with seasonally expected values.

3.2 DATA ASSESSMENT OF SEDIMENT SOLIDS RESULTS

Precision was evaluated through the use of field and laboratory duplicates and replicates. No sample duplicates for dry solid materials were submitted. Precision of sediment analyses must rely on surface and pore water results. Overall, for all analyses, the objectives for analytical precision of less than 20% RPD were met.

Accuracy was assessed by reviewing the results of LCSs and matrix spike samples. Overall, the objective of $\pm 25\%$ recovery for matrix spikes and $\pm 20\%$ for LCSs were met. As noted in Chap. 4, the few exceptions can be attributed to matrix interference in the sample itself. Overall, objectives for calibration data were also met.

Comparability was ensured by the use of similar methods for sampling and analysis. All analytical methods used in the analyses of sediment samples for As, Fe, and Mn were EPA-approved.

4. ANALYTICAL DATA EVALUATION

A total of 49 packages, containing approximately 424 inorganic samples, 173 alkalinity, 360 arsenic speciation, 180 IC, 173 ammonia, and 173 TOC samples, were analyzed by various laboratories during this study. Though this data has not been independently validated, this assessment represents a presentation of the analytical QA/QC data that were analyzed in support of the samples collected for this study. Analytical data are assessed for calibration criteria, blanks, matrix spikes, matrix spike duplicates and laboratory control samples, as appropriate.

4.1 INDUCTIVELY COUPLED PLASMA ANALYSES

ICP analysis of sediment and water samples was conducted by both the Oak Ridge National Laboratory (ORNL) and K-25 Analytical Chemistry Divisions for inorganic metals in surface water, pore water, and sediment, as listed in Table 1. The ORNL Analytical Chemistry Division also reported results for silicon. The SW-846 method 3050 was used to prepare samples, and SW-846 method 6010 was used as the analytical protocol for these analyses. Ninety-three samples were analyzed in 3 batches for the metals listed above by the ORNL Analytical Chemistry Division, and the remaining samples were analyzed in 46 batches by the K-25 Analytical Chemistry Division.

ORNL Analytical Chemistry Division

Calibration. Continuing calibration recoveries were above control limits on one continuing calibration for both silicon (111.7) and iron (115.0) in batch 130211.

Blanks. No contamination that required action was reported. Reported results are within reported QC specifications.

Matrix spikes. All criteria were met with the following exceptions: batch 130211, sediment sample 130510T showed poor recovery in both the spike and post digest spike analyses for selenium and antimony; and batch 130101, case number 14714, sediment sample 130210T showed poor recovery for the spike sample for antimony and poor recovery for both the spike and post digest spike analyses for selenium. These results have been attributed to sample matrix interference problems.

Duplicates. Results were within reported QC specifications.

Laboratory control samples. Results for an LCS sample analysis were not reported for batch 130101, case number 14714; and the recovery for selenium (40.3%) in batch 130101, case number 14713 was low.

K-25 Analytical Chemistry Division

Calibration. All initial and continuing calibration data was within specifications.

Blanks. Preparation blank contamination was indicated on laboratory QC reports for a number of samples. For data reported by the laboratory for June and July 1992, of the 98

water samples analyzed, 95 had preparation blanks in which the results for magnesium and/or calcium exceeded 10 times the detection limit. Of these preparation blanks, however, the results were very low. These levels are suspected to be contamination from the water used to rinse the glassware during the preparation procedure. Because of the low sample volumes the laboratory was unable to rerun these samples.

Rinse blanks associated with the data reported by the laboratory for December 1992 showed contamination for the following analytes: B, Ca, Fe, Mg, Na, Zn, Mn, and Ni. The sample results for calcium and magnesium were all greater than 10 times the rinse blank results. The sample results for the remainder of the above-listed analytes, with the exception of sodium, were similar to the rinse blank levels (Table 3).

Matrix spikes. All criteria were met with the following exceptions:

- Spike recovery results were below the 75% recovery control limit for antimony (29.2), boron (69.4), and potassium (73.6) QA file 30326A.
- Spike recovery results were below the 75% recovery control limit for antimony (30.3) and boron (57.6) QA file 30324B.
- Spike recovery results were below the 75% recovery control limit for iron (64.3) QA file 21104A.
- Spike recovery results were below the 75% recovery control limit for antimony (28.4) QA file 30321A.
- Spike recovery results were above the 125% recovery control limit for iron (151.6) QA file 21209A.

These exceptions appear to be indicative of matrix interference problems. These problems represent 6 of the 98 water sample batches reviewed.

Duplicates. All duplicate RPDs were well within the 20% control limits, with the exception of boron (22.3%) for QA file 30216X.

Laboratory control samples. The LCS recoveries were out of control for calcium and sodium analytes for the following samples: 131702M, 131703M, 131704M, 131804M, 131808M, 132003M, 132007M, 131801M, 131805M, 131900M, 132004M, 132008M, 131802M, 131806M, 132001M, 132005M, 131803M, 131807M, 132002M, and 132006M. The LCS recoveries were out of control for copper and nickel analytes for sample 131501T. The LCS recoveries were out of control for chromium and nickel analytes for sample 131702T and 132001T.

Other. Other analytical indicators that may have an effect on data quality include possible inadequate preservation. All 98 water samples associated with the data collected in June, July, and December (reported in November 1992, December 1992, and March 1993) were identified as having a pH greater than 2.

4.2 ALKALINITY ANALYSIS

Alkalinity determination for water samples were conducted by the ORNL Environmental Sciences Division surface water processing laboratory. The procedure used was based on the Gran titration method, as found in the CR-ERP procedures manual (Energy Systems 1995). This method was used as the analytical protocol for these analyses. Sixty samples were analyzed for alkalinity. QC measures included calibration of sample delivery pipettes, standardization of the electrode to the appropriate pH buffers, and analysis of replicates.

This procedure includes the standardization/calibration of the pH meter and pipette. Alkalinity determinations are based on a reduction of the carbonate species by addition of hydrochloric acid. Measures of pH are made to determine the buffering capacity of the solution. Samples for ICP metals determination were preserved during this alkalinity titration using 0.1 N HCl.

4.3 ARSENIC SPECIATION ANALYSIS

Reproducibility of the arsenic analyses was evaluated by running replicates of samples and standards. Table 7 shows the average percent difference about the mean for As(III) and total inorganic arsenic analyses for both water column and pore water samples. Except for a few cases for As(III), there was no average percent difference between samples greater than 6%. Relative errors for As(III) tended to be higher because of the low concentrations encountered. Errors for water column samples were higher than pore water samples for the same reason.

Field rinse blanks were taken and were found to have no detectable quantities of arsenic species (Table 6).

Duplicate field samples were also taken and analyzed for As(III) and total inorganic arsenic. Because of the low As(III) concentrations measured, relative errors between duplicate samples could be high. However, the maximum difference observed between duplicate samples was 15% or 0.08 nM As(III); the maximum RPD value of 22% was for a difference of 0.04 nM As(III) between routine and replicate samples. The maximum difference between duplicate total inorganic arsenic samples was 14%. These samples were taken at a depth with a sharp gradient in arsenic concentrations. All other duplicates had errors of less than 10% around the mean. The average error for total inorganic arsenic duplicates was 4%.

Beginning with April 1992 processing, recoveries of inorganic arsenic were determined by analysis of NIST SRM 1643C, Trace Metals in Water. This trace standard has a certified arsenic concentration of $82.1 \pm 1.2 \mu\text{g/L}$ ($1.1 \pm 0.02 \mu\text{M}$). Due to the sensitivity of the analysis, only 40- μL aliquots of standard were analyzed, an absolute amount of 3.4 μg (44 pmole). A control chart for analyses of NIST SRM 1643C is shown in Fig. 1. Any recovery result yielding less than 85% of the certified value resulted in recalibration. In only one case did recovery fall below 85%; analysis of a new subsample of the same standard resulted in acceptable values. Certified standards were not analyzed before April 1992, but sensitivity (counts/pmole) for in-house standards were comparable to those for analyses after April 1992.

4.4 ION CHROMATOGRAPHY ANALYSIS

IC analysis of water samples was conducted by the K-25 Analytical Chemistry Division for fluoride, bromide, chloride, nitrite, nitrate, phosphate, and sulfate. The EPA 300.0 method (EPA 1986) was used as the analytical protocol for these analyses. Approximately 180 samples were analyzed in 14 batches for the analytes listed above.

Calibration. All calibration data were within specifications.

Blanks. No blanks were run.

Matrix spikes. All criteria were met.

Duplicates. Reported results are within reported QC specifications.

Other. All 98 water samples associated with the data report for June and July 1992 were identified as exceeding the regulatory holding time. All December 1992 samples were within analytical holding times.

4.5 TOTAL ORGANIC CARBON ANALYSIS

TOC analysis of water samples was conducted by the K-25 Analytical Chemistry Division. The SW-846 method 9060 method was used as the analytical protocol for this analysis. Approximately 173 samples were analyzed in 10 batches.

Calibration. All calibration data were within specifications.

Blanks. No blanks were run.

Matrix spikes. All criteria were met.

Duplicates. Reported results are within reported QC specifications.

4.6 AMMONIA ANALYSIS

Ammonia analysis of water samples was conducted by the K-25 Analytical Chemistry Division. The EPA-350.3 method was used as the analytical protocol for this analysis. Approximately 173 samples were analyzed in 9 batches.

Calibration. All calibration data were within specifications.

Blanks. No blanks were run.

Matrix spikes. All criteria were met.

Duplicates. Replicates were run by the laboratory. Reported results are within reported QC specifications.

5. SUMMARY AND CONCLUSIONS

These conclusions will evaluate the QA/QC results for this study in terms of both the project's quality objectives, found in Sect. 1.3 of Volume 1, and the standard precision, accuracy, representativeness, sensitivity, comparability and completeness, as appropriate. For the first, third, and fourth project quality objectives—to routinely obtain very low analytical detection limits for arsenic speciation in the CR/WBR system—values presented in Tables 4, 6, and 7 indicate that very low detection limits were obtained routinely. It should be noted that detection limit values for standard analytical methodologies ($1\text{ }\mu\text{g/L}$ or 13 nM) are much larger than the values reported routinely from arsenic speciation.

Assessment of the third project quality objective must include discussion of the preservation and holding times issues. As noted above (Sect. 3.1), sample preservation for many samples did not meet the requirement for sample pH, primarily that the samples be preserved to less than pH 2. In the future, this preservation issue might be solved by either defining analytical requirements more carefully or using a more concentrated acid preservative following alkalinity titration. The second problem area involved analytical holding times for IC samples; as is noted previously in the text, the failure to meet the specified analytical holding times for IC samples suggests that a great deal of caution should be exercised with data for which holding times were exceeded.

Evaluation of the precision, accuracy, representativeness, sensitivity, comparability, and completeness parameters is as follows:

Precision: Precision was evaluated through the use of field and laboratory duplicates. Overall, for all analyses, the objectives for analytical precision of less than 20% RPD were met (see Tables 2, 3, and 4).

Accuracy: Accuracy was assessed by reviewing the results of LCSs and matrix spike samples. Overall, the objective of $\pm 25\%$ recovery for matrix spikes and $\pm 20\%$ for LCSs were met.

Representativeness: Quantitative measures of representativeness include the use of SOPs, equipment rinse blanks, analytical method blanks, proper preservation, standard analytical methods, and adherence to holding times. As identified above, a large number of samples for ICP analysis were documented as having a potential sample preservation problem.

Completeness: The completeness objective was to determine (1) temporal and spatial changes in arsenic concentrations and (2) seasonal changes in water distribution coefficients (K_D) for arsenic and metals. Sampling was considered complete when sediment samples had been collected from each of the major sampling sites during each season. Using the observational approach to focusing sampling efforts, initial investigations were made at secondary sites to identify additional sources or sinks for contamination in the CR/WBR system. Data were collected and analyzed from these secondary sources once, and the data were evaluated relative to the project objectives, particularly considering the potential contribution of the site to better characterizing arsenic distribution in the CR/WBR system. If conditions observed at the site were unique from those at adjacent sites and sufficient project resources existed to further characterize the site, it was included in future sampling

events. If either of the two conditions was not observed for the site, it was not included in sites to be investigated further.

Comparability. Comparability was ensured by the use of similar methods for sampling and analysis. All analytical methods used in the analyses of water samples for inorganic, IC, and TOC analyses were EPA-approved. For the arsenic speciation analyses, all samples were analyzed by the same laboratory following the same analytical protocols.

Sensitivity: Analytical sensitivity was ensured by use of ultra-low arsenic detection methodologies and by consistently using comparable methods for different sampling events.

Table 1. Analyses and analytical method specifications

Analysis	Media	Analytical Method
Metals by ICP (aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, potassium, selenium, silicon ¹ , silver, sodium, vanadium, and zinc)	Surface water Sediment ² Pore water	SW-846, Method 3050/6010
Common anions by ion chromatography (fluoride, bromide, chloride, nitrite, nitrate, phosphate, and sulfate).	Surface water Pore water	EPA-300.0
Total organic carbon (TOC)	Surface water Pore water	SW-846, Method 9060
Alkalinity	Surface water Pore water	<i>Gran</i> titration, SOP-2341 in ES/ER/INT-72
Arsenic speciation (inorganic arsenic, arsenite, and methylarsenic)	Surface water Pore water	Methods of Seawater Analysis, 2nd Edition
Ammonia	Surface water Pore water	EPA-350.3

¹ Silicon was only reported for samples analyzed by the Oak Ridge National Laboratory Analytical Chemistry Division.

² Sediment samples were only analyzed for arsenic, iron, and manganese.

Table 2. Relative percent difference values for field and laboratory duplicate major ion data

Date	River Mile	Type	Z (m)	LAB	Major Ions						Comments
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)	
10-Jul-90	TRM 531.0	FD	1	X10	0.79				19		WBR03
10-Jul-90	TRM 531.0	RTN	1	X10	1.16				20		
		RPD		X10	9.43				1.28		
22-Aug-90	CRM 0.5	RTN	3	X10	4.00				20		WBR04
22-Aug-90	CRM 0.5	FD	3	X10	4.00				20		
		RPD		X10	0.00				0.00		
23-Aug-90	TRM 531.0	FD	3	X10	7.00				12		
23-Aug-90	TRM 531.0	RTN	3	X10	7.00				13		
		RPD		X10	0.00				2.00		
02-Jan-91	CRM 1.0	RB	0	X10	4.00				21		WBR05
02-Jan-91	PCK 1.6	RTN	1	X10	3.00				30		
02-Jan-91	PCK 1.6	FD	1	X10	3.00				30		
		RPD		X10	0.00				0.00		
02-Jan-91	CRM 1.0	RTN	1	X10	4.00				21		
02-Jan-91	CRM 1.0	FD	1	X10	4.00				21		
		RPD		X10	0.00				0.00		
03-Jan-91	TRM 539.0	RTN	1	X10	6.00				14		
03-Jan-91	TRM 539.0	FD	1	X10	6.00				14		

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions							Comments
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)	NH ₃ (mg/L)	
		RPD		X10	0.00				0.00			
04-Jan-91	MCBK 0.3	RTN	1	X10	4.00				25			
04-Jan-91	MCBK 0.3	FD	1	X10	4.00				25			
		RPD		X10	0.00				0.00			
04-Jan-91	CRM 37.5	RB	12	X10	1.00				1			
04-Jan-91	CRM 37.5	RTN	12	X10	4.00				26			
		RPD		X10								WBR08
06-Feb-92	MCBK 0.3	RTN	7	X10	3.71	1	2.8	3	22	7	1.47	Br, F, PO ₄ < d.l.
06-Feb-92	MCBK 0.3	LD	7	X10	3.50	1	2.9	1	22	3.4	0.05	Br, F, PO ₄ < d.l.
		RPD		X10	1.46	0.00	0.88	25.00	0.00	17.31	46.71	
07-Feb-92	PCK 1.6	RTN	0	X10	6.40	1	5.3	3	38	3.3	0.03	Br, F, PO ₄ < d.l.
07-Feb-92	PCK 1.6	LD	0	X10	5.90	1	5.2	3	34	2.8	0.09	Br, F, PO ₄ < d.l.
		RPD		X10	2.03	0.00	0.48	0.00	2.78	4.10	25.00	
07-Feb-92	PCK 1.6	RTN	1	X10	3.80	1	3.2	3	22	3	0.04	Br, F, PO ₄ < d.l.
07-Feb-92	PCK 1.6	FD	1	X10	4.20	1	3.4	3	23	3.8	0.01	Br, F, PO ₄ , NH3 < d.l.
		RPD		X10	2.50	0.00	1.52	0.00	1.11	5.88	30.00	
08-Feb-92	TRM 531.0	FD	0	X10	7.40	1	3.4	3	15	2.5	0.02	Br, F, PO ₄ < d.l.

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions						Comments	
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)		NH ₃ (mg/L)
08-Feb-92	TRM 531.0	RTN	0	X10	6.40	1	3.3	3	14	2.8	0.01	Br, F, PO ₄ < d.l.
		RPD		X10	3.62	0.00	0.75	0.00	1.72	2.83	16.67	
23-Jun-92	PCK 1.6	_RE G	5	K25	5.40	0.46	4.6	4.6	36	7	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
23-Jun-92	PCK 1.6	LD	5	K25	5.30	0.43	4.3	4.3	35	8	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
		RPD		K25	0.47	1.69	1.69	1.69	0.70	3.33	0.00	
24-Jun-92	TRK 849.2	_RE G	26	K25	4.70	0.46	4.6	4.6	23	8	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
24-Jun-92	TRM 531.0	LD	26	K25	5.00	0.48	4.8	4.8	24	8	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
		RPD		K25	1.55	1.06	1.06	1.06	1.06	0.00	0.00	
25-Jun-92	MCBK 0.3	RTN	2	K25	6.90	0.51	5.1	5.1	26	7	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
25-Jun-92	MCBK 0.3	LD	2	K25	6.90	0.47	4.7	4.7	25	7	2	Br, F, NO ₃ , PO ₄ , NH ₃ < d.l.
		RPD		K25	0.00	2.04	2.04	2.04	0.98	0.00	0.00	
25-Jun-92	MCBK 0.3	_RE G	8	K25	4.70	0.47	4.7	4.7	31	6	2	All except SO ₄ and TOC < d.l.

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions							Comments
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)	NH ₃ (mg/L)	
25-Jun-92	MCBK 0.3	LD	8	K25	4.70	0.47	4.7	4.7	32	6	2	All except SO ₄ and TOC < d.l.
		RPD		K25	0.00	0.00	0.00	0.00	0.79	0.00	0.00	
29-Jun-92	MCBK 0.3	REG	3	K25	4.30	0.43	4.3	4.3	30	6	2	All except SO ₄ and TOC < d.l.
29-Jun-92	MCBK 0.3	LD	3	K25	4.00	0.4	4	4	28	6	2	All except SO ₄ and TOC < d.l.
		RPD		K25	1.81	1.81	1.81	1.81	1.72	0.00	0.00	
29-Jun-92	CRK 60.5	RTN	13	K25	4.50	0.45	4.5	4.5	32	5	2	All except SO ₄ and TOC < d.l.
29-Jun-92	CRM 37.5	LD	13	K25	3.80	0.38	3.8	3.8	30	6	2	All except SO ₄ and TOC < d.l.
		RPD		K25	4.22	4.22	4.22	4.22	1.61	4.55	0.00	
30-Jun-92	MCBK 0.35	RTN	2	K25	4.70	0.47	4.7	4.7	31	9	2	All except SO ₄ and TOC < d.l.
30-Jun-92	MCBK 0.35	LD	2	K25	3.80	0.38	3.8	3.8	28	6	2	All except SO ₄ and TOC < d.l.
		RPD		K25	5.29	5.29	5.29	5.29	2.54	10.00	0.00	
30-Jun-92	MCBK 0.7	REG	3	K25	4.90	0.49	4.9	4.9	32	16	2	All except SO ₄ and TOC < d.l.

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions						Comments	
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)		NH ₃ (mg/L)
30-Jun-92	MCBK 0.7	LD	3	K25	4.50	0.45	4.5	4.5	30	8	2	All except TOC < d.l.
		RPD		K25	2.13	2.13	2.13	2.13	1.61	16.67	0.00	
01-Jul-92	MCBK 0.5	RTN	4	K25	4.50	0.45	4.5	4.5	30	10	2	All except SO ₄ and TOC < d.l.
01-Jul-92	MCBK 0.5	LD	4	K25	4.90	0.49	4.9	4.9	32	8	2	All except TOC < d.l.
		RPD		K25	2.13	2.13	2.13	2.13	1.61	5.56	0.00	
01-Jul-92	MCBK 0.4	REG	7	K25	4.90	0.49	4.9	4.9	32	7	2	All except SO ₄ and TOC < d.l.
01-Jul-92	MCBK 0.4	LD	7	K25	4.50	0.45	4.5	4.5	31	8	2	All except SO ₄ and TOC < d.l.
		RPD		K25	2.13	2.13	2.13	2.13	0.79	3.33	0.00	
15-Oct-92	MCBK 0.3	RTN		X10	4.00	0.1	2.1	3	24	1.2	1.5	Br F PO ₄ < d.l.
15-Oct-92	MCBK 0.3	FD		X10	4.00	0.1	2.2	3	24	1.4	0.3	Br F PO ₄ < d.l.
		RPD		X10	0.00	0.00	1.16	0.00	0.00	3.85	33.33	
16-Oct-92	PCK 1.6	RTN		X10	8.40	0.1	4.3	3	34	1.7	0.28	Br F PO ₄ < d.l.
16-Oct-92	PCK 1.6	FD		X10	8.40	0.1	4.2	3	34	1.3	6.8	Br F PO ₄ < d.l.
		RPD		X10	0.00	0.00	0.59	0.00	0.00	6.67	46.05	

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions						Comments	
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)		NH ₃ (mg/L)
16-Oct-92	CRK 1/6	RTN		X10	3.60	0.1	1.6	3	22	1.2	0.2	Br F PO ₄ < d.l.
16-Oct-92	CRK 1.6	FD		X10	3.70	0.1	1.6	3	22	1	0.2	Br F PO ₄ < d.l.
		RPD		X10	0.68	0.00	0.00	0.00	0.00	4.55	0.00	
17-Oct-92	TRM 531	RTN		X10	9.90	0.1	1	1	13	1.4	0.2	All ex. Cl SO ₄ TOC < d.l.
17-Oct-92	TRM 531	FD		X10	9.80	0.1	1	1	2	1.8	0.2	All ex. Cl TOC < d.l.
		RPD		X10	0.25	0.00	0.00	0.00	36.67	6.25	0.00	
15-Dec-92	MCBK 0.85	FD	1	K25	7.20	0.55	5	5	43	nr	nr	All ex. Cl F SO ₄ TOC < d.l.
15-Dec-92	MCBK 0.85	RTN	1	K25	7.20	0.57	5	5	43	6	3	All ex. Cl F SO ₄ TOC < d.l.
		RPD		K25	0.00	0.89	0.00	0.00	0.00	50.00	50.00	
15-Dec-92	MCBK 0.7	RTN	3	K25	7.40	0.53	5	5	43	6	3	All ex. SO ₄ TOC < d.l.
15-Dec-92	MCBK 0.7	FD	3	K25	7.40	0		0	43	nr	nr	All ex. SO ₄ < d.l.
		RPD		K25	0.00	50.00	50.00	50.00	0.00	50.00	50.00	
16-Dec-92	MCBK 0.5	FD	4	K25	5.00	0.5	5	5	28	nr	nr	All ex. SO ₄ < d.l.
16-Dec-92	MCBK 0.5	RTN	4	K25	5.00	0.5	5	5	27	4	3	All ex. SO ₄ TOC < d.l.
		RPD		K25	0.00	0.00	0.00	0.00	0.91	50.00	50.00	

Table 2 (continued)

Date	River Mile	Type	Z (m)	LAB	Major Ions						Comments	
					Cl (mg/L)	F (mg/L)	NO ₃ (mg/L)	PO ₄ (mg/L)	SO ₄ (mg/L)	TOC (mg/L)		NH ₃ (mg/L)
16-Dec-92	MCBK 0.4	FD	6	K25	5.00	nr	nr	nr	26	nr	nr	All ex. SO ₄ < d.l.
16-Dec-92	MCBK 0.4	RTN	6	K25	5.00	0.5	5	5	27	4	3	All ex. SO ₄ TOC < d.l.
		RPD		K25	0.00	50.00	50.00	50.00	0.94	50.00	50.00	
17-Dec-92	CRK 60.5	RTN	5	K25	9.00	2.1	5	5	56	5	3	All ex. SO ₄ TOC < d.l.
17-Dec-92	CRK 60.5	FD	5	K25	9.00	1.7	5	5	56	nr	nr	All ex. SO ₄ < d.l.
		RPD		K25	0.00	5.26	0.00	0.00	0.00	50.00	50.00	
17-Dec-92	CRK 60.5	RTN	12	K25	9.00	1.5	5	5	56	6	3	All ex. SO ₄ TOC < d.l.
17-Dec-92	CRM 37.5	FD	12	K25	15.00	3	10	10	94	NR	NR	All ex. SO ₄ < d.l.
		RPD		K25	12.50	16.67	16.67	16.67	12.67	50.00	50.00	

Table 3. Relative percent difference values for ICP metals data from field duplicates

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
02-Jan-91	PCK 1.6	RTN	1	X10		24	0		7	0	5			
02-Jan-91	PCK 1.6	FD	1	X10		25	0		7	0	5			
		RPD		X10		1.02	ERR		0.00	ERR	0.00			
02-Jan-91	PCK 1.6			X10		25	0		7	0	5			
02-Jan-91	PCK 1.6			X10		25	0		7	0	5			
				X10		0.00	ERR		0.00	ERR	0.00			
06-Feb-92	MCB K 0.3	RTN	7	X10	0.1	34	0.1	nr	8.9	0.01	10	0.6	0.01	Al Fe Ni Na Zn < d.l.
06-Feb-92	MCB K 0.3	LD	7	X10	0.1	33	0.1	nr	8.8	0.012	10	0.6	0.01	Al Fe Ni Na Zn < d.l.
		RPD		X10	0.00	0.75	0.00	ERR	0.28	4.55	0.00	0.00	0.00	
07-Feb-92	PCK 1.6	RTN	0	X10	0.1	33	0.1	nr	8.6	0.083	10	0.6	0.01	Al Fe Ni Na Zn < d.l.
07-Feb-92	PCK 1.6	LD	0	X10	0.1	33	0.1	nr	8.6	0.078	10	0.6	0.01	Al Fe Ni Na Zn < d.l.
		RPD		X10	0.00	0.00	0.00	ERR	0.00	1.55	0.00	0.00	0.00	
07-Feb-92	PCK 1.6	RTN	1	X10	0.1	33	0.1	nr	8.2	0.0047	10	0.6	0.01	Al Fe Ni Na Zn < d.l.

Table 3 (continued)

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
07-Feb-92	PCK 1.6	FD	1	X10	0.1	33	0.1	nr	8.2	0.0098	10	0.6	0.01	Al Fe Ni Na Zn < d.l.
		RPD		X10	0.00	0.00	0.00	ERR	0.00	17.59	0.00	0.00	0.00	
23-Jun-92	PCK 1.6	_RE G	5	K25	0.2	33	0.05	53	8.7	0.025	7.6	0.1	0.13	Al Ni < d.l.
23-Jun-92	PCK 1.6	LD	5	K25	0.2	33	0.24	6.8	8.6	0.019	8	0.12	0.043	Cr=0.13, Al < d.l.
		RPD		K25	0.00	0.00	32.76	38.63	0.29	6.82	1.28	4.55	25.14	
24-Jun-92	TRK 849.2	_RE G	26	K25	0.2	15	0.065	3	3.4	0.21	5.1	0.1	0.24	Al K Ni < d.l.
24-Jun-92	TRM 531.0	LD	26	K25	0.2	16	0.035	3	3.6	0.22	5.3	0.1	0.037	Al K Ni < d.l.
		RPD		K25	0.00	1.61	15.00	0.00	1.43	1.16	0.96	0.00	36.64	
25-Jun-92	MCB K 0.3	RTN	2	K25	0.2	18	0.025	3	3.6	0.019	7	0.1	0.069	Al Fe K Ni < d.l.
25-Jun-92	MCB K 0.3	LD	2	K25	0.2	17	0.025	3	3.6	0.019	6.8	0.1	0.032	Al Fe K Ni < d.l.
		RPD		K25	0.00	1.43	0.00	0.00	0.00	0.00	0.72	0.00	18.32	
25-Jun-92	MCB K 0.3	_RE G	8	K25	0.11	33	0.079	4.5	8.8	0.015	5.4	0.054	0.082	All detected
25-Jun-92	MCB K 0.3	LD	8	K25	0.1	34	0.12	3.1	8.9	0.006	5.5	0.12	0.4	Al < d.l.
		RPD		K25	2.38	0.75	10.30	9.21	0.28	21.43	0.46	18.97	32.99	
29-Jun-92	MCB K 0.3	_RE G	3	K25	0.2	31	0.11	3	8.8	0.0093	5.5	0.1	0.066	Al K Ni < d.l.

Table 3 (continued)

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
29-Jun-92	MCB K 0.3	LD	3	K25	0.2	31	0.075	3	8.8	0.006	5.1	0.1	0.035	Al K Ni < d.l.
		RPD		K25	0.00	0.00	9.46	0.00	0.00	10.78	1.89	0.00	15.35	
29-Jun-92	CRK 60.5	RTN	13	K25	0.1	33	0.035	3	9	0.018	5.2	0.068	0.036	Al K < d.l.
29-Jun-92	CRM 37.5	LD	13	K25	0.13	33	0.065	3	9.1	0.016	5.1	0.005	0.16	K Ni < d.l.
		RPD		K25	6.52	0.00	15.00	0.00	0.28	2.94	0.49	43.15	31.63	
30-Jun-92	MCB K 0.35	RTN	2	K25	0.1	34	0.053	3	9	0.0092	5.2	0.1	0.097	Al K Ni < d.l.
30-Jun-92	MCB K 0.35	LD	2	K25	0.1	34	0.096	3	8.9	0.019	5.8	0.1	0.024	Al K Ni < d.l.
		RPD		K25	0.00	0.00	14.43	0.00	0.28	17.38	2.73	0.00	30.17	
30-Jun-92	MCB K 0.7	_RE G	3	K25	0.1	34	0.056	3	8.9	0.012	6	0.1	0.17	Al K Ni < d.l.
30-Jun-92	MCB K 0.7	LD	3	K25	0.34	36	0.38	3	9	0.022	6.8	0.1	2.3	K Ni < d.l.
		RPD		K25	27.27	1.43	37.16	0.00	0.28	14.71	3.13	0.00	43.12	
01-Jul-92	MCB K 0.5	RTN	4	K25	0.13	33	0.06	3	8.8	0.028	6	0.075	0.027	K < d.l.
01-Jul-92	MCB K 0.5	LD	4	K25	0.14	34	0.1	3	9	0.031	5.8	0.057	0.04	K < d.l.
		RPD		K25	1.85	0.75	12.50	0.00	0.56	2.54	0.85	6.82	9.70	
01-Jul-92	MCB K 0.4	_RE G	7	K25	0.1	34	0.063	3	8.9	0.028	6.1	0.065	0.16	Al K < d.l.

Table 3 (continued)

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
01-Jul-92	MCB K 0.4	LD	7	K25	0.11	34	0.16	3	8.9	0.028	6	0.05	0.99	Al K Ni < d.l.
		RPD			2.38	0.00	21.75	0.00	0.00	0.00	0.41	6.52	36.09	
15-Oct-92	MCB K 0.3	RTN		X10	0.1	37	0.1	5.82	10.4	0.0591	6.56	0.1	0.01	Al Fe Ni Zn < d.l.
15-Oct-92	MCB K 0.3	FD		X10	0.1	36.7	0.1	2.64	10.4	0.043	6.54	0.1	0.01	Al Fe Ni Zn < d.l.
		RPD		X10	0.00	0.20	0.00	18.79	0.00	7.88	0.08	0.00	0.00	
16-Oct-92	PCK 1.6	RTN		X10	0.1	38.9	0.135	2.87	9.74	0.0055	9.19	0.02	0.0118	Al Ni < d.l.
16-Oct-92	PCK 1.6	FD		X10	0.1	39	0.1	2.99	9.77	0.0043	9.05	0.02	0.01	Al Fe Ni Zn < d.l.
		RPD		X10	0.00	0.06	7.45	1.02	0.08	6.12	0.38	0.00	4.13	
16-Oct-92	CRK 1/6	RTN		X10	0.1	32.7	0.1	1.69	9.02	0.0204	6.24	0.02	0.01	Al Fe Ni Zn < d.l.
16-Oct-92	CRK 1.6	FD		X10	0.1	33	0.1	4.1	9.13	0.0199	6.07	0.02	0.01	Al Fe Ni Zn < d.l.
		RPD		X10	0.00	0.23	0.00	20.81	0.30	0.62	0.69	0.00	0.00	
17-Oct-92	TRM 531	RTN		X10	0.1	18.2	0.1	12.9	4.47	0.0837	8.4	0.02	0.01	Al Fe Ni Zn < d.l.
17-Oct-92	TRM 531	FD		X10	0.1	18.2	0.1	3.09	4.46	0.0824	8.43	0.02	0.01	Al Fe Ni Zn < d.l.
		RPD		X10	0.00	0.00	0.00	30.68	0.06	0.39	0.09	0.00	0.00	
15-Dec-92				K25	0.2	1.9	0.05	nr	0.19	0.01	1	0.1	0.14	All ex. Ca Mg Zn < d.l., Zn contam.

Table 3 (continued)

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
15-Dec-92	MCB K 0.85	FD	1	K25	0.1	39	0.12	nr	9.7	0.21	6.8	0.05	0.023	Al Ni < d.l.
15-Dec-92	MCB K 0.85	RTN	1	K25	0.1	39	0.051	nr	9.7	0.012	7	0.05	0.019	Al Ni < d.l.
		RPD		K25	0.00	0.00	20.18	ERR	0.00	44.59	0.72	0.00	4.76	
15-Dec-92	MCB K 0.7	RTN	3	K25	0.1	37	0.12	nr	10	0.01	7.8	0.05	0.048	Al Ni < d.l.
15-Dec-92	MCB K 0.7	FD	3	K25	0.2	37	0.08	nr	10	0.016	8.3	0.1	0.55	Al Ni < d.l.
		RPD		K25	16.67	0.00	10.00	ERR	0.00	11.54	1.55	16.67	41.97	
16-Dec-92	MCB K 0.5	FD	4	K25	0.2	31	0.05	nr	9.7	0.01	7.2	0.1	0.026	All ex Ca Mg Na Zn < d.l.
16-Dec-92	MCB K 0.5	RTN	4	K25	0.1	0.04	0.025	nr	0.015	0.005	0.1	0.05	0.01	All < d.l.
		RPD		K25	16.67	49.87	16.67	ERR	49.85	16.67	48.63	16.67	22.22	
16-Dec-92	MCB K 0.4	FD	6	K25	0.1	33	0.042	nr	10	0.0075	7.6	0.05	0.011	
16-Dec-92	MCB K 0.4	RTN	6	K25	0.1	35	0.055	nr	10	0.0076	7.9	0.05	0.14	
		RPD		K25	0.00	1.47	6.70	ERR	0.00	0.33	0.97	0.00	42.72	
17-Dec-92				K25	0.1	0.55	0.15	nr	0.16	0.0063	0.34	0.051	0.021	
17-Dec-92	CRK 60.5	RTN	5	K25	1.3	33	0.11	nr	9.8	0.019	7.3	0.05	0.097	
17-Dec-92	CRK 60.5	FD	5	K25	0.1	33	0.038	nr	9.8	0.0061	7.7	0.05	0.014	

Table 3 (continued)

Date	River Mile	Type	Z (m)	LAB	ICP Metals									Comments
					Al (mg/L)	Ca (mg/L)	Fe (mg/L)	K (mg/L)	Mg (mg/L)	Mn (mg/L)	Na (mg/L)	Ni (mg/L)	Zn (mg/L)	
17-Dec-92	CRK 60.5	RPD		K25	42.86	0.00	24.32	ERR	0.00	25.70	1.33	0.00	37.39	
		RTN	12	K25	0.1	33	0.055	nr	9.8	0.016	7.9	0.05	0.025	
17-Dec-92	CRM 37.5	FD	12	K25	0.1	34	0.091	nr	10	0.0087	8	0.05	0.022	
		RPD		K25	0.00	0.75	12.33	ERR	0.51	14.78	0.31	0.00	3.19	

Table 4. Duplicate sample analyses and relative percent difference values for arsenic speciation data, in nM.

Date	River kilometer	Depth (m)	Inorganic As (nM)	RPD	As III (nM)	RPD
July 1990	CRK 66.7	2	4.52/ 4.52	0	1.26/ 1.23	0.6
July 1990	McBK 1.6	0	464/ 461	0.7	1.08/ 1.04	3.8
July 1991	McBK 0.3	5	7.81/ 6.63	16	0.99/ 0.99	0
Feb. 1992	McBK 0.3	2	4.69/ 6.24	28	0.16/ 0.20	22
Feb. 1992	PCK 1.6	2	2.3/ 2.2	4.6	0.00/ 0.00	0
Feb. 1992	TRK 849.6	15	3.59/ 3.14	13	0.05/ 0.05	0
Feb. 1992	CRK 1.6	6	10.5/ 10.5	0	0.07/ 0.05	33
June 1992	PCK 1.6	2	6.3/ 6.44	2.2	0.58/ 0.5	15
Oct. 1992	McBK 0.3	6	4.52/ 4.82	6.4	0.54/ 0.53	1.9
Dec. 1992	McBK 0.4	2	4.31/ 4.17	3.3	0.00/ 0.00	0

Table 5. Charge balance calculations for surface water and pore water data

Cations								Anions					pH	pK	Organic Anions ueq/l	Total Anions meq/l	Cation Anion ratio
Depth (cm)	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l					
TRK 849.6 March 1991																	
21 m	536.3	1.8	36.7	227.4	0.1	---	0.6	1.032	148.9	29.0	137.4	1.29	7.72	5.6	113.40	1.856	0.556
24 m	561.9	0.0	39.8	227.4	0.1	---	---	1.057	152.6	29.0	137.4	1.22	7.71	5.6	86.78	1.763	0.599
0-3	515.8	4.4	59.8	208.4	62.1	---	<0.56	1.125	196.6	13.1	124.9	1.31	7.61	5.5	173.32	1.943	0.579
3-6	461.0	11.9	48.1	185.8	117.7	---	<0.56	1.140	178.5	39.4	44.6	1.54	7.68	5.6	312.27	2.159	0.528
6-12	430.7	43.6	46.0	171.3	99.8	---	<0.56	1.106	194.6	103.7	14.9	1.53	7.32	5.5	103.47	1.962	0.564
12-18	461.5	40.5	49.1	181.8	106.6	---	10.0	1.178	228.5	177.4	8.2	1.67	7.39	5.5	110.53	2.203	0.535
18-24	436.3	68.1	55.2	173.5	131.1	---	611.1	1.848	228.5	8.1	25.8	1.82	7.23	5.4	126.22	2.234	0.827
24-30	566.9	83.2	66.0	212.4	176.7	---	355.0	1.933	240.6	8.1	25.8	2.28	7.23	5.4	183.59	2.764	0.699
30-36	673.2	124.5	69.0	243.4	226.7	---	357.8	2.289	268.5	8.1	4.6	2.74	7.18	5.4	171.93	3.198	0.716
36-42	856.9	95.0	81.2	286.9	303.1	---	407.2	2.715	268.5	8.1	4.8	3.06	7.20	5.4	160.52	3.507	0.774
42-48	639.7	123.0	77.6	232.1	205.4	---	---	1.838	---	---	---	2.55	7.73	5.6	0.00	2.550	0.721
48-54	857.7	130.6	79.9	291.4	227.5	---	540.6	2.777	225.1	8.1	7.3	3.14	8.23	5.7	209.15	3.597	0.772
54-60	830.9	143.5	78.8	278.3	265.2	---	528.3	2.812	224.8	8.1	7.0	2.99	7.22	5.4	195.00	3.432	0.819
60-66	859.4	91.6	105.5	296.3	188.1	---	600.0	2.717	226.5	8.1	6.7	3.36	7.08	5.4	205.74	3.814	0.712
CRK 1.6, March 1991																	
6m	715.2	0.0	33.8	337.0	0.2	0.0	<0.56	1.423	82.1	31.3	202.0	---	7.89	5.6	98.53	---	---
9m	741.1	0.0	36.9	345.5	0.2	0.0	<0.56	1.469	82.4	30.2	202.0	---	7.89	5.6	90.42	---	---
0-3	692.9	0.8	46.8	308.9	31.8	0.0	<0.56	1.423	110.9	<8.06	254.0	1.36	7.36	5.5	112.78	2.092	0.680
3-6	535.3	17.2	53.0	243.8	63.2	0.0	---	1.237	---	---	---	1.21	7.54	5.5	---	---	---
6-12	590.8	53.5	50.0	275.4	90.0	0.0	2.2	1.481	136.8	<8.06	83.2	1.95	7.11	5.4	137.29	2.390	0.619
12-18	1043.7	93.6	85.6	430.3	228.4	0.0	<0.56	2.634	127.8	<8.06	6.7	3.52	7.21	5.4	126.17	3.787	0.695
18-24	1234.6	92.4	103.4	519.8	268.3	0.0	328.9	3.428	144.7	<8.06	5.8	4.22	7.09	5.4	160.07	4.536	0.756
24-30	1529.4	132.5	98.9	652.3	346.3	0.0	302.8	4.193	149.2	<8.06	5.8	4.63	7.07	5.4	159.99	4.951	0.847
30-36	1572.2	149.2	110.9	703.1	330.5	0.0	588.9	4.637	123.5	<8.06	4.5	5.76	7.01	5.4	182.50	6.075	0.763
36-42	1655.2	130.3	128.1	704.4	331.1	0.0	705.6	4.820	123.5	<8.06	6.0	5.89	7.07	5.4	217.09	6.243	0.772

Table 5 (continued)

Depth (cm)	Cations							Anions					pH	pK	Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l			Anions ueq/l	Total Anions meq/l	
42-48	1577.7	166.1	129.4	693.8	287.8	0.0		4.002				---	7.31	5.5	---	---	---
PCK 1.6, March 1991																	
1m	612.9	0.0	36.9	290.6	1.3	0.0	<0.56	1.234	80.7	31.9	301.9	---	7.52	5.5	79.63	---	---
2m	560.8	0.0	36.8	277.4	1.3	0.0	<0.56	1.155	77.3	27.9	294.6	---	7.53	5.5	43.86	---	---
0-3	691.6	9.6	67.2	299.9	35.5	0.0	18.3	1.467	131.4	44.2	249.9	1.59	7.47	5.5	93.39	2.359	0.622
3-6	850.3	12.8	64.4	361.2	52.6	0.0	<0.56	1.768	139.3	129.0	164.5	2.26	7.58	5.5	138.60	2.996	0.590
6-12	1659.7	30.3	97.2	738.5	59.6	0.0	<0.56	3.414	151.2	188.7	113.5	4.58	7.63	5.6	112.12	5.259	0.649
12-18	378.3	15.7	128.8	200.5	59.1	0.0	0.6	1.058	193.5	483.8	51.1	7.29	7.98	5.7	150.81	8.220	0.129
18-24	2468.5	13.8	138.3	153.8	36.0	0.0	<0.56	3.014	187.0	693.5	19.2	8.89	8.01	5.7	185.66	9.994	0.302
24-30	3047.5	21.9	329.4	1918.8	42.4	0.0	<0.56	7.343	188.7	22.3	11.0	10.02	7.96	5.7	220.38	10.473	0.701
30-36	3366.5	20.1	162.5	2174.3	47.1	0.0	<0.56	8.012	169.5	1032.2	9.0	11.43	7.94	5.6	243.53	12.893	0.621
36-42	3696.3	15.9	194.7	2531.9	53.9	0.0	<0.56	9.095	169.5	<8.06	5.7	12.57	7.99	5.7	290.05	13.041	0.697
MBK 0.3, March 1991																	
5 m	951.6	0.0	42.2	398.7	0.5	0.0	1.1	1.793	103.0	36.9	205.1	---	8.12	5.7	82.45	---	---
6.5 m	875.2	0.0	42.5	382.0	0.3	0.0	<0.56	1.682	86.9	36.4	206.1	---	8.09	5.7	80.11	---	---
0-3	1191.0	2.0	59.5	426.9	12.8	0.0	<0.56	2.134	119.9	5.6	206.1	2.73	7.62	5.6	69.34	3.337	0.640
3-6	877.7	5.7	54.3	349.1	165.7	0.0	<0.56	1.973	112.3	48.1	92.7	2.43	7.50	5.5	72.68	2.848	0.693
6-12	747.2	37.0	52.3	327.2	105.3	0.0	<0.56	1.738	111.1	63.2	83.3	2.25	7.40	5.5	78.31	2.669	0.651
12-18	748.7	46.3	51.9	327.8	62.2	0.0	<0.56	1.673	109.4	<8.06	55.2	2.31	7.28	5.4	76.96	2.607	0.642
18-24	854.4	55.7	65.3	358.6	111.4	0.0	135.6	2.107	99.3	<8.06	9.9	2.79	7.30	5.5	77.01	2.986	0.706
24-30	856.0	119.1	56.4	367.9	106.0	0.0	<0.56	2.098	104.1	10.3	8.5	2.91	6.99	5.3	98.02	3.139	0.668
30-36	910.6	151.2	48.5	390.4	117.7	0.0	195.6	2.473	119.3	0.0	12.2	3.23	6.96	5.3	125.27	3.499	0.707
36-42	751.3	107.8	53.4	333.2	62.4	0.0	0.0	1.812	0.0	0.0	0.0	2.67	7.02	5.4	0.00	2.670	0.679
MBK 0.7, December 1992																	

Table 5 (continued)

Depth (cm)	Cations							Anions									
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l	pH	pK	Organic Anions ueq/l	Total Anions meq/l	Cation Anion ratio
3 m	958.6	2.2	90.3	427.2	0.2	352.3	0.0	2.613	208.7	0.0	447.6	7.51	8.08	5.7	69.65	8.684	0.301
3 m	958.6	1.5	0.0	427.2	0.3	374.9	0.0	2.566	208.7	0.0	447.6	2.49	8.09	5.7	0.00	3.594	0.714
0-3	906.8	3.3	79.7	324.7	18.9	243.9	0.0	2.168	236.9	0.0	499.7	2.68	7.49	5.5	92.27	4.009	0.541
3-6	932.7	13.9	0.0	341.8	68.0	189.7	0.0	2.160	228.5	0.0	291.5	3.04	7.43	5.5	115.22	3.967	0.544
6-12	958.6	74.4	0.0	337.5	83.2	189.7	0.0	2.328	217.2	0.0	281.1	3.24	7.29	5.4	91.92	4.111	0.566
12-18	958.6	26.0	82.3	329.0	49.1	185.2	0.0	2.220	211.5	0.0	291.5	3.00	7.39	5.5	92.11	3.887	0.571
18-24	1036.3	44.6	0.0	354.6	43.5	189.7	0.0	2.301	203.1	0.0	291.5	3.20	7.25	5.4	91.84	4.078	0.564
24-30	1243.6	50.2	0.0	427.2	52.9	180.7	0.0	2.666	200.3	0.0	270.7	3.88	7.18	5.4	91.69	4.713	0.566
30-36	1269.5	61.4	0.0	427.2	58.6	221.3	0.0	2.807	205.9	0.0	270.7	4.11	7.02	5.4	114.09	4.971	0.565
36-42	1425.0	180.4	95.6	512.7	83.2	198.7	0.0	3.470	203.1	0.0	270.7	4.67	6.91	5.3	147.76	5.562	0.624
42-48	1373.1	353.3	111.5	470.0	88.8	203.3	0.0	3.715	214.4	0.0	270.7	4.66	6.74	5.3	0.00	5.416	0.686
48-54	1425.0	483.4	98.3	470.0	86.9	207.8	0.0	4.019	222.8	0.0	270.7	4.92	6.62	5.2	168.31	5.852	0.687
54-60	1761.8	539.2	1673.2	512.7	83.2	216.8	0.0	6.139	236.9	0.0	322.7	4.84	6.64	5.2	179.72	5.902	1.040
MBK 0.85, December 1992																	
1 m	1010.4	0.9	93.0	414.4	0.2	316.2	0.0	2.567	203.1	0.0	447.6	2.56	7.67	5.6	69.39	3.728	0.689
1 m	1010.4	2.2	0.0	414.4	0.4	307.1	0.0	2.459	203.1	0.0	447.6	2.29	7.76	5.6	0.00	3.388	0.726
0-3	1114.1	2.8	0.0	358.9	4.5	212.3	0.0	2.271	234.1	0.0	562.2	1.81	7.62	5.6	0.00	3.168	0.717
3-6	1036.3	4.5	0.0	350.3	15.1	185.2	0.0	2.147	236.9	0.0	478.9	3.04	7.51	5.5	0.00	4.235	0.507
6-12	1010.4	39.0	0.0	346.1	39.7	194.2	0.0	2.248	228.5	0.0	0.0	2.16	7.46	5.5	80.70	2.469	0.911
12-18	1062.2	50.2	0.0	337.5	35.9	185.2	0.0	2.280	228.5	0.0	0.0	3.28	7.13	5.4	103.01	3.611	0.631
18-24	1191.8	115.3	106.2	363.2	41.6	185.2	0.0	2.708	231.3	0.0	0.0	3.84	6.87	5.3	102.14	4.173	0.649
24-30	1425.0	223.1	154.0	388.8	54.8	180.7	0.0	3.274	231.3	0.0	0.0	4.58	6.78	5.3	158.30	4.970	0.659
30-36	1606.3	353.3	87.6	393.1	62.4	171.6	444.4	4.099	228.5	0.0	0.0	4.22	6.75	5.3	237.14	4.686	0.875
36-39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	234.1	---	---	---	---	---	---	---	---

* NO ALKALINITY or pH GIVEN FOR THIS SAMPLE (MBK 0.85, 36-39 cm Dec. 1992)

Table 5 (continued)

Depth (cm)	Cations							Anions							pH	pK	Organic Anions ueq/l	Total Anions meq/l	Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l							
MBK 0.4, December 1992																			
4 m	855.0	0.8	0.0	427.2	0.1	343.3	0.0	2.398	0.0	0.0	0.0	3.42	7.85	5.6	0.00	3.420	0.701		
0-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	270.7	2.52	7.47	5.5	103.77	3.165	0.000		
3-6	958.6	10.6	0.0	393.1	83.2	275.5	0.0	2.483	0.0	0.0	187.4	2.76	7.54	5.5	103.89	3.239	0.767		
6-12	829.1	48.3	0.0	337.5	96.4	243.9	0.0	2.281	0.0	0.0	0.0	2.65	7.42	5.5	92.16	2.742	0.832		
12-18	803.2	55.8	0.0	337.5	66.2	225.8	0.0	2.174	0.0	0.0	0.0	2.74	7.32	5.5	103.48	2.843	0.764		
18-24	777.2	52.1	318.7	324.7	51.0	225.8	0.0	2.403	0.0	0.0	0.0	2.51	7.35	5.5	115.05	2.625	0.915		
24-30	777.2	70.7	103.6	329.0	54.8	243.9	0.0	2.278	0.0	0.0	0.0	2.61	7.28	5.4	103.39	2.713	0.839		
30-36	855.0	102.3	0.0	350.3	75.6	216.8	0.0	2.345	0.0	0.0	0.0	2.95	7.02	5.4	114.09	3.064	0.765		
36-39	725.4	42.8	0.0	299.1	62.4	239.4	0.0	2.013	197.4	0.0	0.0	2.51	7.67	5.6	127.21	2.835	0.710		
*Weight missing for 12 to 18 cm deep, no porosity calculated																			
MBK 0.5, December 1992																			
4 m	803.2	0.0	0.0	414.4	0.0	325.2	0.0	2.282	0.0	0.0	291.5	2.24	7.53	5.5	46.17	2.869	0.796		
0-3	880.9	12.1	244.3	350.3	13.0	280.0	0.0	2.436	310.3	0.0	229.0	2.08	7.01	5.4	91.24	2.940	0.829		
3-6	414.5	3.9	0.0	166.6	18.9	158.1	0.0	1.110	0.0	0.0	156.2	2.21	7.33	5.5	115.00	2.637	0.421		
6-12	829.1	63.2	0.0	329.0	56.7	280.0	0.0	2.287	0.0	0.0	83.3	2.43	7.09	5.4	137.19	2.734	0.837		
12-18	725.4	98.5	0.0	277.7	35.9	221.3	0.0	1.992	0.0	0.0	0.0	2.44	6.93	5.3	284.35	2.724	0.731		
18-24	1036.3	4.5	82.3	388.8	ERR	ERR	0.0	ERR	0.0	0.0	0.0	*	*	1.0	0.00	0.000	ERR		
No Alkalinity or pH given for 18-24 cm deep sample, Dec. 1992																			
CRK 60.5, December 1992																			
12 m	855.0	1.0	0.0	418.7	0.3	356.8	0.0	2.409	253.9	0.0	583.0	2.28	7.67	5.6	69.39	3.769	0.639		
12 m	880.9	16.9	0.0	427.2	0.2	361.3	0.0	2.492	423.1	0.0	978.6	2.01	7.60	5.5	0.00	4.390	0.568		
0-3	855.0	10.2	87.6	388.8	102.1	266.5	0.0	2.478	239.8	0.0	497.6	2.67	7.51	5.5	69.23	3.974	0.623		
3-6	829.1	11.9	0.0	371.7	132.3	262.0	0.0	2.385	242.6	0.0	436.2	2.79	7.54	5.5	150.07	4.055	0.588		

Table 5 (continued)

Depth (cm)	Cations							Anions							pH	pK	Organic Anions ueq/l	Total Anions meq/l	Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l							
6-12	855.0	59.5	148.7	388.8	126.6	262.0	333.3	3.011	236.9	80.6	447.6	2.92	7.44	5.5	80.67	4.214	0.715		
12-18	855.0	31.6	183.3	384.5	94.5	243.9	0.0	2.547	273.6	0.0	0.0	2.89	7.44	5.5	80.67	3.244	0.785		
18-24	1010.4	72.5	116.9	470.0	147.4	248.4	0.0	3.004	262.3	0.0	0.0	3.53	7.19	5.4	114.64	3.907	0.769		
24-30	1165.9	85.5	0.0	512.7	187.1	275.5	0.0	3.288	282.1	0.0	0.0	4.18	7.13	5.4	137.35	4.599	0.715		
30-36	1114.1	133.9	0.0	470.0	183.3	271.0	0.0	3.230	256.7	0.0	0.0	4.24	7.03	5.4	159.77	4.656	0.694		
36-39	932.7	85.5	159.4	423.0	153.1	325.2	0.0	3.066	479.5	0.0	0.0	1.74	7.53	5.5	196.21	2.416	1.269		
MBK 0.3, December 1992																			
6	855.0	2.0	0.0	418.7	0.4	329.7	0.0	2.357	253.9	0.0	583.0	2.31	8.01	5.7	58.02	3.788	0.622		
6	215.8	0.7	0.0	418.7	1.2	347.8	0.0	1.753	253.9	0.0	583.0	2.34	8.06	5.7	0.00	3.760	0.466		
0-3	984.5	3.9	85.0	401.6	26.5	280.0	0.0	2.494	313.1	0.0	532.0	2.63	7.46	5.5	115.29	4.122	0.605		
3-6	829.1	7.8	0.0	358.9	105.8	329.7	0.0	2.434	324.4	0.0	441.4	1.63	7.72	5.6	162.00	2.999	0.811		
6-12	829.1	48.3	0.0	363.2	85.1	257.5	0.0	2.337	231.3	0.0	440.4	2.72	7.37	5.5	126.60	3.959	0.590		
12-18	906.8	33.5	79.7	376.0	54.8	271.0	0.0	2.457	268.0	0.0	468.5	2.64	7.31	5.5	126.45	3.971	0.619		
18-24	906.8	29.7	79.7	380.2	49.1	262.0	0.0	2.429	239.8	0.0	454.9	2.82	7.36	5.5	103.57	4.073	0.596		
24-30	984.5	70.7	79.7	397.3	81.3	252.9	0.0	2.669	231.3	0.0	0.0	3.32	7.08	5.4	148.58	3.700	0.721		
30-36	1165.9	158.0	87.6	427.2	115.3	252.9	0.0	3.161	228.5	0.0	0.0	4.01	6.96	5.3	125.25	4.364	0.724		
36-42	1191.8	297.5	93.0	427.2	132.3	230.4	0.0	3.460	231.3	0.0	0.0	4.52	6.85	5.3	136.08	4.887	0.708		
42-48	1165.9	260.3	140.8	410.1	119.1	243.9	0.0	3.374	234.1	0.0	0.0	4.27	6.83	5.3	215.29	4.719	0.715		
48-54	1191.8	446.2	90.3	393.1	107.7	243.9	0.0	3.664	236.9	0.0	0.0	5.68	6.20	5.0	272.51	6.189	0.592		
54-60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	*	*	1.0	0.00	0.000	ERR		
* No Alkalinity or pH given for 54-60 cm sample, Dec. 1992																			
MBK 0.3, October 1992																			
8 m	958.6	0.0	154.6	444.3	1.1	296.3	0.0	2.597	112.8	33.9	249.9	2.41	7.65	5.6	0.00	3.056	0.850		
8 m	950.8	0.0	70.1	444.3	0.4	295.4	0.0	2.501	112.8	35.5	249.9	2.44	7.71	5.6	0.00	3.088	0.810		
0-3	1173.6	2.2	65.9	529.8	101.1	261.5	0.0	3.029	129.7	0.0	124.9	3.65	7.79	5.6	0.00	4.030	0.752		

Table 5 (continued)

Depth (cm)	Cations							Anions					pH	pK	Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l			Anions ueq/l	Total Anions meq/l	
3-6	1057.1	7.4	0.0	487.1	165.4	247.1	0.0	2.871	121.3	0.0	28.1	3.55	7.73	5.6	0.00	3.728	0.770
6-12	909.4	24.2	289.5	402.0	145.7	231.3	72.2	2.877	115.6	0.0	16.7	3.04	7.51	5.5	107.30	3.296	0.873
12-18	862.7	11.4	91.6	379.0	88.1	235.3	88.9	2.471	124.1	0.0	31.2	3.86	7.60	5.5	97.05	4.144	0.596
18-24	917.1	14.8	69.8	410.6	73.1	221.8	133.3	2.561	121.3	0.0	13.5	3.04	7.60	5.5	108.60	3.297	0.777
24-30	992.3	26.6	168.1	440.1	88.3	219.5	161.1	2.870	115.6	0.0	17.7	3.33	7.49	5.5	89.97	3.571	0.804
30-36	1080.4	53.7	109.4	470.0	123.4	226.7	233.3	3.171	124.1	0.0	11.5	3.63	7.42	5.5	137.09	3.914	0.810
36-42	1036.3	66.4	120.0	440.1	132.7	216.8	233.3	3.102	124.1	0.0	15.6	3.65	7.17	5.4	124.89	3.930	0.789
42-48	1049.3	89.1	116.6	431.5	132.5	220.9	261.1	3.175	135.4	0.0	25.0	3.75	7.04	5.4	165.53	4.101	0.774
48-54	1191.8	140.4	120.0	470.0	131.0	240.3	283.3	3.558	152.3	0.0	16.7	4.31	6.94	5.3	151.33	4.647	0.766
54-60	1085.6	109.7	150.1	400.3	95.1	242.6	0.0	2.931	155.1	0.0	16.7	3.81	6.98	5.3	0.00	3.998	0.733
60-63	0.0	0.0	0.0	0.0	0.0	0.0	455.6	0.456	180.5	0.0	32.3	---	---	---	130.55	---	---

* No alkalinity or pH given for 60-63 cm sample, October 1992

CRK 1.6, October 1992

11 m	847.2	0.0	44.9	385.4	0.4	281.8	0.0	2.227	101.5	25.8	229.0	2.14	8.07	5.7	13.93	2.739	0.813
11 m	855.0	0.0	108.9	390.1	0.4	274.2	0.0	2.293	104.4	25.8	229.0	2.08	8.07	5.7	11.61	2.680	0.856
0-3	730.6	3.1	78.3	337.1	51.0	231.7	15.0	2.070	129.7	0.0	208.2	1.79	7.72	5.6	40.50	2.377	0.871
3-6	652.9	9.9	0.0	293.1	93.6	227.6	20.6	1.922	121.3	0.0	135.3	1.90	7.51	5.5	101.54	2.393	0.803
6-12	717.7	29.7	51.0	307.6	122.9	217.3	94.4	2.218	121.3	0.0	104.1	2.11	7.37	5.5	173.79	2.613	0.849
12-18	867.9	54.9	202.4	375.1	147.6	246.6	200.0	2.919	129.7	0.0	0.0	2.89	7.20	5.4	119.25	3.139	0.930
18-24	914.6	81.4	78.9	402.5	168.2	260.6	138.9	2.958	135.4	0.0	0.0	3.25	7.03	5.4	123.25	3.509	0.843
24-30	979.3	102.8	91.9	435.8	183.2	265.1	222.2	3.267	155.1	0.0	20.8	3.57	6.99	5.3	112.84	3.880	0.842
30-36	1088.1	121.2	117.9	482.8	200.4	268.7	227.8	3.580	138.2	0.0	20.8	4.04	7.01	5.4	103.79	4.324	0.828
36-42	1163.3	94.5	115.8	521.2	206.0	271.9	311.1	3.777	155.1	0.0	31.2	4.33	7.01	5.4	85.54	4.633	0.815
42-48	1220.3	85.2	1537.7	551.1	198.5	289.5	272.2	5.279	143.9	0.0	20.8	4.56	7.02	5.4	100.40	4.846	1.089

PCK 1.6, October 1992

4 m	1007.8	2.5	76.2	416.1	0.1	415.1	15.6	2.767	236.9	69.3	354.0	2.22	7.53	5.5	19.62	3.254	0.850
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Table 5 (continued)

Depth (cm)	Cations								Anions				pH	pK	Organic		Total Anions meq/l	Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l			Anions ueq/l			
4 m	1010.4	0.0	0.0	417.4	0.1	408.8	377.8	3.041	236.9	67.7	354.0	2.25	7.75	5.6	15.05	3.278	0.928	
0-3	1093.3	6.6	66.9	470.0	48.2	383.5	77.8	3.054	251.0	0.0	322.7	2.75	7.52	5.5	79.63	3.726	0.820	
3-6	1103.7	6.8	70.1	487.1	60.7	372.6	83.3	3.111	242.6	0.0	218.6	2.93	7.58	5.5	63.53	3.673	0.847	
6-12	1298.0	22.7	85.0	589.6	70.1	356.8	61.1	3.523	282.1	0.0	187.4	3.76	7.51	5.5	98.07	4.515	0.780	
12-18	2171.1	18.8	107.3	1149.3	43.9	266.5	300.0	5.535	256.7	0.0	31.2	6.37	7.82	5.6	128.58	6.818	0.812	
18-24	2528.6	13.8	123.0	1469.7	39.3	234.0	466.7	6.632	228.5	0.0	0.0	8.93	7.87	5.6	156.46	9.315	0.712	
24-30	2901.7	14.7	137.6	2008.0	44.6	234.9	633.3	8.277	169.2	0.0	0.0	10.46	7.83	5.6	184.20	10.813	0.765	
30-36	3264.4	13.6	156.2	2362.6	50.3	233.5	700.0	9.441	141.0	0.0	0.0	12.03	7.87	5.6	154.14	12.325	0.766	
36-42	3471.7	12.7	177.7	2606.1	52.2	227.2	827.8	10.274	141.0	0.0	0.0	13.36	7.91	5.6	207.53	13.709	0.749	
42-48	3679.0	14.8	180.6	2858.2	54.2	217.7	877.8	11.027	141.0	0.0	0.0	14.78	7.85	5.6	108.92	15.030	0.734	
48-54	3860.3	11.4	212.7	3123.1	52.0	214.5	972.2	11.847	141.0	0.0	0.0	15.82	7.93	5.6	251.63	16.213	0.731	
54-60	3964.0	10.3	208.0	3238.5	55.2	211.4	1038.9	12.242	253.9	0.0	0.0	16.22	7.94	5.6	171.63	16.645	0.735	
60-66	4067.6	7.3	308.1	3464.9	45.4	220.0	1138.9	12.990	253.9	0.0	0.0	17.33	7.94	5.6	230.78	17.815	0.729	
TRK 849.6, October 1992																		
26 m	471.5	0.0	342.6	191.0	1.6	381.2	0.0	1.962	279.2	0.0	135.3	1.00	7.18	5.4	16.04	1.566	1.253	
26 m	471.5	0.0	0.0	190.5	1.5	380.8	0.0	1.617	276.4	0.0	0.0	1.09	7.20	5.4	20.64	1.387	1.166	
0-3	510.4	14.0	106.8	196.5	230.6	292.7	127.8	2.213	310.3	0.0	83.3	0.72	6.56	5.2	148.74	1.346	1.644	
3-6	658.1	27.3	65.6	254.2	215.5	297.2	216.7	2.529	251.0	0.0	20.8	2.42	6.93	5.3	54.60	2.767	0.914	
6-12	709.9	54.9	76.8	274.3	179.4	311.2	122.2	2.548	234.1	0.0	0.0	2.61	6.91	5.3	85.24	2.929	0.870	
12-18	808.3	49.6	66.4	317.0	163.9	313.5	116.7	2.679	214.4	0.0	0.0	2.80	7.03	5.4	45.65	3.060	0.876	
18-24	738.4	92.8	59.2	290.1	154.6	304.9	177.8	2.660	225.7	0.0	0.0	2.69	6.95	5.3	40.98	2.957	0.900	
24-30	790.2	110.3	105.7	302.1	192.8	307.1	233.3	2.954	225.7	0.0	0.0	2.97	6.94	5.3	70.54	3.266	0.904	
30-36	836.8	122.3	78.1	310.2	219.3	321.1	211.1	3.072	203.1	0.0	0.0	3.22	6.98	5.3	88.87	3.512	0.875	
36-42	865.3	135.7	81.5	310.2	230.6	307.1	288.9	3.203	180.5	0.0	0.0	3.38	6.97	5.3	82.01	3.643	0.879	
42-48	873.1	120.7	125.4	310.6	224.9	306.2	338.9	3.262	194.6	0.0	0.0	3.48	6.99	5.3	74.08	3.749	0.870	
48-54	808.3	90.2	95.6	282.8	200.4	311.2	0.0	2.673	0.0	0.0	0.0	3.05	7.11	5.4	0.00	3.050	0.876	

Table 5 (continued)

Depth (cm)	Cations							Anions					pH	pK	Organic Anions ueq/l	Total Anions meq/l	Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l					
PCK 1.6, June 1992																	
4.9 m	855.0	0.0	1407.6	371.7	0.5	343.3	0.0	3.693	152.3	0.0	374.8	1.08	7.72	5.6	81.00	2.063	1.790
4.9 m	855.0	4.5	180.6	367.4	0.4	361.3	0.0	2.503	149.5	0.0	364.4	2.12	7.92	5.6	92.76	3.091	0.810
0-3	1114.1	20.5	292.1	512.7	54.8	280.0	166.7	3.309	172.1	274.2	239.4	3.36	7.58	5.5	69.30	4.354	0.760
3-6	906.8	12.1	79.7	405.9	58.6	239.4	555.6	2.974	0.0	0.0	229.0	3.03	7.68	5.6	0.00	3.488	0.853
6-12	1425.0	39.0	114.2	769.0	54.8	262.0	111.1	3.900	126.9	291.9	45.8	5.57	7.67	5.6	80.95	6.161	0.633
12-18	2020.8	18.2	185.9	1367.2	37.8	239.4	500.0	6.032	0.0	0.0	0.0	8.99	7.88	5.6	173.86	9.164	0.658
18-24	2383.6	31.6	191.2	1794.4	47.3	262.0	222.2	7.067	174.9	1161.2	0.0	11.56	7.81	5.6	220.07	13.116	0.539
24-30	2590.8	35.3	255.0	2050.7	52.9	239.4	8388.9	15.991	222.8	0.0	0.0	14.09	7.68	5.6	254.45	14.567	1.098
30-36	2849.9	35.3	204.5	2307.1	58.6	225.8	222.2	8.530	203.1	0.0	0.0	15.60	7.89	5.6	243.43	16.047	0.532
36-42	3368.1	40.9	260.3	2947.9	69.9	280.0	9833.3	20.139	149.5	0.0	0.0	17.02	7.93	5.6	278.30	17.448	1.154
42-48	3627.1	52.1	233.7	3118.8	69.9	271.0	111.1	10.996	149.5	2290.1	0.0	18.71	7.71	5.6	242.97	21.393	0.514
48-54	3730.8	31.6	236.4	3289.7	56.7	234.9	12166.7	23.360	163.6	0.0	0.0	19.02	7.84	5.6	289.66	19.473	1.200
54-60	3627.1	24.2	478.1	3503.3	52.9	243.9	277.8	12.032	0.0	0.0	0.0	20.81	7.85	5.6	278.10	21.088	0.571
60-66	3627.1	22.3	265.6	3717.0	52.9	252.9	3777.8	15.761	0.0	0.0	0.0	20.93	7.87	5.6	289.74	21.220	0.743
66-72	3886.2	26.0	265.6	3802.4	58.6	262.0	5333.3	17.783	143.9	0.0	0.0	22.59	7.84	5.6	312.83	23.047	0.772
CRK 1.6, June 1992																	
12 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	0.75	7.33	5.5	0.00	0.750	0.000
12 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	1.11	7.41	5.5	0.00	1.110	0.000
0-3	492.3	40.9	0.0	217.9	92.6	329.7	0.0	1.855	0.0	0.0	0.0	1.40	7.25	5.4	---	---	---
3-6	414.5	61.4	0.0	213.6	52.9	293.6	0.0	1.658	0.0	0.0	0.0	1.05	7.20	5.4	---	---	---
6-12	544.1	297.5	0.0	277.7	58.6	496.8	0.0	2.805	394.9	822.5	385.2	1.10	7.11	5.4	114.39	3.202	0.876
12-18	673.6	223.1	0.0	363.2	104.0	307.1	166.7	2.835	191.8	0.0	187.4	2.35	7.10	5.4	194.41	3.111	0.911
18-24	855.0	161.8	93.0	384.5	141.8	280.0	166.7	3.051	0.0	0.0	0.0	3.25	7.04	5.4	171.24	3.421	0.892
24-30	1114.1	241.7	151.4	512.7	187.1	293.6	500.0	4.236	0.0	0.0	0.0	4.46	7.03	5.4	422.25	4.882	0.868

Table 5 (continued)

Cations									Anions							Organic Total		Cation
Depth	Ca	Fe	K	Mg	Mn	Na	NH4	Total	Cl	NO3	SO4	Total	pH	pK	Anions	Total	Cation	
(cm)	umol/l	umol/l	umol/l	umol/l	umol/l	umol/l	umol/l	Cations	umol/l	umol/l	umol/l	Alkalinity			ueq/l	Anions	Anion	
								meq/l				meq/l				meq/l	ratio	
30-36	1243.6	223.1	148.7	598.1	189.0	320.7	277.8	4.332	0.0	0.0	0.0	4.20	7.10	5.4	285.90	4.486	0.966	
36-42	1347.2	241.7	151.4	640.9	155.0	334.2	611.1	4.853	0.0	0.0	0.0	5.50	7.11	5.4	171.59	5.672	0.856	
42-48	1425.0	297.5	180.6	683.6	121.0	365.9	500.0	5.041	166.4	0.0	0.0	6.14	7.13	5.4	228.91	6.535	0.771	
48-54	1502.7	334.7	193.9	769.0	62.4	361.3	944.4	5.696	174.9	0.0	0.0	6.39	7.10	5.4	251.59	6.816	0.836	
54-60	1425.0	278.9	215.1	769.0	47.3	365.9	611.1	5.173	234.1	0.0	0.0	6.35	7.11	5.4	274.54	6.859	0.754	
60-66	1295.4	241.7	199.2	683.6	32.1	411.0	333.3	4.565	0.0	0.0	0.0	5.99	7.26	5.4	344.48	6.334	0.721	
MBK 0.3, June 1992																		
7.5 m												2.23	7.30	5.5				
7.5 m												2.18	7.47	5.5				
0-3	---	---	---	---	---	---	---	---	---	---	---	---	---	1.0				
3-6	---	---	---	---	---	---	---	---	---	---	---	3.82	7.59	5.5				
6-12	---	---	---	---	---	---	---	---	---	---	---	3.55	7.47	5.5				
12-18	---	---	---	---	---	---	---	---	---	---	---	3.11	7.43	5.5				
18-24	---	---	---	---	---	---	---	---	---	---	---	2.91	7.33	5.5				
24-30	---	---	---	---	---	---	---	---	---	---	---	3.07	7.22	5.4				
30-36	---	---	---	---	---	---	---	---	---	---	---	3.15	7.07	5.4				
36-42	---	---	---	---	---	---	---	---	---	---	---	3.19	7.03	5.4				
42-48	---	---	---	---	---	---	---	---	---	---	---	3.01	6.84	5.3				
48-54	---	---	---	---	---	---	---	---	---	---	---	2.36	6.87	5.3				
TRK 849.6, June 1992																		
26.5 m	---	---	---	---	---	---	---	---	---	---	---	1.02	7.23	5.4				
26.5 m	---	---	---	---	---	---	---	---	---	---	---	1.09	7.28	5.4				
0-3	855.0	6.3	0.0	363.2	207.9	347.8	555.6	3.261	---	---	---	2.92	7.80	5.6	266.38	3.186	1.023	
3-6	829.1	16.9	0.0	337.5	264.6	243.9	333.3	2.888	---	---	---	3.09	7.82	5.6	139.01	3.229	0.894	
6-12	570.0	81.8	0.0	269.2	145.5	252.9	0.0	2.069	143.9	153.2	---	2.08	7.50	5.5	57.68	2.435	0.850	

Table 5 (continued)

Cations								Anions										
Depth	Ca	Fe	K	Mg	Mn	Na	NH4	Total				Total	pH	pK	Organic	Total	Cation	
(cm)	umol/l	umol/l	umol/l	umol/l	umol/l	umol/l	umol/l	Cations	Cl	NO3	SO4	Alkalinity			Anions	Anions	Anion	
								meq/l	umol/l	umol/l	umol/l	meq/l			ueq/l	meq/l	ratio	
12-18	492.3	72.5	0.0	226.4	81.3	243.9	111.1	1.852	132.6	132.2	---	1.78	7.43	5.5	46.09	2.091	0.886	
18-24	570.0	100.4	0.0	239.3	94.5	280.0	0.0	1.998	141.0	211.3	---	2.04	7.23	5.4	45.90	2.438	0.820	
24-30	647.7	143.2	93.0	273.4	153.1	289.1	2222.2	4.680	149.5	---	---	2.73	7.08	5.4	80.01	2.959	1.581	
30-36	699.5	133.9	0.0	286.2	183.3	293.6	111.1	2.605	172.1	545.1	---	3.05	7.10	5.4	148.67	3.916	0.665	
36-42	751.3	204.5	0.0	299.1	207.9	316.2	1666.7	4.473	203.1	---	---	6.35	7.03	5.4	159.77	6.713	0.666	
42-48	829.1	223.1	82.3	337.5	245.7	347.8	111.1	3.331	---	---	---	3.63	7.00	5.3	216.63	3.847	0.866	
48-54	829.1	241.7	93.0	329.0	245.7	379.4	333.3	3.647	220.0	---	---	3.75	6.92	5.3	147.81	4.118	0.886	
54-60	855.0	260.3	212.5	346.1	245.7	356.8	333.3	3.819	236.9	---	---	3.87	7.04	5.4	171.24	4.278	0.893	
60-66	906.8	278.9	0.0	341.8	245.7	347.8	333.3	3.669	220.0	---	---	4.22	7.02	5.4	159.72	4.600	0.798	
CRK 60.5, June 1992																		
13m	---	---	---	---	---	---	---	---	---	---	---	2.15	7.46	5.5	0.00	2.150	0.000	
13m	---	---	---	---	---	---	---	---	---	---	---	2.21	7.65	5.6	0.00	2.210	0.000	
0-3cm	958.6	7.4	0.0	470.0	71.8	239.4	0.0	2.536	0.0	0.0	333.1	3.22	7.82	5.6	104.26	3.991	0.635	
3-6	958.6	68.8	0.0	470.0	126.6	212.3	0.0	2.714	0.0	0.0	0.0	3.58	7.82	5.6	266.43	3.846	0.706	
6-12	829.1	39.0	0.0	393.1	107.7	203.3	0.0	2.315	95.9	62.9	85.4	3.18	7.68	5.6	69.40	3.579	0.647	
12-18	777.2	39.0	0.0	363.2	79.4	203.3	0.0	2.147	93.1	0.0	0.0	2.94	7.65	5.6	80.93	3.114	0.689	
18-24	829.1	68.8	0.0	405.9	98.3	212.3	0.0	2.400	115.6	0.0	0.0	3.10	7.49	5.5	92.27	3.308	0.725	
24-30	906.8	65.1	0.0	410.1	122.9	203.3	0.0	2.509	0.0	143.5	0.0	3.40	7.41	5.5	92.15	3.636	0.690	
30-36	932.7	100.4	0.0	423.0	132.3	216.8	0.0	2.678	0.0	161.3	0.0	3.45	7.29	5.4	126.40	3.738	0.716	
36-42	906.8	102.3	0.0	410.1	117.2	216.8	0.0	2.600	0.0	0.0	0.0	3.40	7.30	5.5	183.89	3.584	0.725	
MBK 0.35, June 1992																		
3 m	---	---	---	---	---	---	---	---	---	---	---	3.37	8.11	5.7	---	---	---	
3 m	---	---	---	---	---	---	---	---	---	---	---	2.19	8.09	5.7	---	---	---	
0-3	1114.1	8.6	0.0	470.0	52.9	262.0	0.0	2.701	0.0	0.0	0.0	3.59	7.67	5.6	0.00	3.590	0.752	
3-6	1191.8	29.7	0.0	470.0	128.5	221.3	0.0	2.891	0.0	0.0	0.0	4.17	7.50	5.5	0.00	4.170	0.693	

Table 5 (continued)

Depth (cm)	Cations							Anions					pH	pK	Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l			Anions ueq/l	Anions meq/l	
6-12	1373.1	122.7	0.0	555.4	136.1	203.3	0.0	3.408	118.5	140.3	0.0	4.97	7.26	5.4	103.35	5.332	0.639
12-18	1269.5	146.9	0.0	555.4	83.2	203.3	0.0	3.247	0.0	129.0	0.0	4.45	7.26	5.4	80.38	4.659	0.697
18-24	958.6	145.0	0.0	470.0	62.4	234.9	0.0	2.783	0.0	0.0	0.0	3.41	7.11	5.4	388.94	3.799	0.733
24-30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	*	*	1.0	12.67	0.013	0.000
30-36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	*	*	1.0	0.00	0.000	ERR
* No pH or alkalinity values were listed for 24-30 or 30-36 cm depths, June 1992																	
MBK 0.7, June 1992																	
3 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	2.35	7.71	5.6	0.00	2.350	0.000
3 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0	1.74	7.82	5.6	0.00	1.740	0.000
0-3	1114.1	10.8	0.0	470.0	100.2	207.8	0.0	2.691	0.0	0.0	0.0	3.71	7.64	5.6	127.16	3.837	0.701
3-6	1347.2	7.1	0.0	512.7	124.7	221.3	0.0	3.079	0.0	193.5	0.0	4.51	7.63	5.6	138.70	4.842	0.636
6-12	1399.0	35.3	0.0	512.7	111.5	203.3	0.0	3.125	141.0	161.3	0.0	4.49	7.47	5.5	57.65	4.850	0.644
12-18	1295.4	46.5	87.6	470.0	85.1	185.2	0.0	2.956	138.2	129.0	0.0	4.18	7.58	5.5	57.75	4.505	0.656
18-24	1140.0	50.2	87.6	423.0	66.2	180.7	0.0	2.668	93.1	103.2	0.0	3.88	7.55	5.5	46.18	4.122	0.647
24-30	1140.0	61.4	79.7	414.4	69.9	185.2	0.0	2.681	0.0	0.0	0.0	3.84	7.61	5.6	138.66	3.979	0.674
30-36	1088.1	68.8	119.5	401.6	81.3	216.8	200.0	2.945	112.8	0.0	0.0	3.89	7.41	5.5	69.11	4.072	0.723
36-42	1140.0	148.7	116.9	427.2	92.6	248.4	133.3	3.224	0.0	0.0	0.0	4.02	7.12	5.4	114.42	4.134	0.780
42-48	1062.2	171.1	127.5	410.1	86.9	275.5	238.9	3.316	0.0	0.0	0.0	3.02	7.10	1.0	12.67	3.033	1.093
48-54	1399.0	260.3	122.2	512.7	104.0	325.2	288.9	4.214	189.0	0.0	0.0	4.75	7.12	5.4	114.42	5.053	0.834
54-60	1373.1	353.3	130.1	470.0	83.2	347.8	305.6	4.317	0.0	0.0	0.0	4.76	6.98	5.3	182.30	4.942	0.874
MBK 0.85, June 1992																	
1.5 m	---	---	---	---	---	---	---	---	0.0	0.0	0.0	2.26	7.92	5.6	0.00	2.260	0.000
1.5 m	---	---	---	---	---	---	---	---	0.0	0.0	0.0	2.31	8.09	5.7	0.00	2.310	0.000
0-3	1269.5	5.6	0.0	512.7	0.0	0.0	0.0	0.000	0.0	0.0	0.0	4.03	7.69	5.6	0.00	4.030	0.709
3-6	1787.7	55.8	98.3	512.7	85.1	189.7	0.0	2.856	112.8	0.0	0.0	4.52	7.49	5.5	46.14	4.679	0.800

Table 5 (continued)

Depth (cm)	Cations							Anions							Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l	pH	pK	Anions ueq/l	Total Anions meq/l	
6-12	1528.6	16.5	0.0	418.7	43.5	135.5	363.3	3.744	0.0	209.7	0.0	5.82	7.37	5.5	126.60	6.156	0.444
12-18	1191.8	33.5	79.7	371.7	39.7	126.5	0.0	2.731	0.0	161.3	0.0	4.67	7.59	5.5	57.76	4.889	0.499
18-24	1165.9	63.2	98.3	384.5	52.9	126.5	0.0	2.441	0.0	0.0	0.0	3.84	7.47	5.5	80.71	3.921	0.641
24-30	1114.1	68.8	79.7	350.3	64.3	112.9	0.0	2.514	0.0	0.0	0.0	3.71	7.42	5.5	92.16	3.802	0.684
30-36	1165.9	102.3	98.3	363.2	83.2	131.0	138.9	2.599	0.0	0.0	0.0	3.69	7.27	5.4	137.83	3.828	0.774
36-42	1347.2	18.6	0.0	470.0	71.8	212.3	197.8	2.961	0.0	0.0	0.0	3.84	7.36	5.5	149.59	3.990	0.763
42-48	1243.6	132.0	0.0	393.1	92.6	144.5	244.4	3.043	0.0	0.0	0.0	4.12	7.13	5.4	0.00	4.120	---
48-54	932.7	107.8	0.0	260.6	58.6	126.5	0.0	2.664	0.0	0.0	0.0	2.83	7.16	5.4	0.00	2.830	0.000
MBK 0.3, February 1992																	
5 m	880.9	0.0	0.0	380.2	0.2	0.0	81.7	1.723	104.4	45.2	229.0	2.16	7.87	5.6	81.13	2.849	0.605
5 m	855.0	2.2	0.0	376.0	0.2	0.0	2.8	1.615	98.7	46.8	229.0	2.11	8.05	5.7	39.46	2.753	0.586
0-3	1010.4	5.2	0.0	354.6	6.0	0.0	4.4	1.747	160.8	96.8	333.1	2.39	7.59	5.5	51.98	3.366	0.519
3-6	855.0	8.6	0.0	337.5	64.3	0.0	0.0	1.676	158.0	116.1	166.6	2.34	7.71	5.6	72.89	3.020	0.555
6-12	725.4	26.0	0.0	316.2	81.3	0.0	0.0	1.572	121.3	69.3	83.3	2.40	7.42	5.5	61.06	2.818	0.558
12-18	699.5	40.9	0.0	316.2	56.7	0.0	0.0	1.527	110.0	132.2	52.1	2.41	7.56	5.5	64.66	2.821	0.541
18-24	751.3	16.4	0.0	329.0	62.4	0.0	1.7	1.568	118.5	140.3	51.0	2.55	7.53	5.5	75.02	2.986	0.525
24-30	855.0	33.5	0.0	346.1	100.2	0.0	110.6	1.925	124.1	0.0	0.0	2.94	7.36	5.5	89.76	3.154	0.610
30-36	958.6	53.9	0.0	380.2	128.5	0.0	3.3	2.087	423.1	758.0	30.2	3.14	7.08	5.4	148.58	4.530	0.461
36-42	984.5	93.0	0.0	380.2	134.2	0.0	171.7	2.371	152.3	0.0	35.4	3.65	7.08	5.4	160.01	4.033	0.588
42-48	1010.4	130.2	0.0	388.8	119.1	0.0	203.9	2.490	152.3	0.0	25.0	3.78	6.92	5.3	159.18	4.141	0.601
48-54	1010.4	113.4	0.0	376.0	98.3	0.0	0.0	2.186	0.0	0.0	0.0	3.96	6.82	5.3	237.85	4.198	0.521
54-60	1036.3	126.4	0.0	371.7	85.1	0.0	0.0	2.203	0.0	0.0	0.0	3.86	6.81	5.3	486.83	4.347	0.507
CRK 1.6, February 1992																	
10.5 m	855.0	0.0	0.0	350.3	0.1	0.0	2.2	1.558	107.2	51.6	229.0	2.10	8.23	5.7	34.86	2.752	0.566
10.5 m	855.0	0.0	0.0	350.3	0.2	0.0	0.0	1.556	118.5	54.8	239.4	2.01	7.81	5.6	44.01	2.706	0.575
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0			1.0	0.00	0.000	ERR

Table 5 (continued)

Depth (cm)	Cations							Anions							Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l	pH	pK	Anions ueq/l	Total Anions meq/l	
0-3	621.8	7.8	0.0	273.4	20.8	0.0	0.0	1.226	0.0	0.0	0.0	1.45	7.47	5.5	219.08	1.669	0.734
3-6	621.8	10.8	0.0	273.4	75.6	0.0	0.0	1.341	0.0	0.0	0.0	1.61	7.68	5.6	0.00	1.610	---
6-12	647.7	35.3	0.0	286.2	68.0	0.0	2.2	1.429	132.6	64.5	229.0	1.86	7.47	5.5	115.30	2.630	0.543
12-18	647.7	35.3	0.0	286.2	68.0	0.0	0.0	1.427	112.8	98.4	99.9	2.05	7.50	5.5	93.44	2.555	0.559
18-24	880.9	59.5	0.0	367.4	102.1	0.0	72.8	2.012	124.1	0.0	27.1	2.86	7.32	5.5	137.97	3.176	0.633
24-30	984.5	80.0	0.0	418.7	111.5	0.0	140.0	2.345	129.7	258.0	23.9	3.27	7.22	5.4	160.61	3.866	0.606
30-36	1036.3	89.2	0.0	427.2	109.6	0.0	168.3	2.457	126.9	0.0	26.0	3.48	7.25	5.4	195.16	3.854	0.637
36-42	1036.3	161.8	0.0	470.0	104.0	0.0	210.6	2.718	121.3	0.0	27.1	3.44	7.22	5.4	160.61	3.776	0.720
PCK 1.6, February 1992																	
3 m	855.0	0.0	0.0	367.4	1.6	0.0	1.7	1.595	180.5	85.5	395.6	1.63	7.92	5.6	38.26	2.725	0.585
3 m	855.0	0.0	0.0	367.4	1.5	0.0	5.0	1.598	166.4	83.9	354.0	1.78	7.93	5.6	32.47	2.771	0.577
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.0	0.0	0.0			1.0	0.00	0.000	ERR
0-3	777.2	17.5	0.0	346.1	20.8	0.0	3.9	1.550	169.2	46.8	364.4	1.75	7.36	5.5	50.63	2.745	0.565
3-6	906.8	33.5	0.0	393.1	472.5	0.0	0.0	2.705	0.0	0.0	0.0	2.32	7.66	5.6	0.00	2.320	---
6-12	1450.9	33.5	0.0	769.0	43.5	0.0	0.0	3.143	268.0	274.2	114.5	4.55	7.68	5.6	0.00	5.321	0.591
12-18	2072.7	14.3	0.0	1367.2	30.2	0.0	0.0	4.896	183.3	548.3	47.9	7.84	7.84	5.6	0.00	8.667	0.565
18-24	2564.9	8.4	0.0	1879.8	22.7	0.0	0.0	6.387	197.4	693.5	33.3	11.30	7.99	5.7	0.00	12.258	0.521
24-30	2849.9	4.6	0.0	2136.2	24.6	0.0	392.8	7.573	205.9	0.0	21.9	11.97	7.97	5.7	0.00	12.220	0.620
30-36	3109.0	9.1	0.0	2435.3	28.4	0.0	605.6	8.660	180.5	0.0	19.8	12.87	7.89	5.6	0.00	13.090	0.662
36-42	3109.0	5.6	0.0	2606.1	28.4	0.0	383.3	8.772	208.7	0.0	22.9	14.25	7.96	5.7	0.00	14.505	0.605
42-48	3368.1	6.3	0.0	2862.5	34.0	0.0	447.2	9.621	197.4	0.0	20.8	15.37	7.90	1.0	0.00	15.609	0.616
48-54	3627.1	5.8	0.0	2990.7	37.8	0.0	577.8	10.273	200.3	0.0	25.0	16.06	7.97	5.7	0.00	16.310	0.630
54-60	3627.1	7.1	0.0	3076.1	39.7	0.0	0.0	9.873	0.0	0.0	0.0	16.49	8.00	1.0	0.00	16.490	0.599
60-66	3368.1	11.3	0.0	3118.8	35.9	0.0	0.0	9.700	0.0	0.0	0.0	14.11	8.04	5.7	0.00	14.110	0.687
66-72	3886.2	9.3	0.0	3332.5	51.0	0.0	0.0	10.672	0.0	0.0	0.0	15.01	8.03	5.7	0.00	15.010	0.711
72-78	3886.2	12.6	0.0	3375.2	56.7	0.0	6.1	10.781	0.0	0.0	0.0	18.28	7.96	5.7	568.34	18.848	0.572

TRK 849.6, February 1992

Table 5 (continued)

Depth (cm)	Cations							Anions					pH	pK	Organic Total		Cation Anion ratio
	Ca umol/l	Fe umol/l	K umol/l	Mg umol/l	Mn umol/l	Na umol/l	NH4 umol/l	Total Cations meq/l	Cl umol/l	NO3 umol/l	SO4 umol/l	Total Alkalinity meq/l			Anions ueq/l	Total Anions meq/l	
24 m	544.1	0.0	0.0	205.1	0.0	0.0	0.6	0.955	180.5	53.2	145.7	1.25	8.23	5.7	32.53	1.808	0.528
24 m	518.2	0.0	0.0	200.8	0.1	0.0	1.1	0.921	208.7	54.8	156.2	1.31	7.81	5.6	28.96	1.915	0.481
0-3	621.8	10.2	0.0	260.6	32.1	0.0	7.2	1.235	248.2	258.0	166.6	1.77	7.40	5.5	51.82	2.661	0.464
3-6	673.6	6.7	0.0	277.7	107.7	0.0	0.0	1.458	0.0	0.0	0.0	2.14	7.61	5.6	47.38	2.187	0.666
6-12	621.8	24.2	0.0	243.5	139.9	0.0	0.0	1.437	225.7	258.0	51.0	2.23	7.37	5.5	69.06	2.885	0.498
12-18	570.0	35.3	0.0	213.6	115.3	0.0	0.0	1.298	245.4	209.7	40.6	1.93	7.24	5.4	47.06	2.513	0.517
18-24	595.9	59.5	0.0	235.0	113.4	0.0	177.2	1.589	231.3	0.0	20.8	2.43	7.07	5.4	60.56	2.763	0.575
24-30	725.4	117.1	0.0	277.7	158.8	0.0	250.0	2.083	225.7	0.0	19.8	3.02	7.00	5.3	71.83	3.357	0.620
30-36	880.9	117.1	0.0	307.6	245.7	0.0	284.4	2.506	0.0	0.0	0.0	3.61	6.95	5.3	85.37	3.695	0.678
36-42	958.6	104.1	0.0	329.0	283.5	0.0	0.0	2.392	0.0	0.0	0.0	4.00	7.00	5.3	107.17	4.107	0.582
42-48	906.8	124.6	0.0	303.3	283.5	0.0	248.9	2.579	0.0	0.0	0.0	4.02	6.91	5.3	125.03	4.145	0.622
48-54	1088.1	204.5	0.0	346.1	321.3	0.0	0.0	2.832	0.0	0.0	0.0	4.59	6.85	5.3	113.40	4.703	0.602
54-60	1088.1	184.1	0.0	354.6	321.3	0.0	0.0	2.808	0.0	0.0	0.0	4.88	6.91	5.3	147.76	5.028	0.559
60-66	1088.1	172.9	0.0	363.2	321.3	0.0	365.0	3.168	282.1	0.0	33.3	4.98	6.94	5.3	147.92	5.477	0.578

**Table 6. Field rinse and filter blank results
for total inorganic arsenic analysis, in nM**

Date	Arsenic Concentration (nM)
Field rinse blanks	
July 1991	<0.02
June 24, 1992	3
June 25, 1992	<0.02
Filter blank	
March 1991	<0.01

Table 7. Average percent difference around the mean for arsenic speciation data, in nM

Date	Water column As(III)	Water column Inorganic As	Porewater As (III)	Porewater Inorganic As
March 1990	8.3	8.3		
July 1990	4.95	2.2		
August 1990	4.9	2.4	8.5	4.3
January 1991	5.2	4.6		
March 1991	7.4	5.4	7.0	2.9
July 1991	5.8	4.6	5.6	3.4
February 1992	5.1	4.5	2.8	2.8
June 1992	2.4	2.5	2.3	2.2
October 1992	2.4	2.5	2.4	2.0
December 1992	6.6	3.1	2.1	2.6

6. REFERENCES

- Andreae, M. O. 1983. "Arsenic." In K. Grasshoff, M. Ehrhardt, and K. Kremling (eds.), *Methods of Seawater Analysis*. pp. 218-225. Verlag-Chemie, Weinheim, Germany.
- Cook, R. B., et al. 1992. *Phase 1 Data Summary Report for the Clinch River Remedial Investigation: Health risk and ecological risk screening assessment*. ORNL/ER-155. Oak Ridge National Laboratory, Oak Ridge, Tennessee.
- Energy Systems (Martin Marietta Energy Systems, Inc.). 1992. *Requirements for Quality Control of Analytical Data for the Environmental Restoration Program*. ES/ER/TM-16. Oak Ridge, Tennessee.
- Energy Systems (Martin Marietta Energy Systems, Inc.). 1995. *Clinch River Environmental Restoration Program Procedures and Instructions Manual*. ES/ER/INT-72. Oak Ridge, Tennessee.
- EPA (U.S. Environmental Protection Agency). 1986. *Test method—The Determination of Inorganic Anions in Water by Ion Chromatography*. EPA-600/4-84-017.
- EPA (U.S. Environmental Protection Agency). 1986a. *Methods for the analysis of water and wastes*. SW-846.

APPENDIX A

Water Quality and Surface Water Arsenic Speciation Data

Table A.1. Water quality and surface water arsenic speciation data, by source and site

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=brsp SITE=crk 66.7 SEASON=spr -----										
0	17.33	.	122.23	.	3.89	.	0.75	.	3.14	.
-----SOURCE=brsp SITE=crk 66.7 SEASON=sum -----										
0.5	.	.	.	.	4.53	.	1.22	.	3.31	.
2	.	.	.	.	4.52	.	1.26	.	3.26	.
4	.	.	.	.	2	.	0.02	.	1.98	.
6	.	.	.	.	2.02	.	0.02	.	2	.
8	.	.	.	.	1.84	.	0	.	1.84	.
10	.	.	.	.	1.83	.	0.02	.	1.81	.
-----SOURCE=brsp SITE=crk 66.7 SEASON=win -----										
0	.	.	.	.	4.59	.	0.04	.	4.55	.
-----SOURCE=brsp SITE=crk 73.6 SEASON=spr -----										
0	19.23	.	120	.	3.65	.	0.31	.	3.34	.
-----SOURCE=brsp SITE=crk 73.6 SEASON=sum -----										
0	24.66	.	96.81	.	4.06	.	0.84	.	3.22	.
-----SOURCE=brsp SITE=crk 78.4 SEASON=sum -----										
0	18.29	.	86.86	.	2	.	0.01	.	1.99	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
----- SOURCE=brsp SITE=crk 80 SEASON=spr -----										
0	.	.	.	.	0.62	.	0.01	.	0.61	.
----- SOURCE=brsp SITE=crk 80 SEASON=sum -----										
0	14.28	.	77.86	.	1.71	.	0	.	1.71	.
----- SOURCE=brsp SITE=crk 80 SEASON=win -----										
0	.	.	.	.	3.41	.	0.07	.	3.35	.
----- SOURCE=ksp SITE=crk 1.6 SEASON=fal -----										
0.5	21.77	.	96.38	.	19	.	2.4	.	16.6	.
3	20.3	.	88.28	.	8.56	.	0.81	.	7.74	.
6	19.58	.	85.2	.	6.61	.	0.74	.	5.86	.
9	18.64	.	86.11	.	7.04	.	0.97	.	6.07	.
11	18.47	.	85.01	.	6.49	.	0.83	.	5.66	.
----- SOURCE=ksp SITE=crk 1.6 SEASON=spr -----										
0.5	13.46	2.62	102.48	8.31	4.76	2.99	0.08	0.06	4.67	3.05
3	11	.	94.8	.	2.74	0.49	0.1	0.05	2.65	0.51
6	11.84	1.46	99.35	7.28	2.63	1.01	0.04	0.01	2.59	1.03
9	10.64	.	93.5	.	2.27	0.75	0.03	0.03	2.24	0.77

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=ksp SITE=crk 1.6 SEASON=sum-----										
0.5	27.87	1.73	98.27	6.83	17.98	3.67	2.4	1.04	15.58	3.03
-----SOURCE=ksp SITE=crk 1.6 SEASON=sum-----										
3	24.94	2.35	89.18	6.45	10.49	3.33	1.44	0.69	9.05	3.22
6	23.25	1.54	90.9	6.17	5.32	2.72	0.56	0.28	4.76	2.46
9	22.34	0.88	81.61	10.05	4.49	1.68	0.47	0.19	4.03	1.68
12	22.29	0.86	82	17.98	4.57	1.68	0.41	0.11	4.17	1.64
-----SOURCE=ksp SITE=crk 1.6 SEASON=win-----										
0.5	11.7	1.16	101.47	19.05	10.02	9.88	0.05	0.02	9.96	9.89
3	11.62	0.96	98.24	15.32	9.99	9.07	0.06	0.01	9.93	9.08
6	10.79	0.18	96.69	12.99	7.13	4.77	0.07	0.01	7.06	4.78
9	10.44	0.71	95.46	10.83	5.04	2.24	0.04	0.01	4.99	2.25
11.5	.	.	.	.	4.38	1.29	0.05	0.01	4.33	1.29
-----SOURCE=ksp SITE=crk 4 SEASON=spr-----										
0	.	.	.	.	4.06	.	0.16	.	3.9	.
-----SOURCE=ksp SITE=crk 4 SEASON=sum-----										
0	.	.	.	.	23	.	1.4	.	21.6	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=ksp SITE=crk 4 SEASON=win -----										
0	.	.	.	.	6.75	.	0.07	.	6.68	.
-----SOURCE=ksp SITE=crk 5.6 SEASON=spr -----										
0	.	.	.	.	2.14	.	0.03	.	2.11	.
-----SOURCE=ksp SITE=crk 5.6 SEASON=sum -----										
0	.	.	.	.	21.8	.	1.73	.	20.07	.
-----SOURCE=ksp SITE=crk 5.6 SEASON=win -----										
0	.	.	.	.	4.41	.	0.04	.	4.37	.
-----SOURCE=ksp SITE=crk 8 SEASON=spr -----										
0.5	.	.	.	.	1.47	.	0	.	1.47	.
2	.	.	.	.	1.41	.	0.01	.	1.4	.
4	.	.	.	.	1.45	.	0.07	.	1.38	.
6	.	.	.	.	1.45	.	0.05	.	1.4	.
7.5	.	.	.	.	1.54	.	0.04	.	1.5	.
9	.	.	.	.	1.6	.	0.02	.	1.58	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=ksp SITE=crk 8 SEASON=sum -----										
0.5	.	.	.	.	20.7	.	1.88	.	18.82	.
3	.	.	.	.	8.95	.	0.93	.	8.02	.
6	.	.	.	.	3.83	.	0.44	.	3.39	.
9	.	.	.	.	3.53	.	0.41	.	3.12	.
12	.	.	.	.	2.92	.	0.31	.	2.61	.
-----SOURCE=ksp SITE=crk 8 SEASON=win -----										
0.5	.	.	.	.	2.68	.	0.05	.	2.63	.
3	.	.	.	.	2.69	.	0.02	.	2.67	.
6	.	.	.	.	2.6	.	0	.	2.6	.
9	.	.	.	.	2.77	.	0.04	.	2.73	.
11	.	.	.	.	2.82	.	0.02	.	2.8	.
-----SOURCE=ksp SITE=trk 907.2 SEASON=spr -----										
0.5	.	.	.	.	1.91	.	0.02	.	1.89	.
3	.	.	.	.	1.71	.	0.05	.	1.66	.
6	.	.	.	.	1.49	.	0.07	.	1.42	.
9	.	.	.	.	1.43	.	0.06	.	1.37	.
11.5	.	.	.	.	1.44	.	0.04	.	1.4	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
14	.	.	.	.	1.46	.	0.08	.	1.38	.
-----SOURCE=ksp SITE=trk 907.2 SEASON=sum-----										
0.5	.	.	.	.	10.97	.	2.11	.	8.86	.
3	.	.	.	.	8.3	.	0.66	.	7.64	.
6	.	.	.	.	4.41	.	0.35	.	4.06	.
9	.	.	.	.	3.35	.	0.19	.	3.16	.
11	.	.	.	.	3.32	.	0.11	.	3.21	.
13	.	.	.	.	4.07	.	0.36	.	3.71	.
-----SOURCE=ksp SITE=trk 907.2 SEASON=win-----										
0.5	.	.	.	.	2.57	.	0.07	.	2.5	.
3	.	.	.	.	2.42	.	0.09	.	2.33	.
6	.	.	.	.	2.58	.	0.09	.	2.49	.
9	.	.	.	.	2.51	.	0.09	.	2.42	.
12	.	.	.	.	2.25	.	0.12	.	2.13	.
14.5	.	.	.	.	2.54	.	0.11	.	2.43	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
----- SOURCE = lmc b SITE = crk 60.5 SEASON = spr -----										
0.5	15.4	.	116.63	.	2.76	.	0.24	.	2.52	.
2	14.92	.	113.39	.	2.75	.	0.31	.	2.44	.
4	13.79	.	105.79	.	2.44	.	0.23	.	2.21	.
6	13.21	.	98.84	.	2.33	.	0.19	.	2.14	.
----- SOURCE = lmc b SITE = crk 60.5 SEASON = sum -----										
0.5	26.75	.	115.52	.	3.27	0.25	0.33	0	2.94	0.25
3	25.52	1.75	110.31	6.97	3.29	0.13	0.37	0.05	2.92	0.08
6	17.94	0.44	83.63	7.69	2.12	0.23	0.23	0.03	1.89	0.26
9	16.16	.	75.13	.	1.72	0.12	0.12	0.03	1.6	0.15
13	15.84	0.23	85.03	15.66	1.99	0.02	0.09	0.04	1.9	0.02
----- SOURCE = lmc b SITE = crk 60.5 SEASON = win -----										
0.5	.	.	.	.	2.99	1.17	0	0.01	2.98	1.16
3	10.03	.	90.28	.	3.9	.	0.1	.	3.8	.
6	10.01	.	90.57	.	3.33	.	0	.	3.33	.
9	10.01	.	90.57	.	3.59	.	0	.	3.59	.
12	9.7	.	89.91	.	3.66	.	0.09	.	3.57	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISO	DISO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=lmc b SITE=mcbk 0.3 SEASON=fal -----										
0.5	17.25	.	113.95	.	2.67	.	0.55	.	2.12	.
2	16.72	.	109.86	.	2.56	.	0.6	.	1.96	.
4	15.9	.	93.33	.	2.93	.	0.61	.	2.33	.
6	15.14	.	79.45	.	4.82	.	0.53	.	4.3	.
8	14.63	.	77.24	.	4.16	.	0.65	.	3.51	.
-----SOURCE=lmc b SITE=mcbk 0.3 SEASON=spr -----										
0.5	14.16	2.5	112.62	20.53	5.17	0.7	0.34	0.37	4.83	1.07
1	13.77	2.79	109.89	17.52	5.92	1.5	0.33	0.19	5.59	1.69
2	13.04	3.46	105.11	18.54	4.3	0.21	0.28	0.2	4.02	0.01
4	12.25	2.87	106.55	13.36	2.16	1.07	0.18	0.26	1.98	0.82
5	11.82	2.54	106.25	13.65	2.81	2.49	0.23	0.27	2.59	2.22
-----SOURCE=lmc b SITE=mcbk 0.3 SEASON=sum -----										
0.5	25.81	1.15	132.67	14.26	8.15	2.2	0.98	0.23	7.17	2.06
1	26.36	0.86	132.9	22.78	8.64	1.4	0.81	0.11	7.84	1.51
2	25.45	1.01	134.82	15.72	5.89	1.52	0.71	0.3	5.18	1.24
3	24.54	.	112.91	.	6.3	1.89	0.96	0.34	5.34	1.59
4	21.46	1.45	93.13	10.93	7.25	2.11	1.33	0.19	5.92	1.92

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
5	18.67	0.52	77.3	23.77	15.67	11.22	2.57	1.89	13.1	9.33
6	19.07	1.94	72.98	23.22	5.88	1.45	0.7	0.24	5.18	1.21
7.5	.	.	.	.	11.57	8.77	1.42	1.16	10.15	7.74
-----SOURCE=lmb SITE=mcbk 0.3 SEASON=win-----										
0.5	10.08	0.68	140.24	66.95	5.22	2.56	0.23	0.42	5	2.16
1	9.97	0.58	120.12	49.42	5.32	3.3	0.48	0.57	4.85	2.72
2	9.81	1.1	134.65	60.31	4.87	0.58	0.21	0.23	4.66	0.54
3	9.81	.	89.89	.	3.61	0.71	0.23	0.34	3.37	0.75
4	9.59	1.06	119.03	48.98	5.22	.	0.1	.	5.12	.
5	9.49	1.56	91.4	.	4.84	2.34	0.4	0.51	4.43	1.86
6	9.37	1.09	114.86	45.01	5.78	2.32	0.17	0.25	5.61	2.39
7	8.68	0.93	127.1	52.54	4.63	2.09	0.18	0.16	4.45	1.93
-----SOURCE=lmb SITE=mcbk 0.5 SEASON=spr-----										
0	.	.	.	.	24	.	0.18	.	23.82	.
-----SOURCE=lmb SITE=mcbk 0.5 SEASON=sum-----										
0	.	.	.	.	14.75	3.75	1.93	0.89	12.82	2.86
0.5	25.56	.	126.91	.	9.05	.	1.81	.	7.24	.
2	25.58	.	132.21	.	10.3	.	1.53	.	8.77	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
4	23.07	.	65.67	.	39.4	.	9.96	.	29.44	.
----- SOURCE=lmb SITE=mcbk 0.5 SEASON=win -----										
0	.	.	.	.	12.3	1.98	0.1	0.03	12.2	2
0.5	9.23	.	87.78	.	5.27	.	0	.	5.27	.
2	9.2	.	88.15	.	4.16	.	0.11	.	4.05	.
4	8.89	.	88.24	.	7.76	.	0.24	.	7.52	.
----- SOURCE=lwbr SITE=trk 849.6 SEASON=fal -----										
0.5	19.49	.	80.74	.	5.01	.	0.48	.	4.52	.
3	19.59	.	79.01	.	4.47	.	0.38	.	4.09	.
6	19.64	.	78.83	.	4.25	.	0.47	.	3.78	.
9	19.67	.	79.21	.	4.52	.	0.43	.	4.09	.
12	19.72	.	79.75	.	4.21	.	0.43	.	3.78	.
15	19.73	.	80.09	.	5	.	0.36	.	4.64	.
18	19.69	.	81.1	.	4.31	.	0.32	.	3.99	.
21	.	.	.	.	4.53	.	0.43	.	4.1	.
24	19.71	.	79.98	.	5.01	.	0.38	.	4.64	.
26	19.72	.	78.18	.	5.27	.	0.59	.	4.69	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
----- SOURCE=lwbr SITE=trk 849.6 SEASON=spr -----										
0.5	12.13	1.7	113.07	15.3	2.2	0.71	0.04	0.04	2.17	0.74
3	11.75	.	106.77	.	2.03	0.38	0.04	0.05	2	0.43
6	10.9	0.79	98.95	4.84	2.02	0.35	0.08	0.01	1.94	0.35
9	10.65	0.49	96.88	3.75	2.07	0.33	0.06	0.03	2.01	0.36
12	10.28	.	93.82	.	2.08	0.31	0.07	0.02	2.02	0.33
15	10.24	.	92.53	.	2.13	0.34	0.07	0.04	2.06	0.38
18	10.19	.	92.33	.	2.28	0.59	0.06	0.02	2.22	0.61
----- SOURCE=lwbr SITE=trk 849.6 SEASON=spr -----										
21	10.16	.	91.89	.	2.29	0.45	0.05	0.01	2.24	0.47
24	10.13	.	91.28	.	2.29	0.52	0.01	0.01	2.28	0.5
----- SOURCE=lwbr SITE=trk 849.6 SEASON=sum -----										
0	25.82	3.01	119.16	15.67	3.72	.	0.08	.	3.64	.
0.5	28.81	0.72	124	1.41	2.29	0.55	0.23	0.24	2.07	0.55
3	26.49	2.51	106.44	25.04	2.78	0.68	0.23	0.2	2.54	0.64
4	28.93	.	100.26	.	2.57	.	0.18	.	2.39	.
5	26.51	.	57.2	.	2.76	.	0.4	.	2.36	.
6	24.91	1.55	68.5	21.34	3.1	0.59	0.39	0.11	2.71	0.55

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
9	23.8	1.48	43.75	18.01	3.98	0.38	0.45	0.12	3.53	0.35
12	23.44	1.37	45.7	19.5	4.43	0.95	0.39	0.21	4.04	1.04
15	23.17	1.57	40.44	17.1	4.98	1.09	0.31	0.14	4.67	1.19
18	22.86	1.98	45.64	11.49	5.73	0.87	0.3	0.17	5.43	1.01
21	22.66	2.12	41.89	13.08	5.88	1.66	0.39	0.2	5.49	1.81
24	22.47	2.2	30.67	12.63	6.38	1.69	0.4	0.2	5.98	1.73
25	22.74	.	4.15	.	7.04	1.65	0.34	0.14	6.7	1.6
26	22.24	2.27	22.63	15.65	5.39	.	1.01	.	4.38	.
-----SOURCE=lwbr SITE=trk 849.6 SEASON=win-----										
0.5	9.53	.	89.1	.	2.79	0.05	0.05	0.03	2.74	0.08
3	9.53	.	88.7	.	3.04	0.3	0.02	0.02	3.03	0.28
6	9.52	.	88.7	.	2.99	0.38	0.05	0.01	2.94	0.4
9	9.54	.	88.7	.	3.16	0.15	0.05	0.01	3.11	0.16
12	9.53	.	88.6	.	1.63	2.3	0.06	0.02	1.57	2.32
15	9.52	.	88.7	.	3.19	0.25	0.07	0.02	3.13	0.28
18	9.51	.	88.7	.	3.12	0.52	0.03	0.01	3.09	0.53
21	9.5	.	88.7	.	3.11	0.53	0.05	0.03	3.06	0.55
23	9.5	.	88.7	.	2.88	.	0.09	.	2.81	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
24	.	.	.	.	3.04	.	0.04	.	3	.
-----SOURCE=lwbr SITE=trk 863.2 SEASON=spr-----										
0.5	.	.	.	.	1.39	.	0.01	.	1.37	.
3	.	.	.	.	1.52	.	0.05	.	1.47	.
6	.	.	.	.	1.62	.	0.04	.	1.58	.
9	.	.	.	.	1.78	.	0.07	.	1.71	.
11	.	.	.	.	1.83	.	0.1	.	1.73	.
-----SOURCE=lwbr SITE=trk 863.2 SEASON=sum-----										
0.5	.	.	.	.	2.42	.	0.12	.	2.3	.
3	.	.	.	.	2.34	.	0.12	.	2.22	.
4	.	.	.	.	2.49	.	0.23	.	2.26	.
5	.	.	.	.	3.7	.	0.88	.	2.82	.
6	.	.	.	.	3.92	.	0.88	.	3.04	.
9	.	.	.	.	4.73	.	0.36	.	4.37	.
11	.	.	.	.	5.07	.	0.42	.	4.65	.
-----SOURCE=lwbr SITE=trk 863.2 SEASON=win-----										
0.5	.	.	.	.	3.46	.	0.13	.	3.33	.
3	.	.	.	.	3.46	.	0.11	.	3.35	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISO	DISO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
6	.	.	.	.	3.28	.	0.08	.	3.2	.
9	.	.	.	.	3.4	.	0.07	.	3.33	.
12	.	.	.	.	3.01	.	0.12	.	2.89	.
15	.	.	.	.	2.81	.	0.08	.	2.73	.
18	.	.	.	.	2.78	.	0.15	.	2.63	.
22	.	.	.	.	2.72	.	0.1	.	2.62	.
-----SOURCE=lwbr SITE=trk 875.2 SEASON=spr-----										
0.5	.	.	.	.	1.56	.	0.04	.	1.52	.
3	.	.	.	.	1.8	.	0.07	.	1.73	.
6	.	.	.	.	2.03	.	0.04	.	1.99	.
9	.	.	.	.	1.93	.	0.09	.	1.84	.
11	.	.	.	.	1.92	.	0.07	.	1.85	.
-----SOURCE=pc SITE=crk 18.4 SEASON=sum-----										
0	.	.	.	.	5.38	.	0.09	.	5.29	.
-----SOURCE=pc SITE=crk 20 SEASON=sum-----										
0	.	.	.	.	2.51	.	0.11	.	2.4	.
-----SOURCE=pc SITE=pck 0.25 SEASON=sum-----										
0	.	.	.	.	5.8	.	0.14	.	5.66	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=pc SITE=pck 1.6 SEASON=fal-----										
0.5	17.09	.	88.02	.	4.68	.	0.41	.	4.27	.
1.5	17.08	.	88.08	.	4.59	.	0.33	.	4.26	.
3	17.06	.	92.31	.	4.16	.	0.54	.	3.62	.
4	17	.	88.47	.	4.04	.	0.35	.	3.69	.
-----SOURCE=pc SITE=pck 1.6 SEASON=spr-----										
0.5	12.93	.	91.3	.	1.36	.	0	.	1.36	.
1	12.72	.	90.4	.	1.21	.	0	.	1.21	.
2	12.66	.	89.8	.	1.31	.	0	.	1.31	.
-----SOURCE=pc SITE=pck 1.6 SEASON=sum-----										
0.5	24.4	1.43	94.01	5.08	5.34	0.38	0.36	0.18	4.98	0.47
1	24.69	0.53	85.87	5.61	5.42	0.28	0.14	0.18	5.28	0.1
2	23.9	0.94	83.88	11.63	5.82	0.5	0.3	0.26	5.52	0.27
-----SOURCE=pc SITE=pck 1.6 SEASON=sum-----										
3	23.84	0.86	77.83	4.14	5.62	0.12	0.18	0.18	5.44	0.3
4	22.08	2.36	86.41	6.76	5.78	0.37	0.43	0.28	5.35	0.22
4.9	.	.	.	.	9.27	.	1.25	.	8.02	.
5	22.07	.	87.39	.	8.1	.	0	.	8.1	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
-----SOURCE=pc SITE=pck 1.6 SEASON=win-----										
0.5	7.68	.	96.37	.	1.84	0.52	0	0	1.84	0.52
1	8.17	0.74	91.14	6.98	1.77	0.63	0.31	0.44	1.46	1.07
2	8.15	0.76	90.71	6.8	1.85	0.57	0.18	0.25	1.67	0.82
3	8.13	0.76	90.66	6.73	1.85	0.6	0.16	0.22	1.69	0.82
3.5	8.68	.	85.8	.	1.38	.	0.65	.	0.73	.
-----SOURCE=rq SITE=mcbk 1.6 SEASON=fal-----										
0	.	.	.	.	229.44	29.68	0.61	0.12	228.67	29.41
-----SOURCE=rq SITE=mcbk 1.6 SEASON=spr-----										
0	.	.	.	.	221.1	64.44	4.89	11.03	216.24	62.71
-----SOURCE=rq SITE=mcbk 1.6 SEASON=sum-----										
0	.	.	.	.	244.86	70.54	17.37	31.01	227.5	72.76
-----SOURCE=rq SITE=mcbk 1.6 SEASON=win-----										
0	.	.	.	.	188.91	61.58	0.69	0.78	188.29	61.32
-----SOURCE=rq SITE=mcbk 1.8 SEASON=fal-----										
0	.	.	.	.	147.82	15.89	0.78	0.44	147	15.96
-----SOURCE=rq SITE=mcbk 1.8 SEASON=spr-----										
0	.	.	.	.	161	19.16	1.12	1.06	160	20.07

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISSO	DISSO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
----- SOURCE=rq SITE=mcbk 1.8 SEASON=sum -----										
0	.	.	.	.	146.67	31.21	2.06	1.87	144.63	30.15
12	10.52	.	42.13	.	275	.	1.02	.	273.98	.
24	.	.	.	.	407	.	6.06	.	400.94	.
----- SOURCE=rq SITE=mcbk 2.0 SEASON=fal -----										
0	.	.	.	.	28.08	5.86	0.24	0.4	27.84	6.16
----- SOURCE=rq SITE=mcbk 2.0 SEASON=spr -----										
0	.	.	.	.	37.37	8.49	0.41	0.29	36.95	8.48
----- SOURCE=rq SITE=mcbk 2.0 SEASON=sum -----										
0	.	.	.	.	40.28	10.56	2.27	3.79	38.02	8.19
----- SOURCE=rq SITE=mcbk 2.0 SEASON=win -----										
0	.	.	.	.	36.5	9.35	0.2	0.23	36.32	9.36
----- SOURCE=umcb SITE=mcbk 0.7 SEASON=spr -----										
0	.	.	.	.	31.7	.	0.22	.	31.48	.
----- SOURCE=umcb SITE=mcbk 0.7 SEASON=sum -----										
0	.	.	.	.	16.55	8.27	3.15	1.35	13.41	6.92
0.5	25.77	.	122.85	.	40.2	.	4.3	.	35.9	.
1	25.72	.	125.06	.	36.5	.	4.07	.	32.43	.

Table A.1 (continued)

DEPTH	TEMP	TEMP S	DISO	DISO S	ASI	ASI S	AS3	AS3 S	AS5	AS5 S
2	25.35	.	104.03	.	93	.	8.01	.	84.99	.
3	23.65	.	49.91	.	112	.	18.54	.	93.46	.
----- SOURCE=umcb SITE=mcbk 0.7 SEASON=win -----										
0	7.08	.	91.99	.	62.8	45.4	0.91	0.19	61.9	45.59
0.5	.	.	.	.	10.81	.	0.48	.	10.33	.
1	7.07	.	91.23	.	1.55	.	0.43	.	1.12	.
2	7.02	.	89.92	.	11.22	.	0.49	.	10.74	.
3	6.85	.	91.15	.	13.4	.	0.74	.	12.66	.
----- SOURCE=umcb SITE=mcbk 0.9 SEASON=spr -----										
0	.	.	.	.	67.4	77.22	0.65	0.41	66.77	77.6
----- SOURCE=umcb SITE=mcbk 0.9 SEASON=sum -----										
0	.	.	.	.	103	.	5.24	.	97.79	.
0.5	.	.	.	.	88.5	.	4.7	.	83.8	.
1.5	.	.	.	.	82.1	.	7.95	.	74.15	.
----- SOURCE=umcb SITE=mcbk 0.9 SEASON=win -----										
1	.	.	.	.	18.18	.	1.19	.	16.99	.

APPENDIX B

Pore Water Arsenic Speciation and Particle-to-Water Distribution Coefficients for Arsenic, Iron, and Manganese

Table B.1. Pore water arsenic speciation and particle-to-water distribution coefficients for arsenic, iron, and manganese, by source, site, and season

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN_KD	MN_KDS
SOURCE=ksp SITE=crk 1.6 SEASON=fal													
1.5	1	123	.	0	.	123	.	434	.	.	.	.	.
4.5	1	118	.	7.3	.	110.7	.	226	.	250000	.	1000	.
9	1	59	.	48.3	.	10.7	.	1584	.	.	.	.	.
15	1	364	.	181.2	.	182.8	.	257	.	.	.	4000	.
21	1	262	.	138.3	.	123.7	.	153	.	6250	.	.	.
27	1	303	.	100.2	.	202.8	.	352	.	13333	.	556	.
33	1	351	.	134.5	.	216.5	.	190	.	.	.	83	.
39	1	339	.	106.9	.	232.1	.	197	.	5000	.	33	.
SOURCE=ksp SITE=crk 1.6 SEASON=spr													
1.5	1	32.5	.	1.3	.	31.2	.	.	.	609832	.	1007	.
4.5	1	98.8	.	14.9	.	83.9	.	.	.	29678	.	530	.
9	1	264	.	98.7	.	165	.	.	.	9009	.	352	.
15	1	605	.	162	.	443	.	.	.	5584	.	144	.
21	1	432	.	104	.	328	.	.	.	5718	.	127	.
27	1	536	.	129	.	407	.	.	.	3947	.	97	.
33	1	508	.	139	.	369	.	.	.	3685	.	107	.
39	1	467	.	144	.	323	.	.	.	4096	.	74	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
45	1	535	.	115	.	420	.	.	.	3267	.	97	.
SOURCE=ksp SITE=crk 1.6 SEASON=sum													
1.5	3	81.7	31.91	2.43	3.39	79.27	34.51	1149	.	10000	.	388	.
4.5	3	360.67	267.57	204.83	216.42	155.83	52.82	538	0	5758	0	429	0
5	0	.	.	.	.	.	.	252	.	.	.	.	.
9	3	301.33	147.97	100.87	63.47	200.47	160.2	384	99	1563	.	516	.
15	3	470.33	24.58	177.43	115.18	292.9	133.91	258	155	2583	.	364	.
21	3	476.9	80.47	164.93	63.52	311.97	75.66	101	103	3333	.	227	.
27	3	483.57	85.29	133.57	72.66	350	57.07	235	151	2077	.	152	.
33	3	516.03	198.69	130.43	61.99	385.6	152.14	245	172	2417	.	160	.
39	3	456.73	102.33	131.7	53.73	325.03	55.59	310	236	2077	.	146	.
45	3	482.67	104.2	131.2	35.34	351.47	103.24	229	165	1250	.	281	.
51	3	488.67	138.48	144.9	90.55	343.77	77.46	262	216	1556	.	727	.
57	3	477	81.66	132.9	80.13	344.1	38.64	261	134	2000	.	800	.
63	3	437.77	87.02	88.6	41.27	349.17	85.3	263	194	1846	.	1294	.
SOURCE=ksp SITE=crk 1.6 SEASON=win													
1.5	1	20.8	.	0.5	.	20.3	.	.	.	.	.	.	.
4.5	1	169	.	19.5	.	149.5	.	.	.	.	.	.	.
9	1	164	.	29.7	.	134.3	.	.	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
15	1	200	.	37.8	.	162.2	.	.	.	.	.	.	.
21	1	322	.	84.2	.	237.8	.	.	.	.	.	.	.
27	1	280	.	80.5	.	199.5	.	.	.	.	.	.	.
33	1	300	.	83.4	.	216.6	.	.	.	.	.	.	.
39	1	303	.	83.8	.	219.2	.	.	.	.	.	.	.
SOURCE=lmcB SITE=crk 60.5 SEASON=sum													
1.5	1	27.4	.	0	.	27.4	.	4384	.	67500	.	1763	.
4.5	1	200.2	.	0.7	.	199.5	.	533	.	7297	.	1060	.
9	1	192	.	0.3	.	191.7	.	626	.	12857	.	1000	.
15	1	181.1	.	18.8	.	162.4	.	663	.	13333	.	1167	.
21	1	153	.	32.2	.	120.8	.	349	.	7027	.	769	.
27	1	266	.	71.9	.	194.1	.	251	.	6571	.	523	.
33	1	227.7	.	85.1	.	142.6	.	293	.	4444	.	443	.
39	1	254.6	.	94.4	.	160.2	.	262	.	4727	.	484	.
SOURCE=lmcB SITE=crk 60.5 SEASON=win													
1.5	1	47.8	.	2	.	45.8	.	2792	.	52727	.	1222	.
4.5	1	68.8	.	3.2	.	65.6	.	2910	.	45313	.	1000	.
9	1	66	.	5.7	.	60.3	.	3033	.	8125	.	821	.
15	1	113	.	10.6	.	102.4	.	1181	.	17647	.	1080	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
21	1	111	.	25.7	.	85.3	.	2405	.	6923	.	615	.
27	1	191	.	62.8	.	128.2	.	1817	.	5870	.	414	.
33	1	176	.	48.2	.	127.8	.	1441	.	3611	.	371	.
37.5	1	135	.	31.3	.	103.7	.	.	.	.	.	.	.
39	0	.	.	.	.	.	.	1977	.	5435	.	407	.
SOURCE=lmc SOURCE=lmcb SITE=mcbk 0.3 SEASON=fal													
1.5	1	74.4	.	0	.	74.4	.	7176	.	87500	.	200	.
4.5	1	749	.	92.1	.	656.9	.	535	.	33333	.	200	.
9	1	735	.	122.8	.	612.2	.	1634	.	.	.	7000	.
15	1	573	.	131.1	.	441.9	.	233	.	900000	.	1500	.
21	1	447	.	79.9	.	367.1	.	.	.	33333	.	1000	.
27	1	379	.	68.3	.	310.7	.	2465	.	23333	.	1000	.
33	1	615	.	131.3	.	483.7	.	868	.	5556	.	333	.
39	1	644	.	187.8	.	456.2	.	829	.	12857	.	500	.
45	1	689	.	238.2	.	450.8	.	1743	.	8889	.	6000	.
51	1	983	.	307.7	.	675.3	.	543	.	.	.	1333	.
57	1	500	.	146.8	.	353.2	.	80	.	.	.	.	.
61.5	1	530	.	179.7	.	350.3	.	.	.	.	.	.	.
63	0	.	.	.	.	.	.	50	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
SOURCE=lmc SITE=mcbk 0.3 SEASON=spr													
1.5	1	30.7	.	0.8	.	29.9	.	.	.	.	.	.	.
4.5	1	337	.	34.4	.	303	.	.	.	.	.	.	.
9	1	491	.	218	.	273	.	.	.	.	.	.	.
15	1	447	.	224	.	223	.	.	.	.	.	.	.
21	1	677	.	236	.	441	.	.	.	.	.	.	.
27	1	605	.	141	.	464	.	.	.	.	.	.	.
33	1	569	.	187	.	382	.	.	.	.	.	.	.
39	1	414	.	177	.	237	.	.	.	.	.	.	.
SOURCE=lmc SITE=mcbk 0.3 SEASON=sum													
1.5	4	613.65	846.7	2.85	2.06	610.8	845.72	286	224	36957	.	393	.
4.5	4	844.93	746.83	178.6	239.2	666.33	510.81	151	45	59479	69090	628	658
9	4	1128.3	790.4	375.38	325.92	752.93	466.73	59	10	11364	12214	369	336
15	4	711.9	249.05	291.68	116.77	420.23	175.77	140	41	9107	9120	433	387
21	4	511.88	283.2	214.48	106.27	297.4	192.91	371	476	5539	3481	415	390
27	4	444.75	234.55	202.1	106.95	242.65	136	273	119	5556	.	462	.
33	4	544.7	374.89	229.93	155.85	314.78	221.47	572	673	3488	.	397	.
39	3	611	289.16	266.53	103.28	344.47	198.35	196	162	2000	.	268	.
45	3	436.17	217.9	221.3	70.27	214.87	162	183	102	1333	.	244	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
SOURCE=lmcbl SITE=mcbl 0.3 SEASON=sum													
51	3	358.2	330.56	130.53	66.46	227.67	269.31	137	62	1450	.	186	.
SOURCE=lmcbl SITE=mcbl 0.3 SEASON=win													
1.5	3	28.73	7.25	0	0	28.73	7.25	19303	1860	125893	30725	7802	5073
4.5	3	157.33	80.48	8.63	14.52	148.7	65.98	2819	1947	52005	14001	791	6
9	3	520	272.34	93.07	94.86	426.93	177.62	659	378	9808	272	634	204
15	3	429.67	213.79	92.9	92.82	336.77	124.4	813	168	12000	4243	909	275
21	3	400.67	141.8	69.2	43.57	331.47	121.34	815	17	8750	1768	582	278
27	3	553.33	182.51	143.9	52.4	409.43	149.52	627	317	7500	187	601	28
33	3	804.33	205.66	210.67	23.03	593.67	187.07	423	30	4225	1483	431	98
37.5	1	490	.	113	.	377	.	.	.	.	.	.	.
39	3	590.33	149.53	211.33	58.31	379	207.85	803	288	6776	7019	445	185
45	2	743.5	3.54	269.5	154.86	474	151.32	465	.	2000	.	254	.
51	2	577	33.94	214	144.25	363	110.31	267	.	833	.	132	.
57	2	359.5	253.85	88.6	44.41	270.9	209.45	1261	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
SOURCE=lmcbl SITE=mcbk 0.5 SEASON=sum													
1.5	1	664.1	.	275.1	.	389	.	221	.	.	.	.	.
4.5	1	1627	.	851.2	.	775.8	.	98	.	.	.	.	.
9	1	2111	.	1097.9	.	1013.1	.	76	.	.	.	.	.
15	1	1453	.	649.4	.	803.6	.	175	.	.	.	.	.
21	1	616.1	.	200.8	.	415.3	.	108	.	.	.	.	.
SOURCE=lmcbl SITE=mcbk 0.5 SEASON=win													
1.5	1	48.7	.	0	.	48.7	.	1370	.	2308	.	188	.
4.5	1	214	.	20.5	.	193.5	.	1622	.	80952	.	940	.
9	1	470	.	169	.	301	.	625	.	4412	.	200	.
15	1	211	.	99.2	.	111.8	.	316	.	3019	.	684	.
21	1	68.5	.	21.2	.	47.3	.	974	.	.	.	.	.
SOURCE=lwbr SITE=trk 849.6 SEASON=fal													
1.5	1	76.5	.	42.3	.	34.2	.	523	.	225000	.	.	.
4.5	1	190	.	53.4	.	136.6	.	140	.	10000	.	150	.
9	1	179	.	73.9	.	105.1	.	298	.	16000	.	889	.
15	1	131	.	56	.	75	.	408	.	10000	.	1286	.
21	1	80.7	.	51.9	.	28.8	.	1489	.	.	.	875	.
27	1	129	.	60.8	.	68.2	.	931	.	30000	.	100	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
33	1	107	.	60	.	47	.	624	.	2500	.	83	.
39	1	103	.	56.1	.	46.9	.	518	.	.	.	50	.
45	1	67.3	.	47.2	.	20.1	.	.	.	5556	.	56	.
51	1	75.4	.	49.5	.	25.9	.	708	.	8000	.	50	.
SOURCE=lwbr SITE=trk 849.6 SEASON=spr													
1.5	1	15.2	.	3.7	.	11.5	.	10395	.	166473	.	997	.
4.5	1	83.6	.	15.5	.	68.1	.	2285	.	60843	.	427	.
9	1	88.1	.	32.2	.	55.9	.	2951	.	16535	.	476	.
15	1	90	.	36.7	.	53.3	.	1489	.	17472	.	488	.
21	1	124	.	35.9	.	88.1	.	1806	.	10568	.	360	.
27	1	161	.	53.5	.	107.5	.	739	.	8500	.	228	.
33	1	146	.	43	.	103	.	1493	.	5638	.	155	.
39	1	157	.	45.5	.	111.5	.	1287	.	7744	.	179	.
45	1	112	.	32.3	.	79.7	.	1661	.	6214	.	313	.
51	1	142	.	52.2	.	89.8	.	1007	.	5362	.	240	.
57	1	130	.	43	.	87	.	421	.	5516	.	233	.
63	1	160	.	57.3	.	102.7	.	769	.	7977	.	395	.
SOURCE=lwbr SITE=trk 849.6 SEASON=sum													
1.5	3	139.6	105.22	26.87	46.53	112.73	60.77	1242	115	108824	0	318	0

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
4.5	3	413	39.89	131.93	52.77	281.07	92.07	159	68	40659	0	264	0
9	3	245.67	70.71	144.87	130.48	108.13	133.82	281	180	8636	0	351	0
15	3	189	58.85	73.87	61.58	115.13	51.06	407	235	10000	0	581	0
21	3	139.8	55.3	66.4	37.76	73.4	45.41	772	33	7407	0	540	0
27	3	177.17	35	79.23	27.24	97.93	58.27	376	130	5065	0	420	0
33	3	181	47.03	65.6	22.95	115.4	68.83	442	120	5139	0	268	0
39	3	195.33	49.22	70.17	20.47	125.17	66.9	374	40	3818	0	218	0
SOURCE=lwbr SITE=trk 849.6 SEASON=sum													
45	3	163.63	59.14	60.4	20.09	103.23	78.5	240	149	3333	0	192	0
51	3	123.77	37.9	55.97	19.81	67.8	54.26	429	0	2923	0	185	0
57	3	120.13	24.72	48.2	26.13	71.93	50.49	678	339	2857	0	162	0
63	3	129.23	47.79	48.4	24.5	80.83	65.42	642	424	2600	0	192	0
69	1	144	.	22.9	.	121.1	.	111	.	.	.	.	.
74	0	.	.	.	.	.	.	1024	.	.	.	.	.
75	1	168	.	32.3	.	135.7	.	.	.	.	.	.	.
81	1	122	.	18.9	.	103.1	.	885	.	.	.	.	.
84	0	.	.	.	.	.	.	741	.	.	.	.	.
87	1	135	.	21	.	114	.	.	.	.	.	.	.
93	1	126	.	22.5	.	103.5	.	595	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
99	1	130	.	12.9	.	117.1	.	.	.	.	.	.	.
SOURCE=lwbr SITE=trk 849.6 SEASON=win													
1.5	1	9.5	.	0.4	.	9.1	.	.	.	.	.	.	.
4.5	1	9.1	.	0	.	9.1	.	.	.	.	.	.	.
9	1	75.8	.	2.9	.	72.9	.	.	.	.	.	.	.
15	1	106	.	12.6	.	93.4	.	.	.	.	.	.	.
21	1	98.2	.	21.8	.	76.4	.	.	.	.	.	.	.
27	1	164	.	33.6	.	130.4	.	.	.	.	.	.	.
33	1	190	.	38.6	.	151.4	.	.	.	.	.	.	.
39	1	162	.	30.9	.	131.1	.	.	.	.	.	.	.
45	1	143	.	28.7	.	114.3	.	.	.	.	.	.	.
51	1	120	.	26.4	.	93.6	.	.	.	.	.	.	.
57	1	170	.	25.3	.	144.7	.	.	.	.	.	.	.
63	1	208	.	27.4	.	180.6	.	.	.	.	.	.	.
SOURCE=pc SITE=pck 1.6 SEASON=fal													
1.5	1	151	.	12.1	.	138.9	.	3536	.	75000	.	400	.
4.5	1	570	.	89.7	.	480.3	.	1639	.	66667	.	.	.
9	1	3000	.	1030	.	1970	.	356	.	40000	.	100	.
15	1	23700	.	18300	.	5400	.	.	.	90000	.	100	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN_KD	MS_KDS
21	1	28200	.	24400	.	3800	.	379	.	225000	.	63	.
SOURCE=pc SITE=pek 1.6 SEASON=fal													
27	1	31600	.	28000	.	3600	.	127	.	200000	.	150	.
33	1	36500	.	31400	.	5100	.	37	.	800000	.	150	.
39	1	39200	.	30700	.	8500	.	136	.	.	.	83	.
45	1	45300	.	37400	.	7900	.	29	.	37500	.	86	.
51	1	40300	.	34100	.	6200	.	99	.	350000	.	120	.
57	1	48600	.	39300	.	9300	.	165	.	133333	.	400	.
63	1	42000	.	34900	.	7100	.	286	.	100000	.	.	.
SOURCE=pc SITE=pek 1.6 SEASON=spr													
1.5	1	310	.	74	.	236	.	59	.	58071	.	774	.
4.5	1	1990	.	530	.	1460	.	.	.	.	.	.	.
9	1	13000	.	10400	.	2600	.	10	.	36238	.	163	.
15	1	29700	.	26500	.	3200	.	.	.	.	.	.	.
21	1	39200	.	32600	.	6600	.	.	.	.	.	.	.
27	1	43500	.	37700	.	5800	.	.	.	.	.	.	.
33	1	57700	.	46400	.	11300	.	.	.	.	.	.	.
39	1	66000	.	50100	.	15900	.	.	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
SOURCE=pc SITE=pck 1.6 SEASON=sum													
1.5	3	256	50.48	8.17	2.75	247.83	49.64	1718	304	20909	0	214	0
4.5	3	1766.67	566.6	273.67	292.92	1493	279.07	541	210	47692	0	174	0
9	3	15486.67	6568.9	9563.33	9371.7	5923.33	7003.5	45	14	10952	0	159	0
15	3	36280	2000.3	25600	12972	10680	14603	44	5	31633	0	195	0
21	2	45105	5239.7	40900	3535.5	4205	1704.1	38	0	10588	0	180	0
27	3	54016.67	5510.5	38800	20524	15216.67	23890	33	5	12105	0	175	0
33	2	56950	4454.8	55555	4179	1395	275.77	39	0	10526	0	168	0
39	3	58233.33	5720.4	43326.67	24234	14906.67	19681	34	17	14091	0	178	0
45	2	56225	883.88	52100	1555.6	4125	2439.5	45	0	10714	0	178	0
51	3	53540	12795	39033.33	19810	14506.67	11291	44	9	17059	0	113	0
57	2	60730	13817	57050	12657	3680	1159.7	34	0	16154	0	175	0
63	3	53680	6784.3	39233.33	19474	14446.67	20883	30	8	12500	0	154	0
69	2	52220	10720	47600	4808.3	4620	5911.4	45	0	15000	0	187	0
75	1	57600	.	49000	.	8600	.	.	.	.	.	.	.
SOURCE=pc SITE=pck 1.6 SEASON=sum													
81	1	49900	.	46600	.	3300	.	.	.	.	.	.	.
87	1	38800	.	38700	.	100	.	.	.	.	.	.	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN_KD	MS_KDS
SOURCE=pc SITE=pek 1.6 SEASON=win													
1.5	1	170	.	10	.	160	.	.	.	.	.	.	.
4.5	1	2170	.	1380	.	790	.	.	.	.	.	.	.
9	1	18000	.	10800	.	7200	.	.	.	.	.	.	.
15	1	30300	.	22800	.	7500	.	.	.	.	.	.	.
21	1	45600	.	31500	.	14100	.	.	.	.	.	.	.
27	1	51100	.	39200	.	11900	.	.	.	.	.	.	.
33	1	61300	.	43700	.	17600	.	.	.	.	.	.	.
39	1	61400	.	46800	.	14600	.	.	.	.	.	.	.
45	1	64800	.	51400	.	13400	.	.	.	.	.	.	.
51	1	82200	.	52600	.	29600	.	.	.	.	.	.	.
57	1	59800	.	52900	.	6900	.	.	.	.	.	.	.
63	1	61000	.	49400	.	11600	.	.	.	.	.	.	.
69	1	68600	.	56000	.	12600	.	.	.	.	.	.	.
75	1	55600	.	52600	.	3000	.	.	.	.	.	.	.
SOURCE=umcb SITE=mebk 0.7 SEASON=sum													
1.5	1	4350	.	2037.5	.	2312.5	.	264	.	41379	.	396	.
4.5	1	4300	.	2405.3	.	1894.7	.	186	.	65789	.	242	.
9	1	5000	.	2581	.	2419	.	179	.	12632	.	220	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN_KD	MS_KDS
15	1	5410	.	2960	.	2450	.	321	.	11200	.	356	.
21	1	4160	.	1934.9	.	2225.1	.	321	.	9630	.	343	.
27	1	4370	.	1876.1	.	2493.9	.	254	.	7576	.	270	.
33	1	3780	.	1534.7	.	2245.3	.	494	.	7027	.	279	.
39	1	4950	.	1223.9	.	3726.1	.	221	.	3375	.	224	.
45	1	4170	.	1128.5	.	3041.5	.	310	.	3043	.	213	.
51	1	5410	.	1414.5	.	3995.5	.	175	.	.	.	.	.
57	1	4770	.	1222.9	.	3547.1	.	84	.	.	.	.	.

SOURCE=umcb SITE=mebk 0.7 SEASON=win													
1.5	1	232	.	38.3	.	193.7	.	3107	.	138889	.	1600	.
4.5	1	1610	.	637	.	973	.	522	.	34667	.	389	.
9	1	2390	.	579	.	1811	.	341	.	6000	.	250	.
15	1	1990	.	967	.	1023	.	530	.	17143	.	369	.
21	1	1950	.	868	.	1082	.	664	.	11250	.	413	.
27	1	2120	.	717	.	1403	.	560	.	9630	.	329	.
33	1	1990	.	801	.	1189	.	597	.	7879	.	258	.
39	1	3140	.	1120	.	2020	.	323	.	2680	.	180	.
45	1	2850	.	1100	.	1750	.	454	.	1263	.	145	.
51	1	3170	.	1230	.	1940	.	421	.	923	.	148	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN KD	MS KDS
57	1	3560	.	1240	.	2320	.	199	.	690	.	168	.
SOURCE=umcb SITE=mcbk 0.85 SEASON=sum													
1.5	1	1280	.	263.6	.	1016.4	.	344	.	43333	.	836	.
4.5	1	3550	.	1528.4	.	2021.6	.	113	.	4333	.	131	.
9	1	6700	.	2776.5	.	3923.5	.	70	.	14607	.	248	.
15	1	4520	.	2238	.	2282	.	103	.	8333	.	271	.
21	1	4560	.	2403.5	.	2156.5	.	97	.	5294	.	204	.
27	1	4910	.	2505.3	.	2404.7	.	128	.	5946	.	235	.
33	1	6820	.	2612.5	.	4207.5	.	106	.	3636	.	175	.
39	1	7360	.	2862.2	.	4497.8	.	78	.	20000	.	221	.
45	1	6620	.	2572.6	.	4047.4	.	73	.	2817	.	190	.
51	1	2150	.	602.8	.	1547.2	.	143	.	3448	.	355	.
SOURCE=umcb SITE=mcbk 0.85 SEASON=win													
1.5	1	308	.	77.5	.	230.5	.	1560	.	81250	.	51000	.
4.5	1	1220	.	454	.	766	.	394	.	93333	.	2250	.
9	1	1770	.	640	.	1130	.	226	.	62500	.	638	.
15	1	1800	.	362	.	1438	.	341	.	9048	.	219	.
21	1	2210	.	778	.	1432	.	332	.	7407	.	237	.
27	1	2270	.	721	.	1549	.	194	.	3065	.	227	.

Table B.1 (continued)

SED_Z	ASIN	ASI_PW	ASI_PWS	AS3_PW	AS3_PWS	AS5_PW	AS5_PWS	AS_KD	AS_KDS	FE_KD	FE_KDS	MN_KD	MS_KDS
33	1	1870	.	1060	.	810	164	.	1500	.	176	.	.
37.5	1	1070	.	589	.	481	.	.	.	.	.	.	.
39	0	.	.	.	.	.	187	.	947	.	158	.	.

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