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# EXECUTIVE SUMMARY

Approximately 180 surface-sediment grab samples and three sediment cores were obtained from the Clinch River-Poplar Creek system around the Oak Ridge Gaseous Diffusion Plant (K-25) and screened for metal, organic, and radioisotope contamination. The results of this scoping study were evaluated to identify potential sources of contamination.

Data from this study indicate that Hg, $^{137}Cs$, and $^{60}Co$ originate from sources outside K-25. External sources also contribute uranium and miscellaneous organic contamination. Within K-25, the K1700 stream, K901A chromate pond, K710A powerhouse, and K1007B pond appear to be the major areas of contamination. Principal contaminants detected in these areas as a result of this survey were U, Cr, Ni, Cu, Ag, and PCBs.

Although the major areas of contamination have been identified, this report does not attempt to identify the specific sources within K-25 nor to quantify the impact of K-25 sources on the major streams.

# 1. INTRODUCTION

The Oak Ridge Gaseous Diffusion Plant (K-25) is one of three large, industrial facilities located on the Oak Ridge Reservation. K-25 has been involved in the production of enriched uranium since 1944. Supporting the uranium enrichment operation are chemical process facilities, research and development laboratories, and a large maintenance force. The support activities generate a wide spectrum of wastes, including metals and organic compounds. These wastes have been generated, stored, and disposed of in several areas around the plant.

A survey of sediments in the streams surrounding the K-25 plant has been conducted to identify sites from which pollutants have historically entered or may currently be entering the surface water. Previous studies (DOE 1979; Hoffman et al. 1984) have attempted to address the general extent of sediment contamination around K-25 and the Oak Ridge Reservation. This study identifies areas surrounding the K-25 site where contaminant levels are high enough to indicate the possible presence of a contamination source--for example, seepage from a surface impoundment. Results from this survey may be used in conjunction with groundwater monitoring data and information on current and historic waste management practices to identify specific sources of contamination.

Due to the absence of established standards for contaminant levels in sediments, no attempt is made in this study to characterize any areas as being hazardous.

From January 10, 1985, through February 28, 1985, approximately 180 surface-sediment grab samples and three sediment cores were collected in the Clinch River-Poplar Creek system and several ponds, discharge pipes, and ephemeral streams on the K-25 site. Every effort was made to obtain samples of recently deposited material, so that the results would indicate current conditions at the plant. The presence of $^{7}$Be (a naturally-occurring, 53-d half life radionuclide) was used to indicate whether the samples were of recent origin.

The K-25 Process Support Department screened the samples for metals using inductively coupled plasma spectroscopy (ICP), for PCBs using gas chromatography (GC), and for other organics using a gas chromatograph-mass spectrometer (GC-MS). The samples were also analyzed for gamma-emitting radioisotopes by the ORNL Environmental Sciences Division.

Results of this study are presented in two parts. The first part, consisting of results from the 180 grab samples, yields a picture of current contaminant levels around the K-25 site. The second part, which addresses the three cores, presents a historical perspective of sediment contamination around K-25.

# 2. METHODOLOGY

## 2.1 SAMPLE COLLECTION

Surface (fine-grained) sediment samples were collected during January and February 1985 in the Clinch River, Poplar Creek, and tributaries draining K-25. The Clinch River sampling was in the vicinity of the K-1515 sludge treatment pond, K-710A scrap yard, and K-901A holding pond (Fig. 1). Poplar Creek was sampled from its confluence with the Clinch River to about 1 km upstream of the mouth of East Fork Poplar Creek. Several samples were also collected from East Fork Poplar Creek. Sampling along Poplar Creek and its tributaries was intensified near all water effluent sites and surrounding disposal areas (Fig. 1). Particular attention was given to the K-1700 stream, which drains areas near the K-1407 holding ponds, coal pile, and the classified burial ground.

The fine-grained sediment sample collected at each site was split into two subsamples. One was hermetically sealed in a 100 $cm^3$ aluminum can (plastic lined), and the other subsample was homogenized and placed in a 225 $cm^3$ (8 oz.) glass jar, sealed with teflon and aluminum foil. Two sediment cores were also collected at each of three sites, using a vibracorer (Lanesky et al. 1979) equipped with a 7.6-cm (3-in.) diam aluminum core pipe. One of the core sites was at the confluence of East Fork Poplar Creek into Poplar Creek (upstream of the K-25 facilities but downstream of the Y-12 Plant and the city of Oak Ridge). The second core site was in lower Poplar Creek near its mouth into the Clinch River (downstream of most K-25 facilities). The

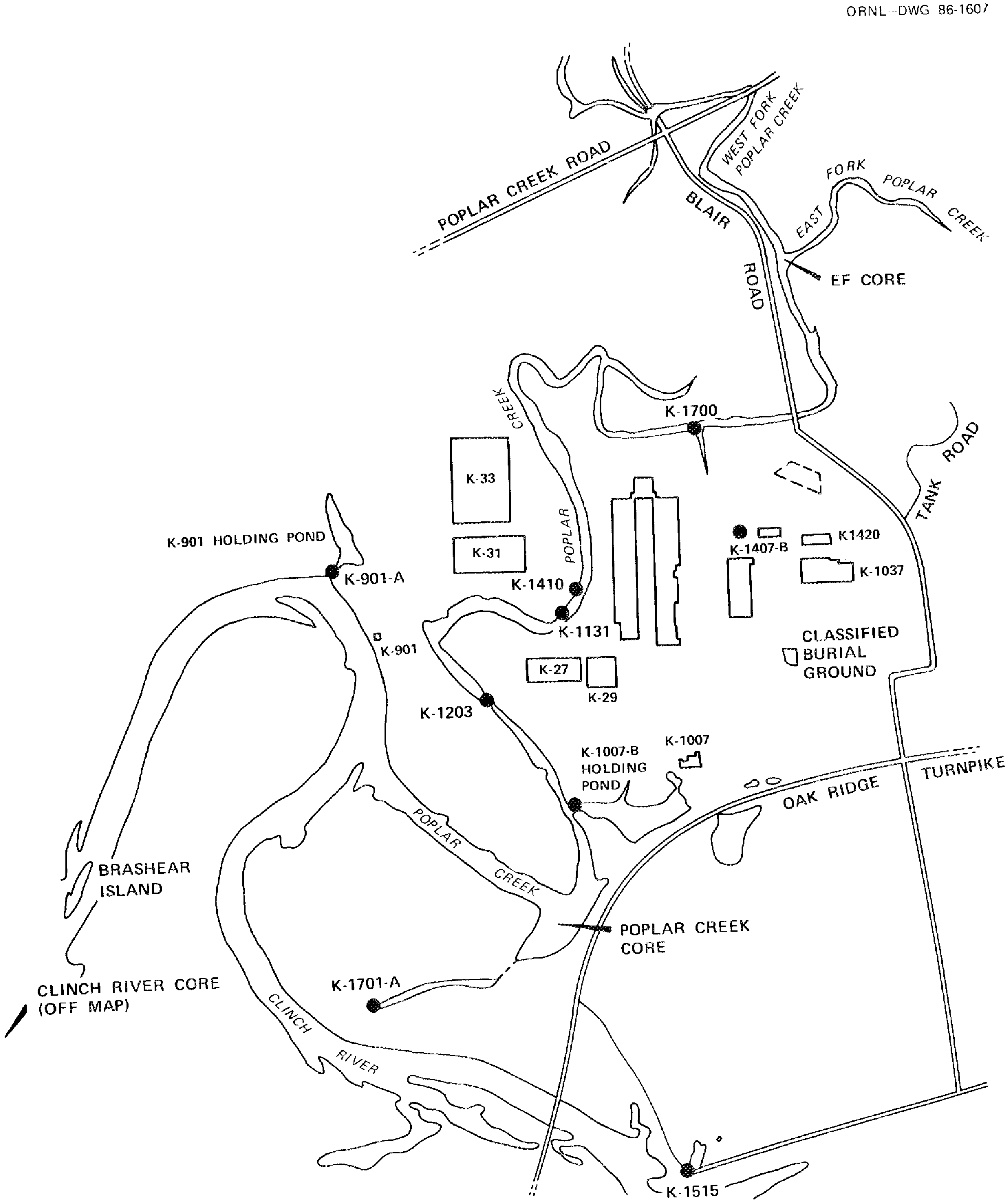


Fig. 1. Map indicating primary sampling areas

third site was in a sediment accumulation zone where the Clinch River widens into Watts Bar Lake.

One of the two cores collected at each site, was sectioned into 2-cm increments in the first 40 cm of the core and into 4-cm increments below 40 cm. These cores were used to determine the vertical distribution of radionuclides and develop a sediment chronology. The second core from each site was sectioned into 4-cm intervals above 80 cm and into 8-cm intervals below 80 cm, to provide enough sedimentary material for the metal and organic analyses. A comparison of the sedimentary structures and characteristics in the two cores during extrusion indicated that both cores could be considered duplicates at the East Fork Poplar Creek and Watts Bar Reservoir sites but not at the Lower Poplar Creek site. Consequently, both cores at the Lower Poplar Creek site were analyzed for gamma-emitting radionuclides.

## 2.2 RADIONUCLIDE ANALYSIS

Radioactivity analysis was accomplished by gamma-ray spectrometry, using either Ge(Li) or intrinsic germanium detectors. Calibration of the detectors has been previously described by Larsen and Cutshall (1981). The canned samples were counted for a period of typically 100 min using a Nuclear Data 6700 microprocessor system to acquire and store accumulated counts in 4096 channels. A modified Nuclear Data software program allows for an automated peak search routine to be performed, corrects for the presence of any background contributions (Cutshall and Larsen 1980), identifies radionuclides by their gamma-ray signature, performs activity calculations, and corrects for decay based on the elapsed time interval between the sample collection and sample analysis dates. A hard copy printout of the data was made for each sample analyzed.

Following radioactivity analysis, each sample was air dried at ~72°C for over 48 h. Radioisotope activity levels were then calculated based on dry sample weight.

Table 1 provides data for the specific radionuclides of interest. For comparison, Tables 2 and 3 illustrate radioactivity analyses performed on certified reference materials. The concentrations are corrected for decay to the date of assay.

Due to low uranium activity in many of the samples, the relatively short counting time, as well as the low photon abundance accompanying the photon decay of uranium, the lower levels of detection may not be achieved, and in such instances, a relatively large analytical uncertainty exists. For $^{235}U$ values to be considered present, at least 2 of the 3 photon peaks listed in Table 1 had to be reported on the hard copy data sheet. Minimum-detectable-activity levels (Pasternak and Harley 1971) for the various radionuclides are presented in Table 4. If any of these quantities of radioactive material were present in the samples when counted for 100 min, then 95% of the time a value greater than zero would be reported for these radionuclides. However, at these low activity levels, the relative analytical uncertainty may range from $\pm$ 40 to 100% of the value. The minimum-detectable activity depends upon matrix composition (i.e., other radionuclides present and their amount), the sample size,

Table 1. Radionuclide decay properties used in analysis

| Isotope | Photon energy (KEV) | Photon abundance (%) | Half-life |
|---|---|---|---|
| $^{7}Be$ | 477.6 | 10.3 | 53.3 d |
| $^{137}Cs$ | 661.6 | 85.1 | 30.17 years. |
| $^{60}Co$ | 1173.2 | 99.9 | 5.27 years. |
| | 1332.5 | 100.0 | |
| $^{235}U$ | 143.8 | 10.5 | 7.04E8 years. |
| | 163.4 | 4.7 | |
| | 205.3 | 4.7 | |
| $^{238}U$(as $^{234m}Pa$)[a] | 1001 | 0.92 | 4.47E9 years. |

[a]Daughter radionuclide of $^{238}U$, assumed to be in equilibrium.

Table 2. Comparison of analysis of uranium samples with certified values (pCi/g ± 1 σ)

| Sample (a) | Radioisotope | Measured | Certified |
|---|---|---|---|
| NBL-76B | $^{238}U$ @1001 | 38.8 ± 3.5 | 33.7 ± 0.3 |
| $^{235}U$ @143 | 2.6 ± 0.2 | (1.6)[a] | |
| @163 | 1.6 ± 0.3 | | |
| @205 | 1.6 ± 0.3 | | |
| CCRM-BL1 | 238U @1001 | 76 ± 12 | 75 ± 2 |
| $^{235}U$ @143 | 5.2 ± 0.7 | (3.4)[a] | |
| @163 | 4.3 ± 1.3 | | |
| @205 | 5.4 ± 1.3 | | |
| CCRM-DL1 | $^{238}U$ @1001 | 17.4 ± 2.6 | 13.7 ± 0.5 |
| $^{235}U$ @143 | 0.9 ± 0.1 | (0.6)[a] | |
| @163 | 0.7 ± 0.2 | | |
| @205 | ND | | |
| CCRM-BL4A | $^{238}U$ @1001 | 402 ± 29 | 419 ± 11 |
| $^{235}U$ @143 | 24.0 ± 1.6 | (19.3)[a] | |
| @163 | 16.3 ± 3.0 | | |
| @205 | 19.6 ± 3.0 | | |

[a]Based on an activity ratio of $^{235}U/^{238}U$ = 4.60%.

NBL: New Brunswick Laboratory, Argonne National Lab., Ill.

CCRM: Canadian Certified Reference Material, Canada Centre for Mineral and Energy Technology, Ottawa, Canada.

ND: Not detected.

Table 3. Comparison of analysis with certified reference materials (pCi/g ± 1 σ)

| Sample | | Cs-137 | K-40 | Ac-228 |
|---|---|---|---|---|
| Rocky Flats Soil #1 NBS SRM 4353 (Assay date: 15 Dec 80) | Measured | 0.49 ± 0.02 | 19.2 ± 0.1 | 1.93 ± 0.08 |
| | Expected | 0.48 ± 0.01 | 19.5 ± 0.6 | 1.89 ± 0.03 |
| | | Cs-137 | Co-60 | |
| IAEA Marine sediment SD-N-1 (Assay date: 1 Jan 82) | Measured | 0.396 ± 0.018 | 0.312 ± 0.029 | |
| | Expected | 0.378 ± 0.012 | 0.319 ± 0.012 | |

Table 4. Estimated minimum-detectable activity levels for a 100-min counting interval

| Radionuclide | MDA pCi | Concentration for an 80-g dry wt sample (pCi/g) |
|---|---|---|
| $^{7}Be$ | 18 | 0.2 |
| $^{137}Cs$ | 3 | 0.04 |
| $^{60}Co$ | 3 | 0.04 |
| $^{235}U$ | 16 | 0.20 |
| $^{238}U$ | 220 | 2.8 |

counting time, detector efficiency, geometry, and any background contributions. Thus the values reported in Table 4 should not be considered absolutes but may range by several factors, depending on the above conditions. Their purpose is to provide a general level of sensitivity expected from a typical 100-min count.

## 2.3 ELEMENTAL AND ORGANIC ANALYSES

### 2.3.1 Sample Preparation and Analysis

For organic analysis, wet subsamples of the refrigerated samples were extracted using methylene chloride and scanned for PCBs and insecticides using GC. Selected samples were further analyzed by GC-MS using a Hewlett-Packard HP 5985-B. Organic priority pollutants were identified and quantified using computer-assisted software coupled with spiked internal standards in each sample.

Elemental analysis (except for mercury) was performed by emission spectroscopy, using a Jarrel-Ash ICP 9000 spectrophotometer.

Approximately 10 g of dried material was placed in a 50 $cm^3$ plastic jar along with a pea-sized plastic impact bead and shaken vigorously for several hours to pulverize the dried sample. One gram of this material was then digested using EPA Method 3050. For the elements Ag, Sb, and Sn, a diluted form of "aqua regia" was used, and for the other elements, a 2% nitric acid solution along with hydrogen peroxide was used. Following digestion, the samples were filtered through #42 Whatman filter paper, and the residue on the filter was discarded. Reagent solutions were treated similarly to determine blank contributions. The analyte solution was then transferred to 100-mL containers and diluted with a 10% nitric acid solution.

Mercury was analyzed by the EPA Method 7470, using a Fisher Atomic Absorption (AA) instrument dedicated exclusively to this analysis.

### 2.3.2 Calibration and Quality Control

Certified solutions of various elements of "Spex standards" were prepared and appropriately diluted using a 10% nitric acid for ICP analysis. A linear calibration of up to a 500-ppm concentration for various elements was performed. Sample concentrations determined beyond this range were verified using a higher concentration of standards when necessary. Table 8 (see Sect. 3.1) lists the lower detection limits expected from this type of analysis. Typical ICP accuracy from aqueous samples is $\pm$ 20% at the 2-sigma level. Quality assurance is regularly performed using an Environmental Research Associates waste water intracalibration solution. For this study, samples of National Bureau of Standards River sediment (1645 and 1646) were submitted and run. Results are illustrated in Table 5. Mercury quality assurance analysis was routinely performed by analysis of an NBS certified solution #1641B. Table 6 presents a comparison of results from duplicate analyses.

Calibration for organic analysis was performed daily using quality assurance standards from the EPA. Routine analyses of quality assurance solutions are performed monthly. Table 7 compares typical values determined by K-25 with the expected concentrations. Limits of detection for priority pollutants are given in Table 8 (see Sect. 3.1). Organics not analyzed for but, in many instances, present include light and heavy hydrocarbons.

Table 5. Analytical results for National Bureau of Standards (NBS) Samples (concentrations in µg/g)

| Element | NBS 1645 River sediment Std. | Prep No.1 | Prep No.2[a] | NBS 1646 Estuarine sediment Std. | Prep No.1 | Prep No. 2 |
|---|---|---|---|---|---|---|
| Arsenic(As) | (66)[b] | 60 | 60 | 11.6 | 22.3 | 27.5 |
| Cadmium(Cd) | 10.2 | 8.3 | 7.6 | 0.4 | 0.7 | 0.5 |
| Chromium(Cr) | 29600 | 26300 | 27200 | 76 | 40.9 | 52.1 |
| Copper(Cu) | 109 | 106 | 112 | 18 | 16.3 | 15.6 |
| Nickel(Ni) | 45.8 | 41.3 | 50.9 | 32 | 24.5 | 27.5 |
| Lead(Pb) | 714 | 650 | 658 | 28.2 | 22.3 | 22.4 |
| Selenium(Se) | (1.5) | NR[c] | NR | (0.6) | <5 | <5 |
| Zinc(Zn) | 1720 | 1490 | 1510 | 138 | 109 | 115 |

[a]Prep #2 is a duplicate of Prep #1. Both preparations followed EPA procedure 3050.
[b]Numbers in parentheses are noncertified results.
[c]NR means value was not reported.

Table 6. Duplicate analytical results for metals

| Element | Number of duplicates[a] | Sample mean (µg/g) | Duplicate mean (µg/g) |
|---|---|---|---|
| Silver (Ag) | 3 | 5.0 | 4.9 |
| Arsenic (As) | 1 | 9.6 | 5.6 |
| Cadmium (Cd) | 0 | | |
| Chromium (Cr)[b] | 4 | 36.8 | 36.5 |
| Copper (Cu) | 4 | 30.5 | 31.2 |
| Mercury (Hg) | 3 | 3.8 | 3.7 |
| Nickel (Ni) | 5 | 42.0 | 40.8 |
| Lead (Pb) | 5 | 20.3 | 20.3 |
| Selenium | 5 | 142 | 140 |
| Zinc (Zn) | 5 | 138 | 126 |

[a]Includes only those samples for which a given element was detected.
[b]Does not include sample/duplicate pair from K901A chromate pond. Results of this pair were 1400 µg/g vs 1200 µg/g.

Table 7. Organic - Typical control data from USEPA environmental monitoring and support lab - Cincinnati (Samples WP-482 and WP-881 Received 7/26/85)

| Component: WP-482 (base neutrals) | Measured conc. (µg/L) | Acceptable range (µg/L) | EPA certified value (µg/L) |
|---|---|---|---|
| 1,4-Dichlorobenzene | 16 | (9-24) | 24.8 |
| Bis (2-chloroisopropyl) ether | 29 | (9-24) | 38.8 |
| Hexachloroethane | 15 | (9-24) | 30.0 |
| Nitrobenzene | 52 | (9-24) | 76.5 |
| Naphthalene | 15 | (9-24) | 24.8 |
| Dimethyl phthalate | 13 | (9-24) | 40.0 |
| Acenaphthylene | 14 | (9-23) | 19.5 |
| Fluorene | 36 | (9-23) | 51.2 |
| 4-Chlorophenol phenyl ether | 35 | (9-23) | 76.7 |
| 4-Bromophenyl phenyl ether | 35 | (9-23) | 41.5 |
| Anthracene | 30 | (9-23) | 40.0 |
| Fluoranthene | 24 | (9-23) | 29.8 |
| Butyl benzyl phthalate | 12 | (9-23) | 51.3 |
| Chrysene | 23 | (9-23) | 69.9 |
| Bis (2-ethylhexyl) phthalate | 10 | (9-23) | 29.1 |
| Benzo (b) fluoranthene | 29 | (9-23) | 40.0 |
| Benzo (a) pyrene | 21 | (9-23) | 24.9 |
| Dibenzo (a,h) anthracene | 35 | (9-23) | 40.7 |
| Benzo (g,h,i) perylene | 76 | (9-23) | 80.4 |

| Component: WP-881 (acids) | Measured conc. (µg/L) | Acceptable range (µg/L) | EPA certified value (µg/L) |
|---|---|---|---|
| 2-Chlorophenol | 29 | (8.1-37) | 30 |
| 2-Nitrophenol | 29 | (8.1-37) | 50 |
| Phenol | 43 | (12-89) | 100 |
| 2.4-Dimethylphenol | 21 | (12-89) | 30 |
| 2.4-Dichlorophenol | 40 | (12-89) | 50 |
| 2.4.6-Trichlorophenol | 19 | (12-89) | 25 |
| 4-Chloro-3-methylphenol | 52 | (17-73) | 75 |
| 2-Methyl-4,6-dinitrophenol | 210 | (17-73) | 250 |
| Pentachlorophenol | 32 | (6.8-77) | 75 |
| 4-Nitrophenol | 7 | (5-40) | 50 |

Table 8. Summary of contaminant levels

| Element/Compound | Detection limit[a] | No. of samples detected | K-25 Mean[b] | Maximum level | No. of high[c] samples |
|---|---|---|---|---|---|
| Silver(Ag) | 0.6 | 29 | 8 | 89 | 4 |
| Arsenic(As) | 5.0 | 14 | 50 | 190 | 2 |
| Cadmium(Cd) | 0.3 | 13 | 2 | 5 | 2 |
| Chromium(Cr) | 1.0 | 51 | 69[d] | 3300 | 11 |
| Copper(Cu) | 0.4 | 51 | 94 | 470 | 12 |
| Lead(Pb) | 5.0 | 49 | 42 | 140 | 9 |
| Mercury(Hg) | 0.1 | 45 | 6 | 45 | 6 |
| Nickel(Ni) | 1.0 | 52 | 220 | 1300 | 13 |
| Selenium(Se) | 5.0 | 38 | 91 | 280 | 5 |
| Zinc(Zn) | 0.1 | 52 | 250 | 990 | 8 |
| | | | | | |
| Total organic carbon | | 180 | 3 | 65 | 4 |
| PCB 1254 | 1.0 | 5 | 7 | 13 | 1 |
| PCB 1260 | 1.0 | 2 | 4 | 5 | 1 |
| Acenaphthylene | 0.004 | 7 | <1 | <1 | 0 |
| Anthracene | 0.002 | 11 | <1 | 2 | 1 |
| Benzo(a)Anthracene | 0.008 | 3 | 1 | 2 | 1 |
| Bis(2-ethylhexyl)phthalate | 0.003 | 23 | 7 | 97 | 2 |
| Chrysene | 0.003 | 4 | 2 | 3 | 1 |
| di-N-butylphthalate | 0.003 | 19 | <1 | 1 | 0 |
| Fluoranthene | 0.002 | 23 | 1 | 10 | 4 |
| Phenanthrene | 0.005 | 23 | 1 | 7 | 4 |
| Pyrene | 0.002 | 24 | 1 | 12 | 4 |
| | | | | | |
| $^{137}$Cesium | 0.04 | 178 | 2 | 15 | 32 |
| $^{60}$Cobalt | 0.04 | 111 | <1 | 2 | 15 |
| $^{238}$Uranium | 2.8 | 40 | 30 | 254 | 8 |
| $^{235}$Uranium | 0.2 | 25 | 4 | 20 | 6 |

[a]Units of measurements are percentage for total organic carbon, µg/g for metals and organics, and pCi/g for radioisotopes. All units are based on dry weight.

[b]The K-25 mean is calculated as the average level of those samples in which a particular element or compound was detected.

[c]"High" is defined as 150% of the K-25 mean or 1µg/g, whichever is greater. For total organic carbon, the threshold is 10%

[d]The K-25 mean for Cr does not include samples from the Chromate Pond.

# 3. RESULTS AND DISCUSSION

## 3.1 SEDIMENT GRAB SAMPLES

Table 8 presents a general summary of contaminant levels for the 182 sediment grab samples (including the top 4 cm of three cores). All 182 samples were analyzed for total organic carbon (TOC) screened for PCBs and counted for radioisotopes. Fifty-two samples were analyzed for metals by ICP and AA. Thirty-two samples were analyzed by GC-MS for extractable organics.

Although the ICP and GC-MS analyses cover a wide range of elements and compounds, this study focused on those contaminants identified by Hoffman et al. (1984, Table VII) as warranting further study on the Oak Ridge Reservation. Hoffman et al. (1984) made this determination based on those contaminants for which an estimated level of intake exceeded the estimated allowable daily intake and which were found in concentrations above minimum detectable limits. The organics list for this study was reduced further by elimination of those components which were not found at levels above detectable limits at K-25.

The K-25 mean for each contaminant represents the average level of all samples for which that contaminant was detected. For example, the K-25 silver mean was determined by averaging the silver content of the 29 samples in which silver was detected.

The K-25 mean provides a basis for determining which samples have relatively high levels of a particular contaminant. The K-25 mean, rather than the background level, is used because the objective is to determine which samples are high for K-25, not to determine which samples are high relative to background. Using the K-25 mean facilitates identification of those areas around the K-25 site which may be sources of contamination.

The number of high samples is based on those samples which exceeded 150% of the mean. For some of the organics, 150% of the mean would still have been less than 1 ug/g, so the number of high samples was based on those exceeding 1 ug/g. For total organic carbon, the threshold was set at 10%. Tables 9, 10, and 11 respectively present the samples that were determined to be high for metals, organics, and radioisotopes. It must be remembered that this is purely an arbitrary designation to determine those areas that are potential sources of contamination. In the absence of definitive standards and further study, no statement can be made about the potential environmental effects, if any, of these contaminant levels. Following is a discussion, by area, of the grab sample results.

The K-901A chromate pond (Fig. 1 and Appendix A, p. A-13) sediments are high in chromium, as would be expected to result from the chromate wastes that have settled in this pond. The reason for the high zinc and selenium levels is not readily apparent, unless these elements are part of the proprietary formula of the chromate corrosion inhibitor used in the recirculating cooling water systems.

The samples identified in Table 9 as being from the Classified Burial Ground were actually taken from ephemeral streams on the north (42) and southeast (216) slopes of the burial ground hill (Fig. 1 and Appendix A, pp. A-4 and A-14). Sample 42 appears to be in the

Table 9. Areas of metal contamination exceeding 150% of K-25 mean

| Area/sample No. | Metals (ug/g) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
| Chromate pond | | | | | | | | | | |
| SS020785-124 | <0.6 | <5 | <0.3 | 740 | 9 | 0.3 | 27 | 17 | 120 | 230 |
| SS020785-125 | <0.6 | <5 | <0.3 | 2800 | 28 | <0.2 | 10 | 8 | <5 | 990 |
| SS020785-126 | 1.2 | <5 | <0.3 | 1600 | 8 | 0.6 | 5 | 8 | <5 | 410 |
| SS020785-127 | <0.6 | <5 | <0.3 | 250 | 0 | 1.1 | 2 | 5 | <5 | 350 |
| SS020785-130 | 1.5 | <5 | <0.3 | 3300 | 8 | 0.6 | 6 | 5 | <5 | 900 |
| SS020885-132 | 1.8 | <5 | <0.3 | 410 | 5 | <0.1 | 20 | 14 | 110 | 140 |
| SS020885-133 | <0.6 | <5 | <0.3 | 2100 | 17 | 0.9 | 26 | 16 | 88 | 560 |
| SS020885-135 | <0.6 | 9 | <0.3 | 1600 | 26 | 0.8 | 39 | 24 | 110 | 230 |
| Class. burial ground | | | | | | | | | | |
| SS020485-42 | 23.0 | <5 | <0.3 | 66 | 77 | 1.4 | 83 | 77 | 58 | 230 |
| SS022885-216 | 1.2 | <5 | <0.3 | 17 | 40 | 0.9 | 120 | 10 | 140 | 41 |
| Clinch River Trib 1 | | | | | | | | | | |
| SS012485-10 | <0.6 | <5 | <0.3 | 51 | 4 | 0.7 | 38 | 22 | 140 | 190 |
| East Fork Poplar Creek | | | | | | | | | | |
| SS022285-138 | <0.6 | <5 | 3.3 | 45 | 76 | 45.0 | 54 | 110 | 37 | 320 |
| EF021585(0-4) | 4.9 | <5 | <0.3 | 49 | 40 | 20.7 | 33 | 26 | 110 | 130 |
| K1007B (PC Trib 4) | | | | | | | | | | |
| SS020485-45 | 12.0 | <5 | <0.3 | 150 | 56 | <0.5 | 89 | 47 | 38 | 210 |
| SS020485-46 | 17.0 | <5 | 1.0 | 63 | 63 | <0.5 | 86 | 37 | 21 | 220 |
| K1700 Stream | | | | | | | | | | |
| SS020485-41R | <0.6 | 23 | <0.3 | 39 | 250 | <1.0 | 420 | 46 | <5 | 160 |
| SS020485-35L | <0.6 | <5 | <0.3 | 69 | 210 | 1.5 | 400 | 39 | 110 | 210 |
| SS020485-34L | <0.6 | 15 | <0.3 | 50 | 220 | 3.0 | 430 | 49 | 48 | 190 |
| SS020485-33L | <0.6 | 34 | 1.3 | 62 | 230 | 1.8 | 460 | 48 | <5 | 240 |
| SS020485-32M | 89.0 | 45 | 1.1 | 65 | 250 | 2.9 | 520 | 73 | <5 | 220 |
| SS020485-31R | <0.6 | 16 | 1.1 | 57 | 210 | 1.8 | 560 | 51 | <5 | 240 |
| SS011085-6L | 1.8 | 22 | 0.8 | 130 | 300 | 6.6 | 830 | 140 | 57 | 410 |
| SS011085-5R | 2.5 | 190 | <0.3 | 100 | 470 | 4.4 | 1200 | 100 | 280 | 450 |
| SS020485-49 | 1.4 | 33 | <0.3 | 91 | 250 | 2.1 | 1000 | 97 | 150 | 330 |
| SS011085-4L | <0.6 | 170 | 4.6 | 98 | 440 | 4.6 | 950 | 120 | <5 | 510 |
| SS011085-3L | <0.6 | 68 | 2.4 | 91 | 260 | 6.1 | 1300 | 94 | <5 | 350 |
| SS011085-2L | 1.4 | 45 | 2.2 | 88 | 260 | 6.1 | 1200 | 94 | <5 | 370 |
| SS011085-1L | <0.6 | 15 | 1.5 | 57 | 140 | 9.5 | 420 | 49 | <5 | 220 |
| Poplar Creek | | | | | | | | | | |
| SS020685-52R | 6.2 | <5 | 2.0 | 67 | 78 | 25.6 | 44 | 43 | 72 | 200 |
| SS020685-111R | <0.6 | <5 | <0.3 | 56 | 47 | 11.0 | 59 | 30 | 77 | 170 |
| SS020785-86R | 44.0 | <5 | <0.3 | 32 | 30 | 5.4 | 46 | 29 | 67 | 170 |
| SS020785-120L | 1.3 | <5 | <0.3 | 95 | 35 | 9.5 | 51 | 27 | 60 | 210 |
| SS020785-115 | <0.6 | <5 | <0.3 | 610 | 62 | <0.5 | 68 | 48 | 45 | 590 |
| SS021185-155R | 2.6 | <5 | <0.3 | 46 | 41 | 7.7 | 60 | 20 | 160 | 150 |

Table 10. Areas of organics contamination exceeding 1 µg/g or 150% of K-25 mean

| | | | | Organics[b] (µg/g) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Area/sample No. | TOC[a] (%) | PCB 1254 | PCB 1260 | 2B | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B |
| Chromate Pond | | | | | | | | | | | | |
| SS020785-125 | 1.9 | <1.0 | <1.0 | ND | ND | ND | 2.9 | ND | ND | 1.6 | 1.1 | 1.4 |
| East Fork Poplar Creek | | | | | | | | | | | | |
| SS022285-138 | 3.9 | <1.0 | <1.0 | ND | ND | 1.3 | 4.7 | 1.9 | ND | 3.1 | 2.8 | 4.0 |
| K1007B (PC Trib 4) | | | | | | | | | | | | |
| SS020485-44 | 0.9 | 6.5 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS020485-45 | ND | 12.6 | <1.0 | 0.7 | ND | ND | 0.5 | 0.5 | 0.2 | 0.9 | 0.3 | 1.2 |
| SS020485-46 | 1.4 | 3.0 | <1.0 | 0.2 | ND | ND | ND | ND | ND | ND | ND | ND |
| SS020485-47 | 1.3 | 5.2 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| K1515 | | | | | | | | | | | | |
| SS013085-16 | 64.6 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| K1700 Stream | | | | | | | | | | | | |
| SS020485-39L | 12.4 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS020485-38R | 11.4 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS020485-35L | 4.6 | <1.0 | <1.0 | ND | 2.4 | ND | ND | ND | 0.1 | 3.0 | 2.4 | 2.5 |
| SS020485-32M | 16.2 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS011085-5R | 7.3 | ND | ND | ND | 0.3 | ND | 13.9 | ND | 0.1 | 0.4 | 0.4 | 0.2 |
| Miscellaneous | | | | | | | | | | | | |
| SS022285-141 | 2.9 | 6.6 | 2.4 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Poplar Creek | | | | | | | | | | | | |
| SS020785-117 | 2.3 | <1.0 | <1.0 | ND | ND | ND | 1.8 | ND | ND | 2.6 | 2.7 | 2.4 |
| SS020785-115 | 2.9 | <1.0 | 5.0 | ND | ND | 2.1 | ND | 3.0 | 0.2 | 9.8 | 6.6 | 12.1 |
| SS021185-154R | 2.7 | <1.0 | <1.0 | ND | 0.4 | ND | 96.7 | ND | 0.1 | 0.5 | 0.7 | 0.8 |
| SS021185-155R | 2.4 | <1.0 | <1.0 | ND | 0.5 | ND | 1.2 | ND | ND | 1.1 | 1.0 | 1.6 |

ND = Not Detected

[a]TOC = total organic carbon.

[b]Organic compound codes are as follows: 2B = Acenaphthylene; 3B = Anthracene; 5B = Benzo(a)Anthracene; 13B = Bis(2-ethylhexyl)phthalate; 18B = Chrysene; 26B = di-N-Butylphthalate; 31B = Fluoranthene; 44B = Phenanthrene; 45B = Pyrene.

Table 11. Areas with radioisotope levels exceeding 150% of K-25 mean

| | Radioisotopes (pCi/g)[a] | | | | |
|---|---|---|---|---|---|
| Area/sample No. | $^{7}Be$ | $^{137}Cs$ | $^{60}Co$ | $^{238}U$ | $^{235}U$ |
| Clinch River | | | | | |
| SS013185-22 | ND | 14.90 | 0.70 | ND | ND |
| SS013085-14 | ND | 13.40 | 1.07 | ND | ND |
| SS013185-21 | 0.22 | 5.71 | 0.64 | ND | ND |
| SS021185-151L | ND | 12.82 | 1.14 | ND | ND |
| SS013185-24 | 0.81 | 7.16 | 0.49 | ND | ND |
| SS021585-166L | ND | 9.15 | 0.70 | 2.8 | 0.1 |
| SS021585-165L | ND | 6.41 | 0.19 | ND | ND |
| SS021585-164L | 0.33 | 8.57 | 0.84 | ND | ND |
| SS021585-163L | 0.85 | 7.04 | 0.55 | ND | ND |
| SS022185-208 | ND | 7.87 | 0.45 | 5.5 | 0.7 |
| SS013185-30 | 0.63 | 11.20 | 0.85 | 5.0 | 0.2 |
| SS022185-209 | ND | 12.28 | 0.77 | ND | ND |
| SS021585-162L | 0.69 | 7.22 | 0.71 | ND | ND |
| SS021585-161R | ND | 7.77 | 0.52 | ND | ND |
| SS020785-129 | 1.52 | 14.40 | 1.34 | ND | ND |
| SS020785-123 | 0.80 | 7.21 | 0.66 | ND | ND |
| SS021185-156L | ND | 8.75 | 0.61 | ND | ND |
| SS021185-157L | ND | 9.05 | 0.86 | ND | ND |
| WB021485[0-4CM] | ND | 9.70 | 0.80 | ND | ND |
| Clinch River Trib 1 | | | | | |
| SS012485-10 | ND | 3.73 | ND | ND | ND |
| SS012485-11R | 1.80 | 5.26 | 0.38 | ND | ND |
| SS012485-12R | 1.74 | 5.29 | 0.33 | ND | ND |
| SS012485-9L | ND | 5.06 | 0.39 | ND | ND |
| SS013185-23 | ND | 6.23 | 0.51 | ND | ND |
| East Fork Poplar Creek | | | | | |
| SS022185-210 | ND | 4.00 | 1.42 | ND | ND |
| SS022285-139 | ND | 3.27 | 0.94 | ND | ND |
| EF021585(0-4) | ND | 4.20 | 1.60 | 7.2 | 0.4 |
| K1515 | | | | | |
| SS013085-13 | ND | 12.90 | 1.38 | ND | ND |
| SS013085-16 | ND | 0.29 | 1.94 | ND | ND |
| SS013085-17 | ND | 10.50 | 1.35 | ND | ND |
| SS013185-18 | ND | 14.30 | 1.85 | ND | ND |
| SS013185-19 | ND | 12.60 | 1.27 | ND | ND |
| SS013185-20 | 1.42 | 11.60 | 1.67 | ND | ND |
| K1700 Stream | | | | | |
| SS020485-33L | 5.29 | 1.00 | ND | 58.5 | 3.7 |
| SS011085-6L | 2.30 | 1.14 | ND | 76.8 | 5.4 |
| SS011085-5R | 6.29 | 0.99 | ND | 145.0 | 12.8 |
| SS020485-49 | ND | 0.88 | ND | 57.1 | 7.0 |
| SS020485-48 | 6.20 | 0.85 | ND | 80.9 | 6.4 |
| SS011085-4L | ND | 1.39 | 0.20 | 254.0 | 19.5 |
| SS011085-3L | 1.61 | 1.24 | 0.8 | 82.4 | 7.1 |
| SS011085-2L | 1.83 | 1.06 | ND | 81.7 | 7.5 |
| Poplar Creek | | | | | |
| SS020685-52R | ND | 4.26 | 1.70 | ND | ND |
| SS020685-67 | 2.05 | 1.38 | 1.28 | ND | ND |
| SS020685-76 | 1.38 | 1.41 | 1.25 | ND | ND |
| SS021185-154R | 0.71 | 1.46 | 1.01 | ND | ND |
| SS020885-94R | ND | 3.30 | 0.35 | 6.8 | 0.7 |
| SS021185-155R | 4.20 | 3.49 | 0.72 | ND | ND |
| Powerhouse | | | | | |
| SS013185-28 | 0.66 | 3.03 | 0.35 | ND | ND |
| SS013185-29 | 1.91 | 3.45 | 0.17 | 12.8 | 1.2 |

ND = Not Detected

watershed for the K1700 stream, and its high silver and lead levels are consistent with similarly high levels in that stream.

The metal and organic levels shown for the Clinch River are interesting, but probably do not indicate any significant K-25 sources. Sample 165L was taken from the opposing bank of the river downstream of the Gallaher Road Bridge and upstream of the K710A powerhouse (Fig. 1 and Appendix A, p. A-11). This is a backwater area, and the reason for the relatively high selenium level is not apparent. The other sample is actually the top 4 cm of the core taken from the Clinch River near the city of Kingston. The cadmium value should be verified before the suspected source is investigated further. Sample 10 (Appendix A, p. A-12), which appears high in phthalate, is also in a backwater area below the K1515 water treatment plant. Again, the source is unclear.

The $^{137}Cs$ and $^{60}Co$ in the Clinch River are most likely from ORNL (Turner, Olsen, and Wilcox 1985). These radioisotopes are concentrated in the K1515 sludges. The radioisotope levels in Clinch River Tributary 1, which is downstream of K1515 (Fig. 1), indicate that this area is probably a backwater area, instead of a source to the Clinch River.

The metal, organic, and $^{238}U$ levels in K1007B pond (Fig. 1) may be attributable to lab drains which are reported to empty into this pond (J. E. Stone, personal interview, February 1985).

High levels of uranium isotopes, Ag, Cd, Cu, Ni, and Zn in the K1700 Stream (Fig. 1 and Appendix A, p. A-4) may be due to the metal cleaning and other operations in K1420. However, since these samples generally represent recent deposition, and since drains from K1420 currently go to one or more of the K1407-B holding ponds and since K 1407-C Pond once received sediment from K-1407-B Pond (Fig. 1), some connection must exist, or must have existed in the recent past, between the ponds and the surface stream sediments.

The actual mechanism for this connection is unclear. An electromagnetic conductivity survey of the K1407C pond (R. H. Ketelle, and T. L. Ashwood, unpublished data, March 1985) indicated the presence of a groundwater plume from the pond toward the stream; however, it is by no means certain that groundwater contamination is the only source of elevated sediment levels. The K1407B pond has an overflow discharge directly into the K1700 stream. Contamination has been detected both upstream and downstream from this discharge. Another possible contamination mechanism might be breaching and/or erosion of the pond embankments. For example, there appears to be a small seep in the K1407C embankment adjacent to sample 41R (Appendix A, p. A-4).

Samples 5R, 48, and 49, collected upstream of the K1700 weir (Appendix A, p. A-4), had a visible, oily sheen. Apparently the excessive hydrocarbon levels effectively blinded the PCB scan (L. W. McMahon, personal interview, May 1985). Further analyses should be conducted.

The sources of elevated arsenic and lead levels in the K1700 stream also are unclear. High TOC and miscellaneous organics might well come from the coal pile and/or K1420 activities.

East Fork Poplar Creek appears to be a source of Cd, Pb, Hg, $^{137}Cs$, $^{60}Co$, $^{238}U$ and several organics. The Hg from East Fork Poplar Creek is evident in decreasing levels downstream in Poplar

Creek. The role of East Fork Poplar Creek as a contaminant source is discussed further in Sect. 3.2, Sediment Cores.

In addition to K1700 and East Fork there are two other areas along Poplar Creek that have high contaminant levels in the sediments. The stretch of stream that separates K31 and K27 (Fig. 1 and Appendix A, p. A-6) contains sediments having elevated levels of uranium isotopes and silver (sample points 84L, 86R, 88R, and 89R). Since the K27 area contains the purge cascade, which has an atmospheric vent, the elevated uranium levels could represent released material. However, a more likely explanation is that the uranium comes from the K1700 Stream. The silver anomaly is also consistent with K1700 sediments. It should also be noted that several anomalously high silver concentrations have been measured in the sediment core collected in the segment of Poplar Creek downstream of K27 (Appendix E).

Sediment from a pipe outfall downstream of the K27 facility (Appendix A, p. A-6, sample point 115) contains elevated levels of Cr, Zn, PCB, and various organics. PCBs do not show up in samples downstream of this point.

The K710A powerhouse area (Appendix A, p. A-10, samples 29, 204, and 207) appears to be a source of uranium contamination, although the Clinch River sediments below the powerhouse (Appendix A, p. A-9, samples 162L and 161R) do not show uranium contamination. Use of the powerhouse for storage of uranium-contaminated metal scrap from the Cascade Improvement Program may account for elevated uranium levels.

## 3.2 SEDIMENT CORES

Deposition, in association with particulate matter, is the principal mechanism for removing chemically reactive contaminants from aquatic systems (Olsen, Cutshall, and Larsen 1982), and burial by sedimentation is the principal mechanism for isolating these contaminants from contact with epibenthic and pelagic biota (Cutshall, Larsen, and Nichols 1981). Since the fine-grained sediments accumulating in river-reservoir areas generally reflect the character of the material transported or released into these areas, changes in the contaminant concentration or chemistry associated with this material generally reflect changes in contaminant input. This pollution input history is recorded in the sedimentary column and can be documented using sedimentary core data.

The concentration and vertical distribution of several radionuclides, organic compounds, and metals in the three cores collected as part of this study are illustrated in Fig. 2. The respective vertical distribution data are listed in Appendix E along with additional data for several other contaminants. It is evident from Fig. 2 and Appendix E that contaminant levels in subsurface sediments often greatly exceed concentrations near the surface, reflecting the relatively large quantities of contaminants released during the 1950s and early 1960s. Turner, Olsen, and Wilcox (1985) have shown the Hg and $^{137}Cs$ profiles in sediment cores collected from the Clinch River and Watts Bar Reservoir to be strongly correlated with documented discharge histories for Hg from the Y-12 Plant and $^{137}Cs$ from ORNL. With an independent means of determining an accurate

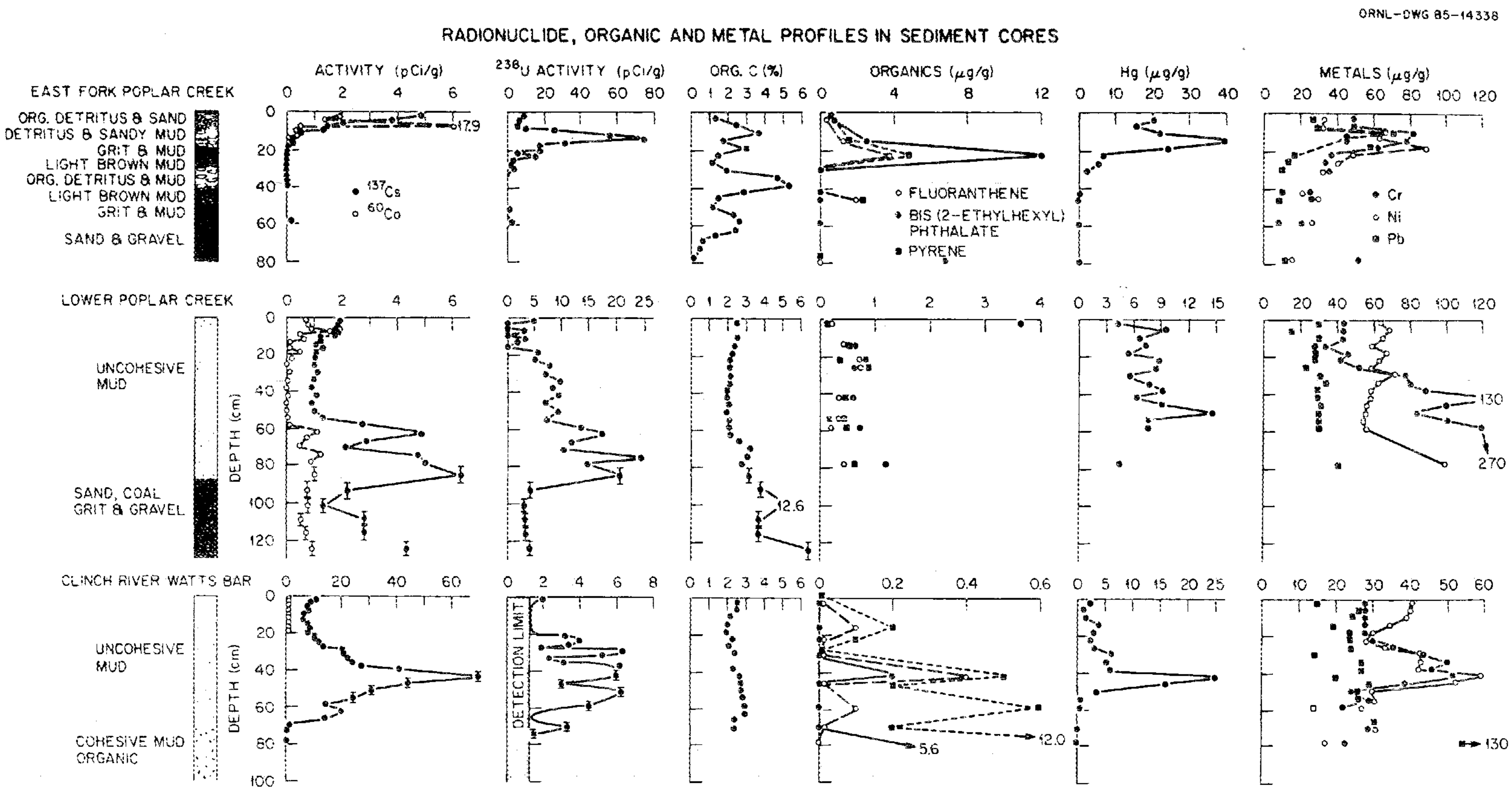


Fig. 2. Radionuclide, organic and metal profiles in sediment cores

sediment chronology (perhaps from other natural radionuclides or pollen profiles), it would be possible to estimate contaminant transport times and total contaminant retention within the Poplar Creek, Clinch River, and Watts Bar Reservoir systems, but such estimates would require several more core profiles, as well as data concerning contaminant water-to-particle distributions, an undertaking beyond the objectives of this study.

A comparison of the concentration and vertical distributions of $^{137}Cs$ and $^{60}Co$ in the East Fork Poplar Creek core with concentrations and distributions in the other two cores (Fig. 1 and Appendix E) indicates that the Y-12 Plant and the city of Oak Ridge have been relatively insignificant sources of these two radionuclides, relative to the input from ORNL via White Oak Creek and the Clinch River. The large subsurface peak of $^{60}Co$ in the East Fork Poplar Creek core at the 4- to 6-cm-depth interval, however, is an order of magnitude greater than the maximum level of $^{60}Co$ measured for the 180 surface sediment samples collected throughout the system (Table 8). This subsurface peak does not coincide with the deeper (12 to 16 cm) peak in Hg and $^{238}U$ concentration (Fig. 2) and, when compared with the $^{60}Co$ distributions in surface sediments along East Fork Poplar Creek, implies that there has been a relatively recent and large release of this radionuclide from the Oak Ridge Sewage Treatment Facility (Merritt 1984). Although ORNL is the source of most of the $^{60}Co$ in the Poplar Creek, Clinch River, and Watts Bar Reservoir system, it is apparent that this recent release from the Oak Ridge Sewage Treatment Plant has been manifested throughout the lower portion of Poplar Creek, as evidenced by the $^{60}$Co peak at the 6- to 8-cm-depth increment of the Lower Poplar Creek core (Fig. 2).

Although large variations in the sedimentary characteristics of the East Fork Poplar Creek core (Fig. 2) make it difficult to document the history of contaminant discharge accurately, the high concentrations of Hg and $^{238}$U in this core, the coincidence of their subsurface peaks, and their general decrease in concentration downstream imply that releases from the Y-12 Plant may be a significant source of both contaminants. In addition, the relatively high concentrations of Pb, Cd, Cu, Zn, and several organic compounds in this core (Appendix E) imply that discharges from Y-12 may be an important source of these contaminants relative to releases from other facilities on the Oak Ridge Reservation.

The sediments in the top 88 cm of the Lower Poplar Creek core consisted of uncohesive, fine-grained muds, exhibiting little variation in sediment texture or organic carbon (Fig. 2). Below 88 cm, to the core bottom at 128 cm, the sediments consisted of relatively coarse-grained sands, coal, slag, ash, and gravel. Although $^{137}$Cs, $^{60}$Co, and $^{238}$U concentrations sharply decreased below 88 cm, all three nuclides were nevertheless detectable to the core bottom, and organic carbon and $^{226}$Ra concentrations actually increased by a factor of 2 to 3 in the coarse-grained material below (Appendix E). We interpret this abrupt change in sedimentary characteristics to reflect the 1964 cessation of discharge associated with the operation of the K710A powerhouse on the Clinch River (Fig. 1). This powerhouse operated from the mid 1940s to 1964 (T. C. Wilson, telephone conversation, August 1985), pumping water from the Clinch River and discharging this water into Poplar Creek near the site of core collection (Fig. 1). Surface sediment samples (26 and 27, see Appendix A, p. A-10) collected along this discharge route (which is now a backwater area of Poplar Creek) were contaminated with $^{137}Cs$ (Appendix B) as a result of this pumping-discharge operation. We suggest that the coarse-grained material reflects the erosion of fine-grained material and the deposition of sand, coal, slag, and ash during discharge from the powerhouse. In addition, we suggest that the top 88 cm of fine-grained sediment reflects the accumulation of backwater muds since 1964. The high concentrations of $^{137}Cs$ and $^{60}Co$ and the relatively low concentration of Hg in the sediments between 88 and 60 cm imply that Clinch River muds formed a major component of the fine-grained material which accumulated immediately after powerhouse operation ceased in 1964. Since the major releases of both Hg and $^{238}U$ from the Y-12 Plant occurred prior to 1964 (Turner, Olsen, and Wilcox 1985), we suggest that the sharp increase in $^{238}U$ concentration at 88 cm does not reflect a large release of uranium but reflects the change in sedimentary character. We also suggest that the gradual decrease in $^{238}U$ concentrations from 88 cm to the sediment surface reflects a general decrease in the extent of $^{238}U$ contamination since 1964. In addition, the high concentrations of Ni, Ag, Cr, and Zn in the Lower Poplar Creek core relative to the other cores (Appendix E) are consistent with the surface sediment data, which indicate that the primary source of these metals is discharges from the K-25 facility. Two major uncertainties which may affect the preceding evaluation are the unknown effects of closing Melton Hill Dam (ca. 1963) and the two-way circulation patterns in Poplar Creek caused by seasonal water level fluctuations. Further study of these phenomena is required before our evaluation can be confirmed.

The Watts Bar Reservoir core was collected from an area where the Clinch River widens into Watts Bar Lake. Because Watts Bar Dam was first closed in 1942 and because reservoirs serve as efficient fine-particle and contaminant traps, this core should contain a complete pollution record, integrating discharges from all three of the DOE facilities on the Oak Ridge Reservation. Although the $^{238}U$ concentrations in the sediments of this core (Appendix E) are very near our detection limit for a 1000-min count and 80 gram sample (1.4 pCi/g), there appear to be several peaks in the $^{238}U$ concentration below 20 cm (Fig. 2). This is not consistent with data published previously by Turner, Olsen, and Wilcox (1985) which indicated that there was only one peak in the $^{238}U$ concentration and that this peak correlated with the peak levels of Hg and $^{137}Cs$. At the present time, it is still not possible to discern the relative contribution of $^{238}U$ from the K-25 facility. The strong correlation between the Hg and $^{238}U$ profile in the East Fork Poplar Creek core implies that the Y-12 facility maybe a significant source for the uranium contamination in the Poplar Creek, Clinch River and Watts Bar Reservoir system, but an examination of Hg and U peak and inventory ratios in several more cores collected downstream of the East Fork Poplar Creek site would be needed to document this with more certainty. In addition, a comparison of the $^{238}U$ peak profile in the

Watts Bar core with an accurate sediment chronology and $^{238}U$ release records from the K-25 plant would help discern the extent and history of uranium contribution from the K-25 facility.

# 4. SUMMARY AND CONCLUSIONS

Based on approximately 180 sediment grab samples and 3 sediment cores, the following areas appear to have levels of various contaminants which exceed the K-25 mean levels:

- K901A Chromate Pond--Cr, Se, Zn, and some organics;
- Classified Burial Ground--Ag, Pb, and Se;
- Clinch River--Cd, Se, $^{137}Cs$, $^{60}Co$, and $^{238}U$;
- K1007B Pond--Ag, Cd, Cr, PCB, and $^{238}U$;
- K1700 Stream--Ag, As, Cd, Cr, Ni, Pb, Se, Zn, several organics, and uranium isotopes;
- East Fork Poplar Creek--Cd, Hg, Pb, Se, several organics, $^{137}Cs$, $^{60}Co$ and $^{238}U$;
- Poplar Creek--Ag, Cd, Cr, Hg, Se, Zn, several organics, PCB, and radioisotopes;
- K710A Powerhouse--Uranium isotopes

Several conclusions can be drawn from a review of these data, including:

1. $^{137}Cs$ and $^{60}Co$ come primarily from ORNL via the White Oak Creek and the Clinch River; however, some $^{137}Cs$ and $^{60}Co$ have recently entered Poplar Creek via East Fork;
2. Although surface sediments in several areas (primarily K1700, K710A, and K27) are contaminated with uranium, the significance of these areas as sources of uranium contamination in the major streams is uncertain;
3. Mercury contamination is coming from East Fork Poplar Creek;
4. The most heavily contaminated sediments occur in the K1700 stream and the K901A chromate pond. The actual effects of these potential sources on Poplar Creek and the Clinch River are not clear.
5. PCB contamination from K1007B and the pipe outfall at K1203 do not appear to be manifested at levels greater than 1 μg/g in sediments downstream from these sites.

## 5. ACKNOWLEDGMENTS

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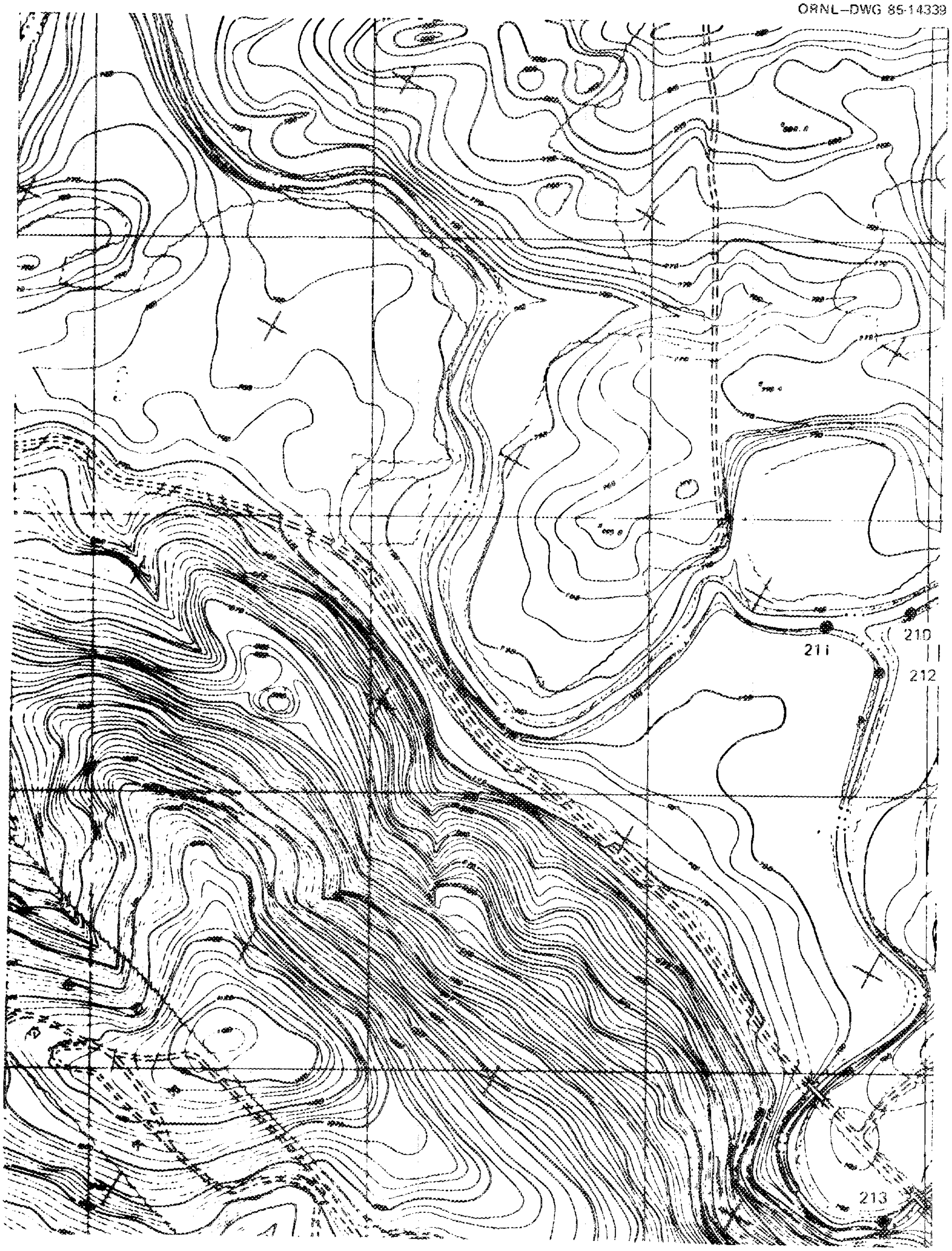
# APPENDICES

# APPENDIX A

# SAMPLE LOCATIONS

ORNL-DWG 85-14339




East Fork Poplar Creek and Bear Creek

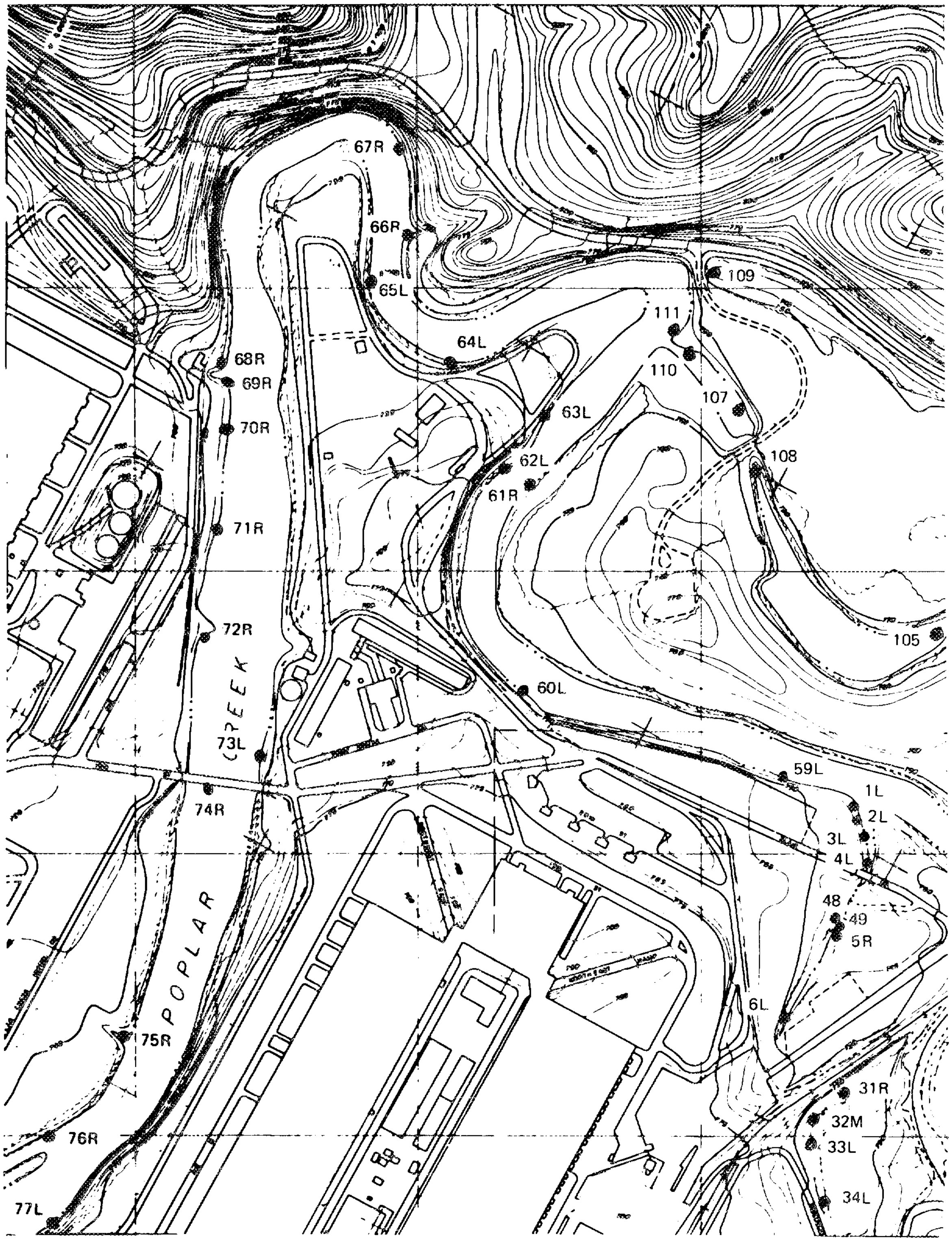
ORNL–DWG 85-14340


Upper Poplar Creek and East Fork

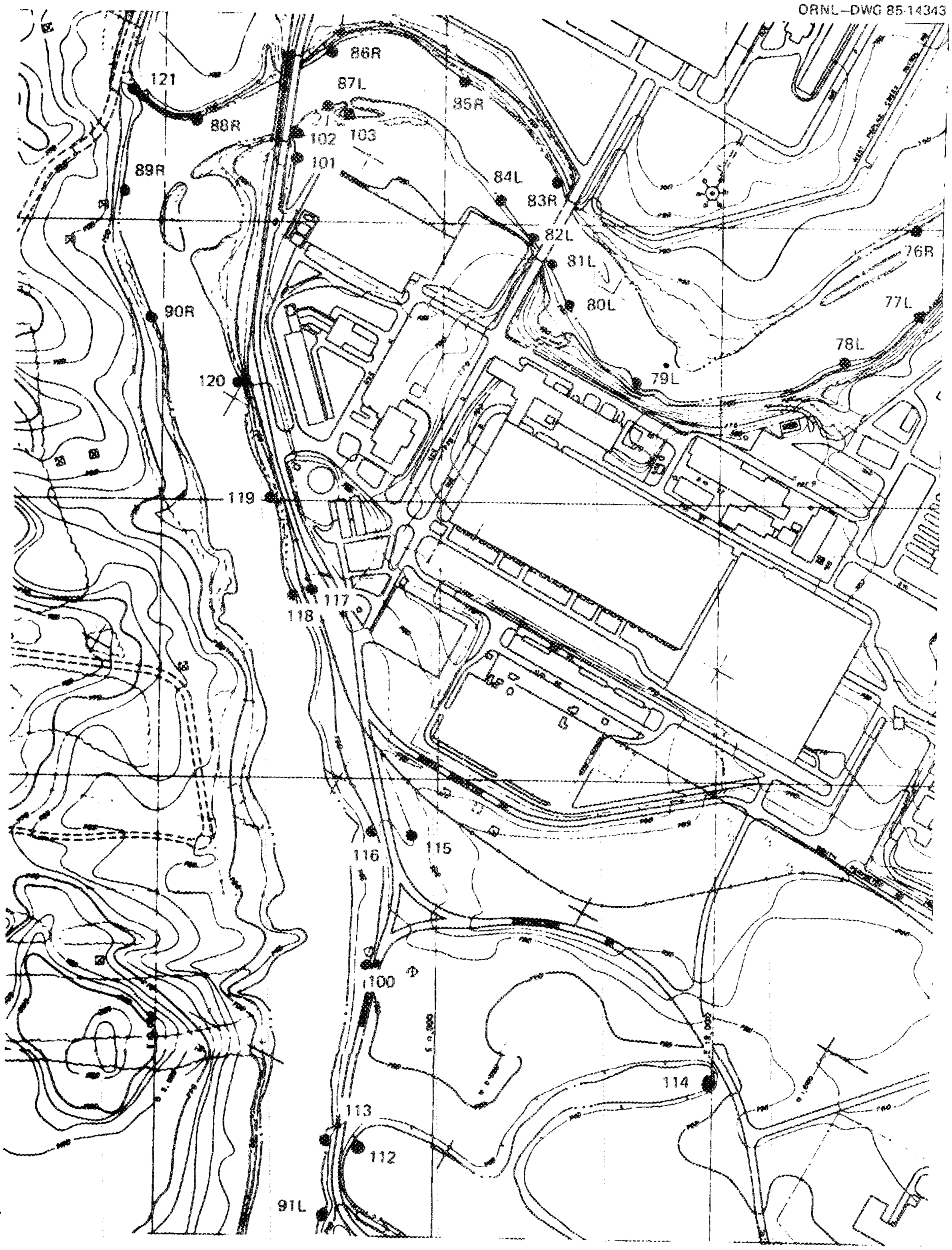
ORNL-DWG 85-14341


K1700 Stream

ORNL-DWG 85-14342

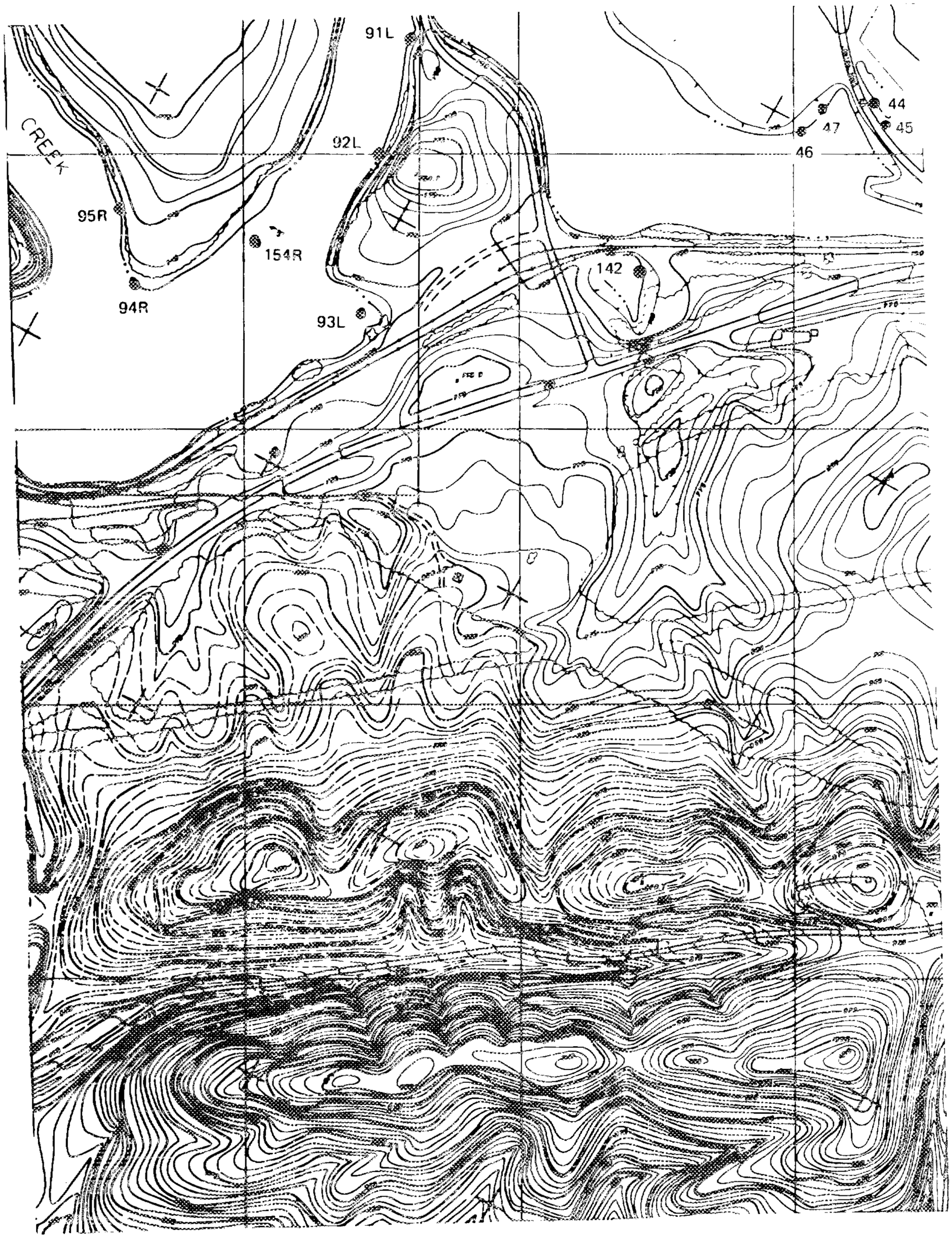



Poplar Creek

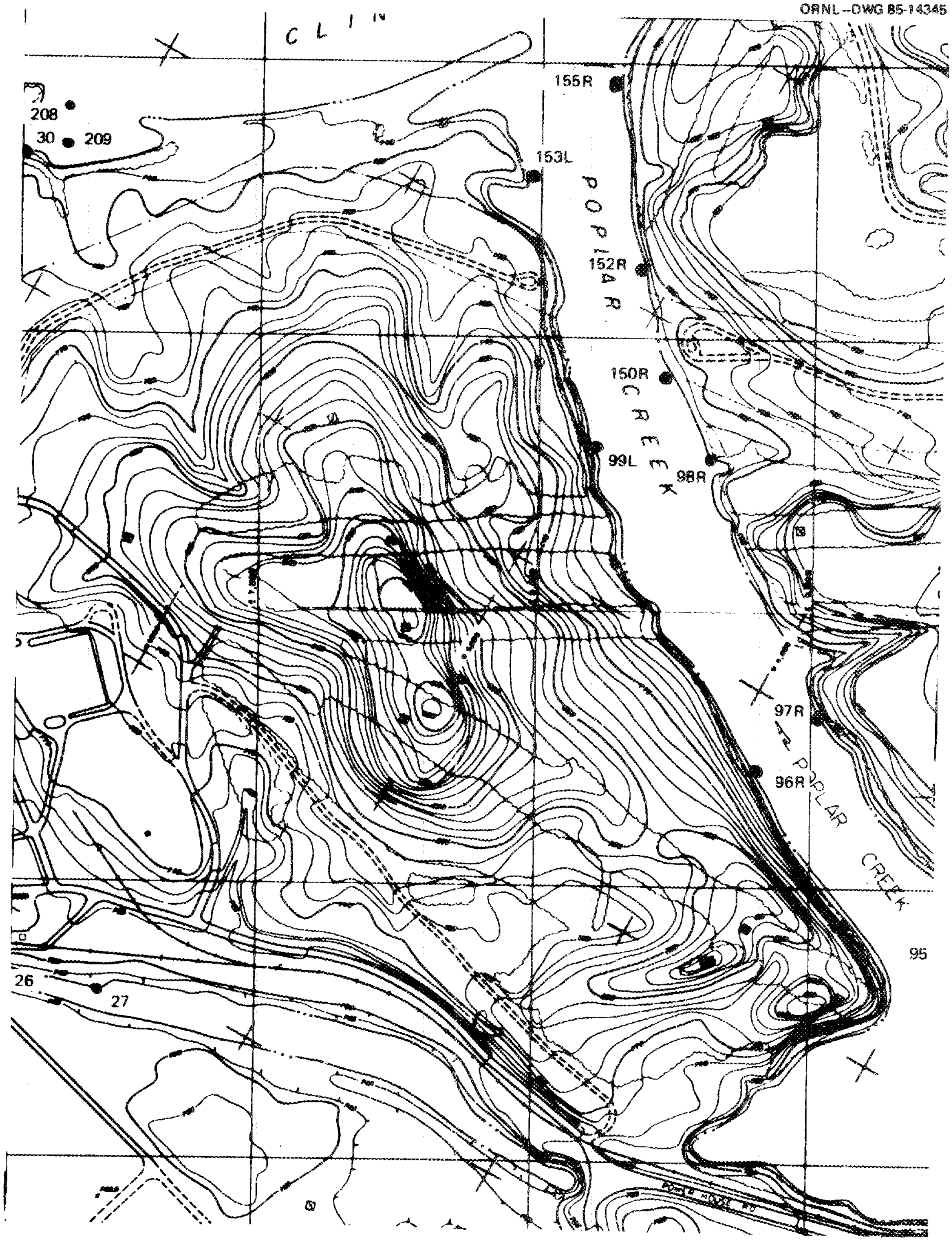



Poplar Creek

ORNL-DWG 85-14344

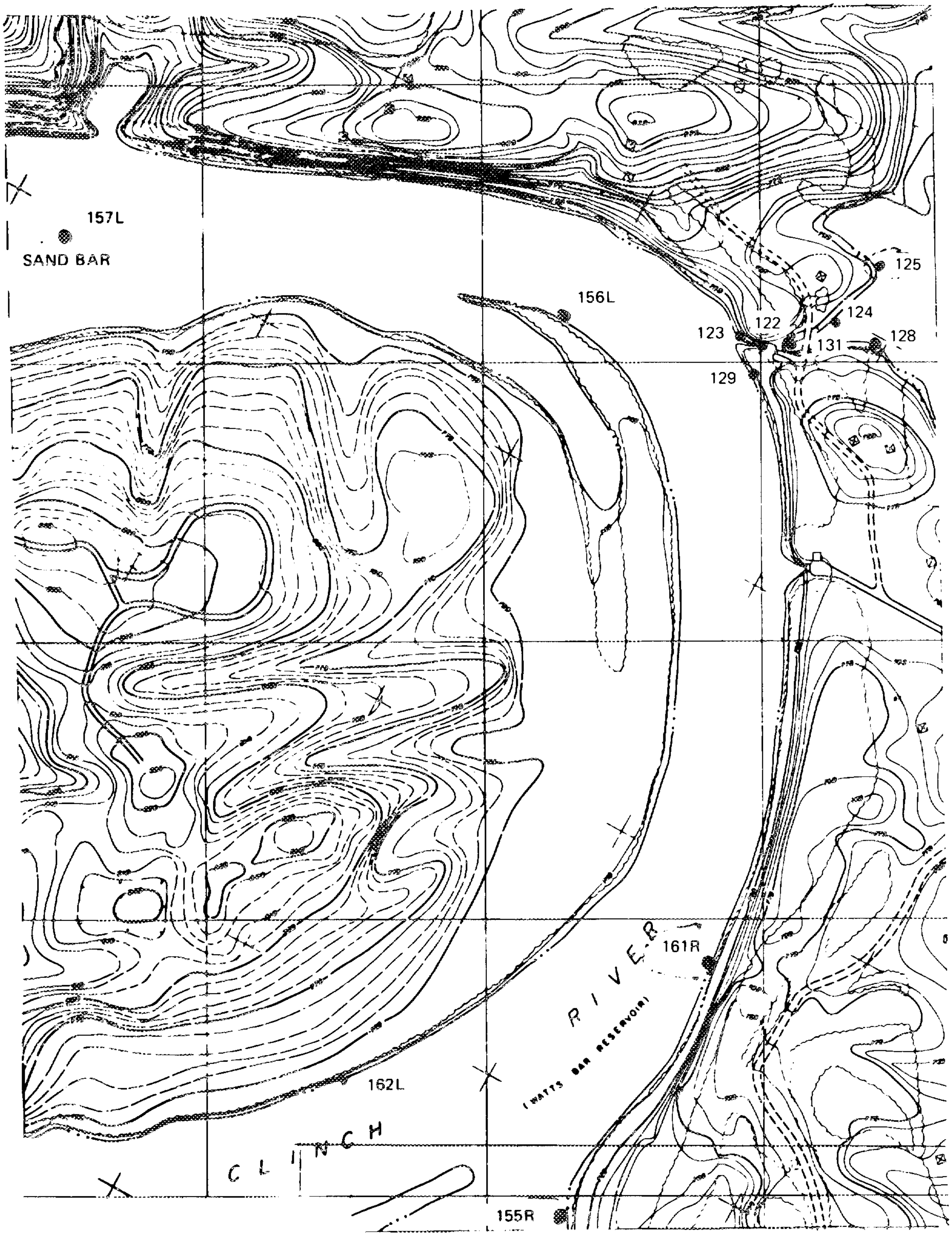



Poplar Creek and K1007B

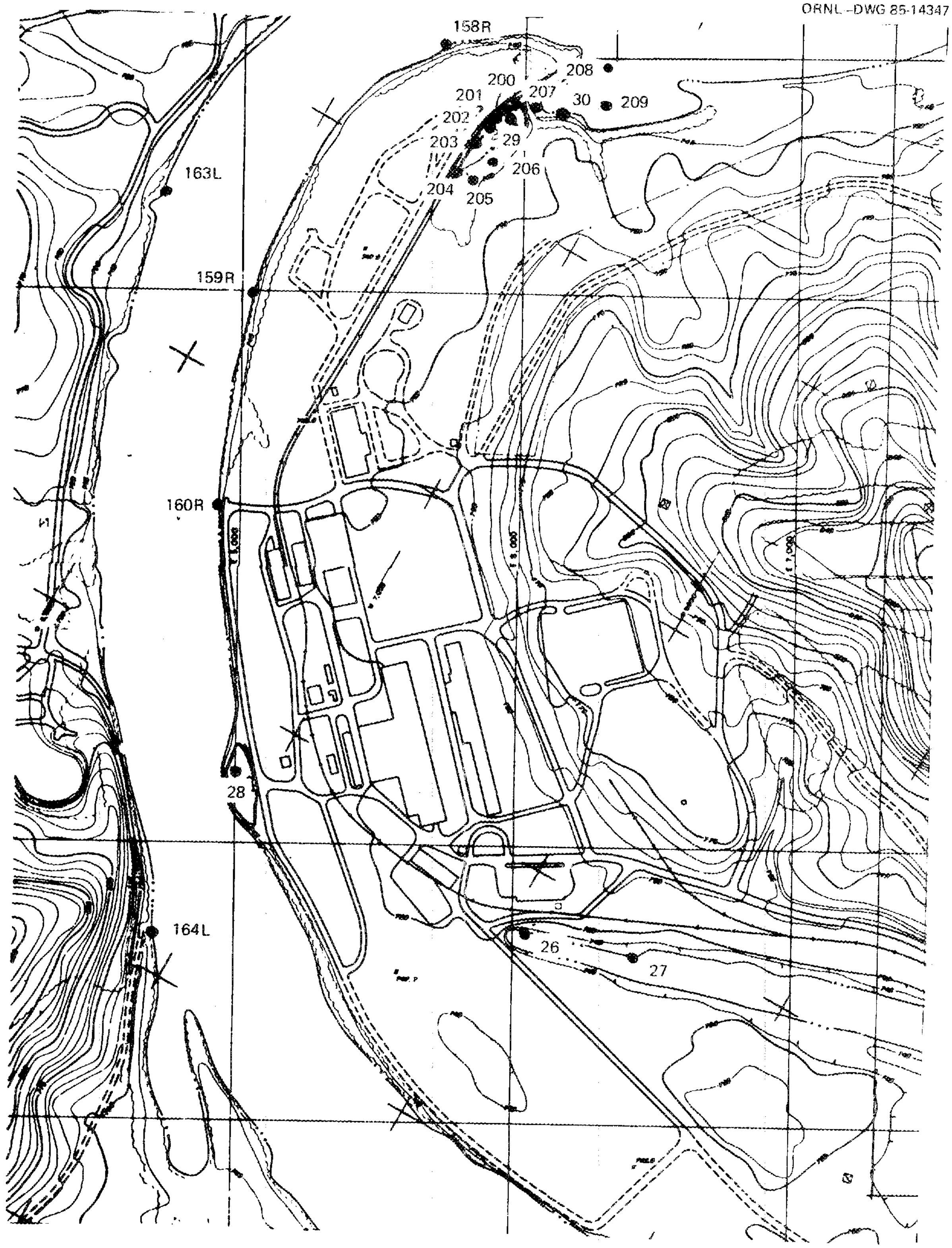



Poplar Creek

ORNL-DWG 85-14346

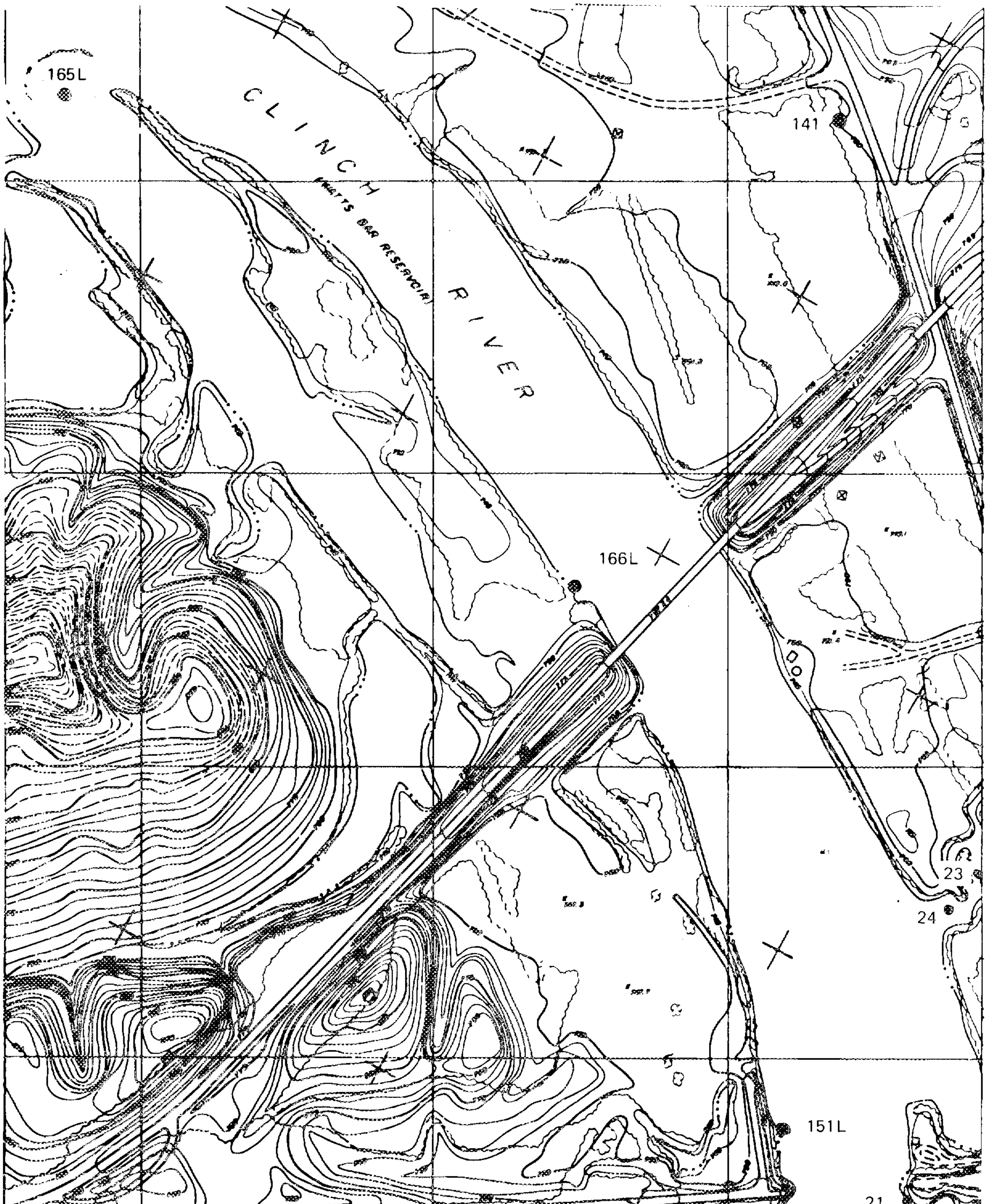



Clinch River

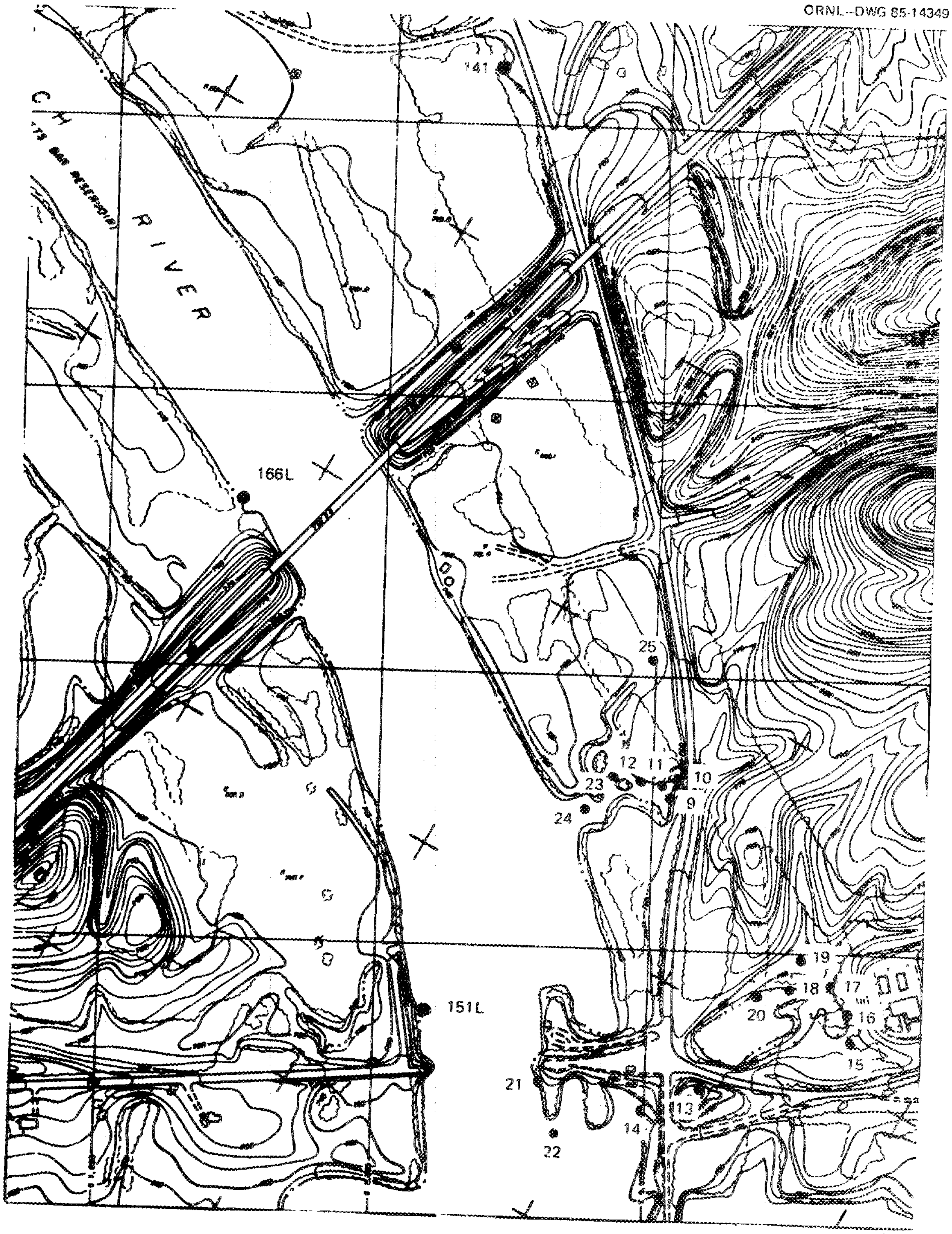



Clinch River and K710A Powerhouse

ORNL–DWG 85-14348

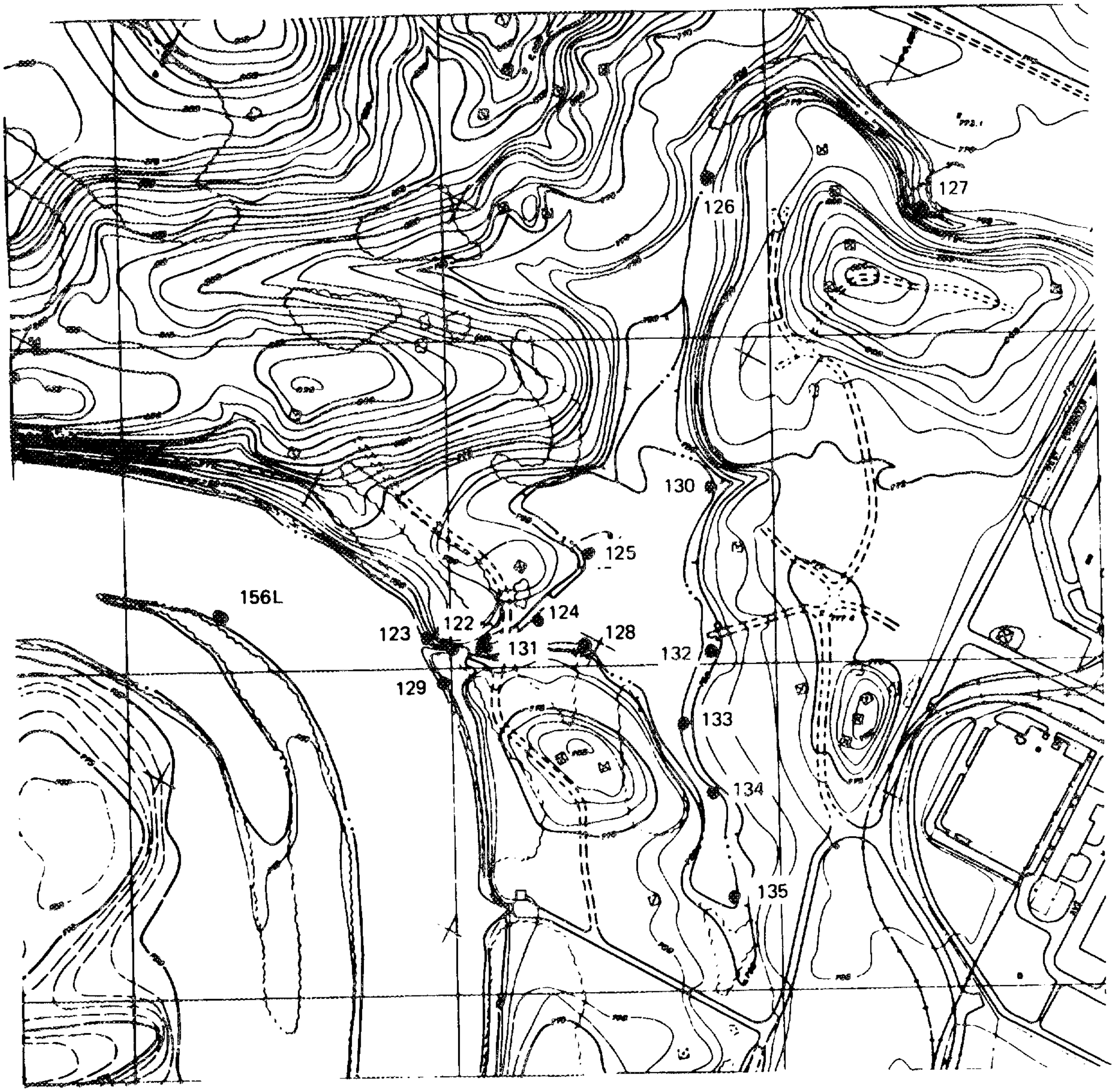



Clinch River




Clinch River and K1515

ORNL-DWG 85-14350




K-901A Chromats Pond


Miscellaneous

# APPENDIX B

# RADIOISOTOPES

# APPENDIX B

## RADIOISOTOPE DATA

| AREA/SAMPLE NO. | RADIOISOTOPES (pCi/g) | | | | |
|---|---|---|---|---|---|
| | Be7 | Cs137 | Co60 | U238 | U235 |
| CHROMATE POND | | | | | |
| SS020785-122 | 1.78 | 1.74 | .20 | 2.7 | ND |
| SS020785-124 | 1.00 | .49 | ND | ND | ND |
| SS020785-125 | 2.65 | 1.13 | .15 | 4.7 | ND |
| SS020785-126 | ND | 1.09 | .17 | ND | ND |
| SS020785-127 | ND | 1.21 | .15 | ND | ND |
| SS020785-128 | ND | .06 | ND | 2.6 | ND |
| SS020785-130 | .98 | 1.33 | .19 | ND | ND |
| SS020785-131 | 2.96 | .69 | ND | ND | ND |
| SS020885-132 | .57 | .40 | ND | ND | ND |
| SS020885-133 | 1.46 | 1.94 | .19 | ND | ND |
| SS020885-134 | ND | .63 | ND | 3.8 | ND |
| SS020885-135 | 3.04 | 1.41 | ND | ND | ND |
| CLASS. BURIAL GRND | | | | | |
| SS020485-42 | .17 | .16 | ND | 1.9 | ND |
| SS020485-43 | .56 | .15 | ND | 2.9 | ND |
| SS022885-215 | ND | .34 | ND | ND | ND |
| SS022885-216 | ND | .32 | ND | ND | ND |
| SS022885-217 | ND | ND | ND | ND | ND |
| SS022885-218 | .77 | .14 | ND | ND | ND |
| CLINCH RIVER | | | | | |
| SS013185-22 | ND | 14.90 | .70 | ND | ND |
| SS013085-14 | ND | 13.40 | 1.07 | ND | ND |
| SS013185-21 | .22 | 5.71 | .64 | ND | ND |
| SS021185-151L | ND | 12.82 | 1.14 | ND | ND |
| SS013185-24 | .81 | 7.16 | .49 | ND | ND |
| SS021585-166L | ND | 9.15 | .70 | 2.8 | .1 |
| SS021585-165L | ND | 6.41 | .19 | ND | ND |
| SS021585-164L | .33 | 8.57 | .84 | ND | ND |
| SS021485-160R | ND | 1.41 | .12 | ND | ND |
| SS021485-159 | .26 | 2.38 | .24 | ND | ND |
| SS021585-163L | .85 | 7.04 | .55 | ND | ND |
| SS021485-158R | .80 | .31 | ND | ND | ND |
| SS022185-208 | ND | 7.87 | .45 | 5.5 | .7 |
| SS013185-30 | .63 | 11.20 | .85 | 5.0 | .2 |
| SS022185-209 | ND | 12.28 | .77 | ND | ND |
| SS021585-162L | .69 | 7.22 | .71 | ND | ND |
| SS021585-161R | ND | 7.77 | .52 | ND | ND |
| SS020785-129 | 1.52 | 14.40 | 1.34 | ND | ND |
| SS020785-123 | .80 | 7.21 | .66 | ND | ND |
| SS021185-156L | ND | 8.75 | .61 | ND | ND |
| SS021185-157L | ND | 9.05 | .86 | ND | ND |
| WB021485[0-4CM] | ND | 9.70 | .80 | ND | ND |

# RADIOISOTOPE DATA

| AREA/SAMPLE NO. | RADIOISOTOPES (pCi/g) Be7 | Cs137 | Co60 | U238 | U235 |
|---|---|---|---|---|---|
| CLINCH RIVER TRIB 1 | | | | | |
| SS012485-10 | ND | 3.73 | ND | ND | ND |
| SS012485-11R | 1.80 | 5.26 | .38 | ND | ND |
| SS012485-12R | 1.74 | 5.29 | .33 | ND | ND |
| SS012485-9L | ND | 5.06 | .39 | ND | ND |
| SS013185-23 | ND | 6.23 | .51 | ND | ND |
| SS013185-25 | ND | 2.25 | .20 | ND | ND |
| EAST FORK POPLAR CR | | | | | |
| SS022185-210 | ND | 4.00 | 1.42 | ND | ND |
| SS022185-211 | ND | .15 | ND | ND | ND |
| SS022185-212 | ND | .08 | ND | ND | ND |
| SS022185-213 | ND | .19 | ND | ND | ND |
| SS022285-138 | 4.85 | 1.53 | ND | ND | ND |
| SS022285-139 | ND | 3.27 | .94 | ND | ND |
| SS022285-140 | 1.23 | 2.57 | .96 | 3.3 | ND |
| EF021585(0-4) | ND | 4.20 | 1.60 | 7.2 | .4 |
| K1007B | | | | | |
| SS022285-142 | ND | 1.00 | ND | ND | ND |
| K1007B (PC TRIB 4) | | | | | |
| SS020485-44 | ND | .36 | ND | ND | ND |
| SS020485-45 | ND | .27 | ND | ND | ND |
| SS020485-46 | 1.10 | .43 | .12 | ND | ND |
| SS020485-47 | ND | .31 | ND | 10.6 | ND |
| SS020685-114 | ND | .26 | ND | ND | ND |
| K1515 | | | | | |
| SS013085-13 | ND | 12.90 | 1.38 | ND | ND |
| SS013085-15 | ND | .68 | ND | ND | ND |
| SS013085-16 | ND | .29 | 1.94 | ND | ND |
| SS013085-17 | ND | 10.50 | 1.35 | ND | ND |
| SS013185-18 | ND | 14.30 | 1.85 | ND | ND |
| SS013185-19 | ND | 12.60 | 1.27 | ND | ND |
| SS013185-20 | 1.42 | 11.60 | 1.67 | ND | ND |
| K1700 STREAM | | | | | |
| SS011085-8R | .36 | .13 | ND | ND | ND |
| SS011085-7R | .90 | .10 | ND | ND | ND |
| SS020485-41R | ND | .37 | ND | 8.7 | .5 |
| SS020485-39L | ND | .36 | ND | ND | ND |
| SS020485-38R | .60 | .47 | ND | 2.8 | ND |
| SS020485-37R | .38 | .48 | ND | 5.2 | .6 |
| SS020485-36R | 1.42 | .36 | ND | 14.4 | .9 |
| SS020485-35L | 1.17 | .63 | ND | 30.2 | 2.1 |
| SS020485-34L | .51 | .83 | ND | 15.0 | 1.1 |
| SS020485-33L | 5.29 | 1.00 | ND | 58.5 | 3.7 |
| SS020485-32M | 1.54 | .89 | ND | 42.6 | 3.5 |

RADIOISOTOPE DATA

| AREA/SAMPLE NO. | RADIOISOTOPES (pCi/g) Be7 | Cs137 | Co60 | U238 | U235 |
|---|---|---|---|---|---|
| K1700 STREAM | | | | | |
| SS020485-31R | 2.16 | .76 | ND | 4.4 | 2.8 |
| SS011085-6L | 2.30 | 1.14 | ND | 76.8 | 5.4 |
| SS011085-5R | 6.29 | .99 | ND | 145.0 | 12.8 |
| SS020485-49 | ND | .88 | ND | 57.1 | 7.0 |
| SS020485-48 | 6.20 | .85 | ND | 80.9 | 6.4 |
| SS011085-4L | ND | 1.39 | .20 | 254.0 | 19.5 |
| SS011085-3L | 1.61 | 1.24 | .08 | 82.4 | 7.1 |
| SS011085-2L | 1.83 | 1.06 | ND | 81.7 | 7.5 |
| SS011085-1L | .51 | 1.16 | .36 | 29.4 | 2.5 |
| MISCELLANEOUS | | | | | |
| SS020885-136 | ND | .13 | ND | 3.1 | ND |
| SS020885-137 | ND | ND | ND | ND | ND |
| SS022185-214 | ND | .91 | ND | ND | ND |
| SS022285-141 | ND | .25 | ND | ND | ND |
| PC TRIB 3 | | | | | |
| SS020685-105 | .91 | .53 | ND | ND | ND |
| SS020685-106 | 1.69 | .54 | ND | ND | ND |
| SS020685-107 | ND | .67 | ND | ND | ND |
| SS020685-108 | .64 | .27 | ND | ND | ND |
| SS020685-110 | ND | 1.02 | .18 | ND | ND |
| POPLAR CREEK | | | | | |
| SS021585-137 | .60 | .16 | ND | ND | ND |
| SS021585-138R | ND | ND | ND | ND | ND |
| SS020685-50L | 1.30 | .40 | ND | ND | ND |
| SS020685-51R | 1.20 | .20 | ND | ND | ND |
| SS020685-52R | ND | 4.26 | 1.70 | ND | ND |
| SS020685-53R | 1.52 | .43 | ND | ND | ND |
| SS020685-54R | 1.92 | .27 | ND | ND | ND |
| SS020685-55R | ND | 1.03 | .23 | ND | ND |
| SS020685-104 | 1.49 | 1.05 | .41 | ND | ND |
| SS020685-56R | 2.38 | 1.09 | .48 | ND | ND |
| SS020685-57 | .81 | .99 | .31 | ND | ND |
| SS020685-58 | 1.98 | 1.23 | .40 | ND | ND |
| SS020685-59 | 1.49 | 1.06 | ND | ND | ND |
| SS020685-60 | 2.33 | .91 | .17 | ND | ND |
| SS020685-61 | 2.40 | 1.50 | .57 | ND | ND |
| SS020685-62 | 1.91 | 1.09 | .37 | ND | ND |
| SS020685-63 | 2.07 | .95 | .34 | ND | ND |
| SS020685-111R | 1.94 | 1.84 | .56 | ND | ND |
| SS020685-109 | ND | 1.06 | .38 | ND | ND |
| SS020685-64 | ND | 1.67 | .47 | ND | ND |
| SS020685-65L | 1.70 | 1.26 | .58 | ND | ND |
| SS020685-66 | ND | 1.38 | .65 | ND | ND |
| SS020685-67 | 2.05 | 1.38 | 1.28 | ND | ND |
| SS020685-68 | 1.45 | 1.61 | .43 | ND | ND |

# RADIOISOTOPE DATA

| AREA/SAMPLE NO. | RADIOISOTOPES (pCi/g) Be7 | Cs137 | Co60 | U238 | U235 |
|---|---|---|---|---|---|
| POPLAR CREEK | | | | | |
| SS020685-69 | 1.57 | 1.46 | ND | ND | ND |
| SS020685-70 | 1.45 | 1.22 | .37 | ND | ND |
| SS020685-71 | .94 | 2.01 | .50 | ND | ND |
| SS020685-72R | 1.86 | 1.94 | .58 | ND | ND |
| SS020685-73 | 1.21 | 1.27 | .46 | ND | ND |
| SS020685-74 | 2.11 | 1.39 | .48 | ND | ND |
| SS020685-75 | .99 | 1.15 | .32 | ND | ND |
| SS020685-76 | 1.38 | 1.41 | 1.25 | ND | ND |
| SS020685-77 | 3.01 | 1.28 | .54 | ND | ND |
| SS020685-78 | 2.72 | 1.39 | .50 | ND | ND |
| SS020785-79L | 1.88 | 1.39 | .96 | ND | ND |
| SS020785-80L | 1.10 | 1.86 | .80 | ND | ND |
| SS020785-81L | 1.36 | 1.20 | .62 | ND | ND |
| SS020785-82L | ND | 1.20 | .64 | ND | ND |
| SS020785-83R | 2.87 | 1.41 | .63 | ND | ND |
| SS020785-84L | ND | 1.76 | .44 | 28.3 | ND |
| SS020785-85R | ND | 1.47 | .39 | ND | ND |
| SS020785-86R | 2.67 | 1.39 | .63 | ND | ND |
| SS020685-103 | ND | .45 | ND | ND | ND |
| SS020785-87L | ND | 1.42 | .48 | ND | ND |
| SS020685-102 | 1.69 | 1.15 | .33 | ND | ND |
| SS020685-101 | .58 | .45 | ND | ND | ND |
| SS020785-88R | 3.15 | 1.71 | .56 | 24.2 | ND |
| SS020785-121 | .68 | .72 | .19 | ND | ND |
| SS020785-89R | 2.74 | 1.49 | .42 | 13.5 | ND |
| SS020785-90R | 2.05 | 1.62 | .70 | ND | ND |
| SS020785-120L | .35 | 1.12 | .17 | 6.3 | .4 |
| SS020785-119 | 1.90 | .73 | .64 | 6.5 | ND |
| SS020785-117 | .71 | .93 | .51 | ND | ND |
| SS020785-118 | .81 | .96 | .35 | ND | ND |
| SS020785-115 | 1.02 | 1.29 | .09 | ND | ND |
| SS020785-116 | ND | 1.19 | .18 | ND | ND |
| SS020685-100L | ND | .72 | ND | ND | ND |
| SS020685-112 | ND | .15 | ND | ND | ND |
| SS020685-113L | 1.94 | 1.75 | .60 | ND | ND |
| SS020885-91L | 1.28 | 1.41 | .25 | ND | ND |
| SS020885-92L | 1.42 | 1.50 | .58 | 5.8 | ND |
| SS021185-154R | .71 | 1.46 | 1.01 | ND | ND |
| SS020885-93L | ND | .93 | .19 | ND | ND |
| PC022085[0-4CM] | ND | ND | ND | ND | ND |
| SS020885-94R | ND | 3.30 | .35 | 6.8 | .7 |
| SS021185-95R | 1.16 | 1.66 | .83 | ND | ND |
| SS020885-96L | ND | 2.89 | .45 | ND | ND |
| SS020885-97R | ND | 1.92 | .61 | ND | ND |
| SS020885-98R | 2.01 | 2.52 | .99 | ND | ND |
| SS020885-99L | 1.54 | 2.60 | .68 | ND | ND |
| SS020885-150R | ND | 2.49 | .62 | ND | ND |
| SS021185-152R | ND | 2.47 | .41 | ND | ND |

RADIOISOTOPE DATA

| AREA/SAMPLE NO. | RADIOISOTOPES (pCi/g) Be7 | Cs137 | Co60 | U238 | U235 |
|---|---|---|---|---|---|
| POPLAR CREEK | | | | | |
| SS021185-153L | 1.00 | 2.52 | .82 | ND | ND |
| SS021185-155R | 4.20 | 3.49 | .72 | ND | ND |
| POWERHOUSE | | | | | |
| SS013185-26 | .22 | .13 | ND | ND | ND |
| SS013185-27 | .34 | .28 | ND | ND | ND |
| SS013185-28 | .66 | 3.03 | .35 | ND | ND |
| SS013185-29 | 1.91 | 3.45 | .17 | 12.8 | 1.2 |
| SS022185-200 | .50 | 1.07 | ND | ND | ND |
| SS022185-201 | 1.56 | 1.54 | ND | ND | ND |
| SS022185-202 | 1.45 | 1.74 | ND | ND | ND |
| SS022185-203 | 1.08 | 1.31 | ND | ND | ND |
| SS022185-204 | ND | .71 | ND | 24.5 | 2.1 |
| SS022185-205 | ND | 1.30 | ND | ND | ND |
| SS022185-206 | ND | .74 | ND | ND | ND |
| SS022185-207 | .32 | 1.84 | .13 | 19.5 | .9 |

ND = Not Detected

# APPENDIX C

# ICP AND MERCURY DATA

# APPENDIX C

## RESULTS OF METALS ANALYSES

| AREA/SAMPLE No. | METALS (ug/g) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
| CHROMATE POND | | | | | | | | | | |
| SS020785-124 | <.6 | <5 | <.3 | 740 | 9 | .3 | 27 | 17 | 120 | 230 |
| SS020785-125 | <.6 | <5 | <.3 | 2800 | 28 | <.2 | 10 | 8 | <5 | 990 |
| SS020785-126 | 1.2 | <5 | <.3 | 1600 | 8 | .6 | 5 | 8 | <5 | 410 |
| SS020785-127 | <.6 | <5 | <.3 | 250 | 0 | 1.1 | 2 | 5 | <5 | 350 |
| SS020785-130 | 1.5 | <5 | <.3 | 3300 | 8 | .6 | 6 | 5 | <5 | 900 |
| SS020885-132 | 1.8 | <5 | <.3 | 410 | 5 | <.1 | 20 | 14 | 110 | 140 |
| SS020885-133 | <.6 | <5 | <.3 | 2100 | 17 | .9 | 26 | 16 | 88 | 560 |
| SS020885-135 | <.6 | 9 | <.3 | 1600 | 26 | .8 | 39 | 24 | 110 | 230 |
| CLASS. BURIAL GRND | | | | | | | | | | |
| SS020485-42 | 23.0 | <5 | <.3 | 66 | 77 | 1.4 | 83 | 77 | 58 | 230 |
| SS022885-216 | 1.2 | <5 | <.3 | 17 | 40 | .9 | 120 | 10 | 140 | 41 |
| CLINCH RIVER | | | | | | | | | | |
| SS013185-21 | <.6 | <5 | <.3 | 16 | 12 | .7 | 12 | 9 | 39 | 35 |
| SS021585-165L | 1.3 | <5 | <.3 | 17 | 17 | .8 | 24 | 12 | 110 | 92 |
| SS021585-161R | 3.7 | <5 | <.3 | 1 | 1 | 5.3 | 2 | 5 | <5 | 6 |
| WB021485[0-4CM] | 1.4 | 7 | 1.8 | 44 | 38 | 4.2 | 64 | 30 | <5 | 160 |
| CLINCH RIVER TRIB 1 | | | | | | | | | | |
| SS012485-10 | <.6 | <5 | <.3 | 51 | 4 | .7 | 38 | 22 | 140 | 190 |
| EAST FORK POPLAR CR | | | | | | | | | | |
| SS022185-212 | <.6 | <5 | .7 | 21 | 11 | 3.5 | 25 | 16 | 29 | 42 |
| SS022285-138 | <.6 | <5 | 3.3 | 45 | 76 | 45.0 | 54 | 110 | 37 | 320 |
| EF021585(0-4) | 4.9 | <5 | <.3 | 49 | 40 | 20.7 | 33 | 26 | 110 | 130 |
| K1007B (PC TRIB 4) | | | | | | | | | | |
| SS020485-45 | 12.0 | <5 | <.3 | 150 | 56 | <.5 | 89 | 47 | 38 | 210 |
| SS020485-46 | 17.0 | <5 | 1.0 | 63 | 63 | <.5 | 86 | 37 | 21 | 220 |
| K1700 STREAM | | | | | | | | | | |
| SS020485-41R | <.6 | 23 | <.3 | 39 | 250 | <1.0 | 420 | 46 | <5 | 160 |
| SS020485-35L | <.6 | <5 | <.3 | 69 | 210 | 1.5 | 400 | 39 | 110 | 210 |
| SS020485-34L | <.6 | 15 | <.3 | 50 | 220 | 3.0 | 430 | 49 | 48 | 190 |
| SS020485-33L | <.6 | 34 | 1.3 | 62 | 230 | 1.8 | 460 | 48 | <5 | 240 |
| SS020485-32M | 89.0 | 45 | 1.1 | 65 | 250 | 2.9 | 520 | 73 | <5 | 220 |
| SS020485-31R | <.6 | 16 | 1.1 | 57 | 210 | 1.8 | 560 | 51 | <5 | 240 |
| SS011085-6L | 1.8 | 22 | .8 | 130 | 300 | 6.6 | 830 | 140 | 57 | 410 |
| SS011085-5R | 2.5 | 190 | <.3 | 100 | 470 | 4.4 | 1200 | 100 | 280 | 450 |
| SS020485-49 | 1.4 | 33 | <.3 | 91 | 250 | 2.1 | 1000 | 97 | 150 | 330 |
| SS011085-4L | <.6 | 170 | 4.6 | 98 | 440 | 4.6 | 950 | 120 | <5 | 510 |
| SS011085-3L | <.6 | 68 | 2.4 | 91 | 260 | 6.1 | 1300 | 94 | <5 | 350 |

METALS (μg/g)

| AREA/SAMPLE No. | Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|---|
| K1700 STREAM | | | | | | | | | | |
| SS011085-2L | 1.4 | 45 | 2.2 | 88 | 260 | 6.1 | 1200 | 94 | <5 | 370 |
| SS011085-1L | <.6 | 15 | 1.5 | 57 | 140 | 9.5 | 420 | 49 | <5 | 220 |
| PC TRIB 3 | | | | | | | | | | |
| SS020685-105 | <.6 | <5 | <.3 | 29 | 18 | <.5 | 34 | 29 | 49 | 45 |
| POPLAR CREEK | | | | | | | | | | |
| SS021585-138R | 8.8 | <5 | <.3 | 20 | 20 | <.1 | 40 | 5 | 120 | 100 |
| SS020685-52R | 6.2 | <5 | 2.0 | 67 | 78 | 25.6 | 44 | 43 | 72 | 200 |
| SS020685-56R | <.6 | <5 | <.3 | 22 | 24 | 6.1 | 40 | 24 | 62 | 150 |
| SS020685-61 | 1.4 | <5 | <.3 | 23 | 27 | 5.8 | 43 | 27 | 61 | 160 |
| SS020685-111R | <.6 | <5 | <.3 | 56 | 47 | 11.0 | 59 | 30 | 77 | 170 |
| SS020685-65L | 2.6 | <5 | <.3 | 51 | 46 | 5.5 | 58 | 28 | 83 | 180 |
| SS020685-72R | 2.7 | <5 | <.3 | 60 | 48 | 8.3 | 62 | 41 | 110 | 200 |
| SS020785-79L | 1.8 | <5 | <.3 | 54 | 48 | .0 | 59 | 30 | 89 | 180 |
| SS020785-86R | 44.0 | <5 | <.3 | 32 | 30 | 5.4 | 46 | 29 | 67 | 170 |
| SS020785-120L | 1.3 | <5 | <.3 | 95 | 35 | 9.5 | 51 | 27 | 60 | 210 |
| SS020785-117 | 2.1 | <5 | <.3 | 87 | 42 | 5.4 | 57 | 40 | 83 | 230 |
| SS020785-115 | <.6 | <5 | <.3 | 610 | 62 | <.5 | 68 | 48 | 45 | 590 |
| SS020685-113L | <.6 | <5 | <.3 | 59 | 41 | 8.4 | 65 | 32 | 93 | 200 |
| SS021185-154R | 1.9 | <5 | <.3 | 33 | 37 | 4.8 | 56 | 10 | 130 | 140 |
| PC022085[0-4CM] | 1.4 | <5 | <.3 | 27 | 43 | 3.1 | 42 | 15 | 130 | 120 |
| SS021185-155R | 2.6 | <5 | <.3 | 46 | 41 | 7.7 | 60 | 20 | 160 | 150 |
| POWERHOUSE | | | | | | | | | | |
| SS013185-29 | <.6 | <5 | <.3 | 45 | 38 | 3.0 | 51 | 58 | 76 | 190 |
| SS022185-207 | 2.8 | <5 | <.3 | 31 | 54 | 2.0 | 48 | 42 | 110 | 180 |

# APPENDIX D

# ORGANICS

# APPENDIX D

## RESULTS OF GC-MS ANALYSES

| AREA/SAMPLE No. | TOC (%) | PCB 1254 | PCB 1260 | ORGANICS (µg/g) 2B | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CHROMATE POND | | | | | | | | | | | | |
| SS020785-125 | 1.9 | <1.0 | <1.0 | ND | ND | ND | 2.9 | ND | ND | 1.6 | 1.1 | 1.4 |
| SS020785-127 | 3.6 | <1.0 | <1.0 | ND | ND | ND | 3.5 | ND | ND | .7 | .6 | 1.0 |
| CLASS. BURIAL GRND | | | | | | | | | | | | |
| SS020485-42 | 1.2 | <1.0 | <1.0 | ND | ND | ND | .1 | ND | ND | .3 | ND | .4 |
| SS022885-216 | 1.8 | <1.0 | <1.0 | .1 | ND | ND | ND | ND | 1.0 | ND | ND | ND |
| CLINCH RIVER | | | | | | | | | | | | |
| SS013185-21 | .5 | <1.0 | <1.0 | ND | ND | ND | 1.9 | ND | ND | ND | ND | ND |
| SS021585-165L | 2.6 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS021585-161R | .8 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| WB021485[0-4C | 2.5 | <1.0 | <1.0 | ND | ND | ND | 3.6 | ND | ND | .1 | .1 | .1 |
| CLINCH RIVER TRIB 1 | | | | | | | | | | | | |
| SS012485-10 | 3.8 | <1.0 | <1.0 | ND | ND | ND | 8.1 | ND | ND | .2 | ND | ND |
| EAST FORK POPLAR CR | | | | | | | | | | | | |
| SS022185-212 | 3.1 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS022285-138 | 3.9 | <1.0 | <1.0 | ND | ND | 1.3 | 4.7 | 1.9 | ND | 3.1 | 2.8 | 4.0 |
| EF021585(0-4) | 1.4 | <1.0 | <1.0 | ND | ND | ND | .7 | ND | .1 | .3 | .1 | .4 |
| K1007B (PC TRIB 4) | | | | | | | | | | | | |
| SS020485-45 | ND | 12.6 | <1.0 | .7 | ND | ND | .5 | .5 | .2 | .9 | .3 | 1.2 |
| SS020485-46 | 1.4 | 3.0 | <1.0 | .2 | ND | ND | ND | ND | ND | ND | ND | ND |
| K1700 STREAM | | | | | | | | | | | | |
| SS020485-35L | 4.6 | <1.0 | <1.0 | ND | 2.4 | ND | ND | ND | .1 | 3.0 | 2.4 | 2.5 |
| SS011085-5R | 7.3 | ND | ND | ND | .3 | ND | 13.9 | ND | .1 | .4 | .4 | .2 |
| SS020485-49 | 4.1 | <1.0 | <1.0 | ND | ND | ND | 8.2 | ND | .7 | .7 | 1.1 | 1.2 |
| POPLAR CREEK | | | | | | | | | | | | |
| SS021585-138R | .9 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS020685-52R | 3.8 | <1.0 | <1.0 | ND | .1 | ND | .6 | ND | .1 | .4 | .3 | .1 |
| SS020685-111R | 2.8 | <1.0 | <1.0 | ND | .2 | ND | .7 | ND | ND | .3 | .3 | .1 |
| SS020685-65L | 3.2 | <1.0 | <1.0 | ND | .2 | ND | .4 | ND | .3 | .3 | .3 | ND |
| SS020685-72R | 3.1 | <1.0 | <1.0 | ND | .1 | ND | .6 | ND | ND | .3 | .3 | .1 |
| SS020785-79L | 2.9 | <1.0 | <1.0 | ND | .2 | ND | .8 | ND | .1 | ND | .3 | ND |
| SS020785-120L | 3.3 | <1.0 | <1.0 | ND | ND | .5 | .8 | .7 | .1 | 1.2 | .5 | 1.5 |
| SS020785-117 | 2.3 | <1.0 | <1.0 | ND | ND | ND | 1.8 | ND | ND | 2.6 | 2.7 | 2.4 |
| SS020785-115 | 2.9 | <1.0 | 5.0 | ND | ND | 2.1 | ND | 3.0 | .2 | 9.8 | 6.6 | 12.1 |
| SS020685-113L | 3.1 | <1.0 | <1.0 | ND | .2 | ND | .7 | ND | .1 | .3 | .3 | .1 |
| SS021185-154R | 2.7 | <1.0 | <1.0 | ND | .4 | ND | 96.7 | ND | .1 | .5 | .7 | .8 |
| PC022085[0-4C | 2.6 | <1.0 | <1.0 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| SS021185-155R | 2.4 | <1.0 | <1.0 | ND | .5 | ND | 1.2 | ND | ND | 1.1 | 1.0 | 1.6 |
| POWERHOUSE | | | | | | | | | | | | |
| SS013185-29 | 2.4 | <1.0 | <1.0 | ND | .1 | ND | 2.6 | ND | .1 | .3 | .4 | .1 |

RESULTS OF GC-MS ANALYSES

| | | | | ORGANICS (μg/g) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AREA/SAMPLE No. | TOC (%) | PCB 1254 | PCB 1260 | 2B | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B |
| POWERHOUSE | | | | | | | | | | | | |
| SS022185-207 | 2.8 | <1.0 | <1.0 | ND | ND | ND | 1.2 | ND | ND | .4 | .2 | .5 |

ND = Not Detected

ORGANIC COMPOUND CODES ARE AS FOLLOWS:

TOC---Total Organic Carbon
2B---Acenaphthylene
3B---Anthracene
5B---Benzo(a)Anthracene
13B---Bis(2-ethylhexyl)phthlate
18B---Chrysene
26B---di-N-Butylphthalate
31B---Fluoranthene
44B---Phenanthrene
45B---Pyrene

# APPENDIX E

# SEDIMENT CORE DATA

EAST FORK POPLAR CREEK SEDIMENT CORE (021585)

| SAMPLE (cm) | Cs-137 (pCi/g) | CO-60 (pCi/g) | U-238 (pCi/g) | U-235 (pCi/g) | Ra-226 (pCi/g) |
|---|---|---|---|---|---|
| 0-2 | 4.8 ± 0.1 | 1.9 ± 0.1 | 8.5 ± 1.0 | 0.3 ± 0.1 | 0.9 ± 0.1 |
| 2-4 | 3.7 ± 0.1 | 1.3 ± 0.1 | 6.0 ± 3.8 | 0.4 ± 0.1 | 0.7 ± 0.1 |
| 4-6 | 2.0 ± 0.1 | 17.9 ± 0.3 | 7.0 ± 3.8 | 0.5 ± 0.1 | 0.8 ± 0.1 |
| 6-8 | 1.4 ± 0.1 | 0.4 ± 0.1 | 9.9 ± 1.6 | 0.7 ± 0.1 | 0.6 ± 0.1 |
| 8-10 | 1.3 ± 0.1 | 0.3 ± 0.1 | 25.7 ± 2.0 | 1.4 ± 0.1 | 0.7 ± 0.1 |
| 10-12 | 0.4 ± 0.1 | 0.4 ± 0.1 | 56.9 ± 1.8 | 2.7 ± 0.1 | 0.9 ± 0.1 |
| 12-14 | 0.2 ± 0.1 | 0.1 ± 0.1 | 74.4 ± 1.9 | 3.7 ± 0.3 | 0.9 ± 0.1 |
| 14-16 | 0.2 ± 0.0 | 0.1 ± 0.0 | 31.4 ± 1.7 | 1.6 ± 0.1 | 1.0 ± 0.1 |
| 16-18 | 0.1 ± 0.0 | 0.1 ± 0.1 | 16.5 ± 1.1 | 0.9 ± 0.2 | 0.9 ± 0.1 |
| 18-20 | 0.1 ± 0.1 | ND | 16.3 ± 1.1 | 0.7 ± 0.1 | 1.1 ± 0.1 |
| 20-22 | 0.1 ± 0.0 | ND | 4.8 ± 1.4 | 0.5 ± 0.1 | 1.2 ± 0.1 |
| 22-24 | ND | ND | 14.5 ± 1.1 | 0.6 ± 0.1 | 1.1 ± 0.1 |
| 24-26 | 0.05±0.01 | 0.02±0.01 | 2.7 ± 0.9 | 0.2 ± 0.1 | 1.0 ± 0.1 |
| 26-28 | 0.05±0.01 | ND | 1.9 ± 0.7 | ND | 0.8 ± 0.1 |
| 28-30 | ND | ND | 3.2 ± 1.0 | ND | 0.9 ± 0.1 |
| 30-32 | ND | ND | ND | ND | 0.8 ± 0.1 |
| 32-34 | 0.03±0.01 | ND | ND | ND | 1.0 ± 0.1 |
| 34-36 | 0.02±0.01 | ND | ND | ND | 1.2 ± 0.1 |
| 36-38 | ND | ND | ND | 0.07±0.04 | 1.0 ± 0.1 |
| 38-40 | ND | ND | ND | ND | 1.2 ± 0.1 |
| 40-44 | ND | ND | ND | ND | 1.2 ± 0.1 |
| 44-48 | ND | ND | ND | ND | 1.2 ± 0.1 |
| 48-52 | 0.03±0.01 | ND | 1.2 ± 0.6 | 0.2 ± 0.1 | 1.2 ± 0.1 |
| 52-56 | ND | ND | ND | ND | 0.7 ± 0.1 |
| 56-60 | 0.12±0.01 | 0.05±0.01 | 2.4 ± 1.7 | 0.1 ± 0.1 | 0.6 ± 0.1 |
| 60-64 | ND | ND | ND | ND | 0.8 ± 0.1 |
| 64-68 | 0.01±0.01 | ND | 0.7 ± 0.3 | ND | 0.6 ± 0.1 |
| 68-72 | ND | ND | ND | ND | 0.5 ± 0.1 |
| 72-76 | ND | ND | ND | ND | 0.6 ± 0.1 |
| 88-92 | ND | ND | ND | ND | 0.8 ± 0.2 |

EAST FORK POPLAR CREEK SEDIMENT CORE (021585)

| SAMPLE DEPTH (cm) | TOC (%) | ORGANICS (ug/g) PCB (1254) | PCB (1260) | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B | METALS (ug/g) Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0–4 | 1.4 | ND | ND | ND | ND | 0.7 | ND | 0.1 | 0.3 | 0.1 | 0.4 | 4.9 | ND | ND | 49 | 40 | 21 | 33 | 26 | 110 | 130 |
| 4–8 | 2.5 | — | — | — | — | — | — | — | — | — | — | ND | ND | 1.9 | 48 | 25 | 16 | 31 | 29 | ND | 100 |
| 8–12 | 3.7 | — | — | — | — | — | — | — | — | — | — | 4.4 | 6.8 | 3.3 | 82 | 87 | 22 | 66 | 70 | ND | 220 |
| 12–16 | 1.7 | ND | ND | ND | ND | 2.5 | ND | 0.3 | 1.2 | 0.3 | 1.5 | 6.3 | ND | ND | 78 | 92 | 39 | 63 | 45 | 150 | 170 |
| 16–20 | 3.0 | — | — | — | — | — | — | — | — | — | — | 5.6 | ND | 1.0 | 62 | 680 | 24 | 89 | 58 | 31 | 220 |
| 20–24 | 1.5 | ND | ND | ND | ND | 12.1 | ND | 0.1 | 3.8 | 1.2 | 4.8 | 7.0 | ND | ND | 37 | 98 | 6.8 | 48 | 16 | 180 | 110 |
| 24–28 | 1.2 | — | — | — | — | — | — | — | — | — | — | 12.0 | ND | ND | 34 | 87 | 5.6 | 40 | 14 | 230 | 98 |
| 28–32 | 1.9 | ND | ND | ND | ND | ND | ND | 0.3 | ND | ND | ND | 3.5 | ND | ND | 36 | 54 | 2.1 | 33 | 10 | 99 | 100 |
| 32–36 | 4.6 | | | | | | | | | | | | | | | | | | | | |
| 36–40 | 5.4 | | | | | | | | | | | | | | | | | | | | |
| 40–44 | 2.8 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 2.3 | ND | ND | 25 | 9 | 0.5 | 24 | 11 | 140 | 59 |
| 44–48 | 1.5 | ND | ND | ND | ND | ND | ND | 0.3 | 1.9 | ND | 2.4 | 2.3 | ND | ND | 26 | 22 | ND | 29 | 9 | 180 | 62 |
| 48–52 | 1.2 | | | | | | | | | | | | | | | | | | | | |
| 52–56 | 2.3 | | | | | | | | | | | | | | | | | | | | |
| 56–60 | 2.6 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 21 | 19 | ND | 27 | 8 | 110 | 65 |
| 60–64 | 2.4 | | | | | | | | | | | | | | | | | | | | |
| 64–68 | 1.3 | | | | | | | | | | | | | | | | | | | | |
| 68–72 | 0.7 | | | | | | | | | | | | | | | | | | | | |
| 72–76 | 0.6 | | | | | | | | | | | | | | | | | | | | |
| 76–80 | 0.2 | ND | ND | ND | ND | 6.8 | ND | ND | ND | ND | ND | ND | ND | ND | 53 | ND | ND | 15 | 15 | 190 | 22 |

ORGANIC COMPOUND CODES:

- TOC---Total Organic Carbon
- 3B ---Anthracene
- 4B ---Benzo(a)Anthracene
- 13B---Bis(2-ethylhexyl)phthalate
- 18B---Chrysene
- 26B---di-n-Butylphthalate
- 31B---Fluoranthene
- 44B---Phenanthrene
- 45B---Pyrene

LOWER POPLAR CREEK SEDIMENT CORE (021485)

| SAMPLE (cm) | Cs-137 (pCi/g) | CO-60 (pCi/g) | U-238 (pCi/g) | U-235 (pCi/g) | Ra-226 (pCi/g) |
|---|---|---|---|---|---|
| 0-2 | 1.9 ± 0.1 | 0.6 ± 0.1 | 4.5 ± 1.6 | 0.5 ± 0.1 | 1.3 ± 0.1 |
| 2-4 | 1.8 ± 0.1 | 0.7 ± 0.1 | ND | ND | 1.3 ± 0.1 |
| 4-6 | 1.7 ± 0.1 | 0.8 ± 0.1 | ND | ND | 1.1 ± 0.1 |
| 6-8 | 1.9 ± 0.1 | 1.8 ± 0.2 | 3.2 ± 2.8 | ND | 1.6 ± 0.2 |
| 8-10 | 1.7 ± 0.1 | 0.5 ± 0.1 | ND | ND | 1.4 ± 0.1 |
| 10-12 | 1.2 ± 0.1 | 0.6 ± 0.1 | 3.1 ± 0.1 | 0.3 ± 0.1 | 1.2 ± 0.1 |
| 12-14 | 1.2 ± 0.1 | 0.2 ± 0.1 | 1.9 ± 1.9 | 0.4 ± 0.1 | 1.1 ± 0.2 |
| 14-16 | 1.1 ± 0.1 | 0.1 ± 0.0 | ND | ND | 1.3 ± 0.2 |
| 16-20 | 1.3 ± 0.1 | 0.4 ± 0.1 | 5.3 ± 1.2 | 0.2 ± 0.1 | 1.2 ± 0.1 |
| 20-24 | 1.1 ± 0.1 | 0.2 ± 0.1 | 5.0 ± 3.8 | 0.4 ± 0.1 | 1.3 ± 0.1 |
| 24-28 | 1.0 ± 0.1 | ND | 7.7 ± 1.8 | 0.5 ± 0.1 | 1.2 ± 0.1 |
| 28-32 | 1.2 ± 0.1 | 0.05±0.02 | 7.0 ± 1.4 | 0.4 ± 0.1 | 1.3 ± 0.1 |
| 32-36 | 1.0 ± 0.1 | 0.03±0.01 | 9.9 ± 1.0 | 0.5 ± 0.1 | 1.4 ± 0.1 |
| 36-40 | 0.9 ± 0.1 | ND | 8.1 ± 1.3 | 0.5 ± 0.1 | 1.2 ± 0.1 |
| 40-44 | 1.1 ± 0.1 | 0.04±0.02 | 9.4 ± 1.1 | 0.5 ± 0.1 | 1.3 ± 0.1 |
| 44-48 | 0.9 ± 0.1 | ND | 6.9 ± 1.8 | 0.5 ± 0.2 | 1.2 ± 0.1 |
| 48-52 | 1.0 ± 0.1 | ND | 9.1 ± 1.1 | 0.5 ± 0.2 | 1.4 ± 0.1 |
| 52-56 | 1.3 ± 0.1 | ND | 7.1 ± 1.2 | 0.5 ± 0.2 | 1.0 ± 0.1 |
| 56-60 | 2.7 ± 0.1 | 0.05±0.02 | 13.8 ± 2.0 | 1.1 ± 0.1 | 1.2 ± 0.1 |
| 60-64 | 4.9 ± 0.1 | 0.11±0.02 | 16.7 ± 1.6 | 0.9 ± 0.1 | 1.3 ± 0.1 |
| 64-68 | 2.9 ± 0.1 | 0.07±0.02 | 12.1 ± 1.2 | 1.0 ± 0.3 | 1.3 ± 0.1 |
| 68-72 | 2.1 ± 0.1 | 0.04±0.01 | 10.6 ± 1.3 | 1.1 ± 0.2 | 1.3 ± 0.1 |
| 72-76 | 4.8 ± 0.1 | 0.12±0.02 | 24.1 ± 1.9 | 1.8 ± 0.2 | 1.5 ± 0.1 |
| 76-80 | 5.0 ± 0.1 | 0.08±0.04 | 14.6 ± 3.5 | 2.6 ± 0.5 | 1.5 ± 0.1 |
| 80-88 | 6.3 ± 0.1 | 0.10±0.02 | 20.2 ± 1.0 | 1.7 ± 0.1 | 1.3 ± 0.1 |
| 88-96 | 2.2 ± 0.1 | 0.07±0.01 | 4.0 ± 0.9 | 0.4 ± 0.1 | 3.0 ± 0.1 |
| 96-104 | 1.3 ± 0.1 | 0.07±0.01 | 2.9 ± 0.9 | 0.2 ± 0.1 | 3.8 ± 0.1 |
| 104-112 | 2.8 ± 0.1 | 0.05±0.02 | 3.2 ± 1.2 | 0.3 ± 0.1 | 3.6 ± 0.1 |
| 112-120 | 2.7 ± 0.1 | 0.06±0.01 | 3.1 ± 0.8 | 0.2 ± 0.1 | 3.5 ± 0.1 |
| 120-128 | 4.3 ± 0.1 | 0.09±0.01 | 3.8 ± 0.8 | 0.1 ± 0.1 | 3.6 ± 0.1 |

# LOWER POPLAR CREEK SEDIMENT CORE (021485)

| SAMPLE | | ORGANICS (ug/g) | | | | | | | | | | METALS (ug/g) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (cm) | TOC (%) | PCB (1254) | PCB (1260) | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B | Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
| 0-4 | 2.5 | ND | ND | ND | ND | 3.6 | ND | ND | 0.1 | 0.1 | 0.1 | 1.4 | 7.9 | 1.8 | 44 | 38 | 4.2 | 64 | 30 | ND | 160 |
| 4-8 | — | — | — | — | — | — | — | — | — | — | — | 3.4 | ND | ND | 43 | 32 | 9.5 | 68 | 15 | 180 | 160 |
| 8-12 | 2.5 | — | — | — | — | — | — | — | — | — | — | 200 | ND | ND | 43 | 36 | 6.6 | 65 | 29 | 55 | 160 |
| 12-16 | 2.4 | ND | ND | ND | 0.1 | 0.6 | 0.1 | 0.1 | 0.4 | 0.2 | 0.5 | 33 | ND | ND | 34 | 32 | 7.2 | 59 | 28 | 74 | 150 |
| 16-20 | 2.2 | — | — | — | — | — | — | — | — | — | — | ND | ND | ND | 46 | 36 | 5.7 | 67 | 28 | 48 | 140 |
| 20-24 | 2.1 | ND | ND | ND | 0.2 | 0.8 | 0.4 | 0.1 | 0.7 | 0.7 | 0.3 | ND | ND | ND | 42 | 31 | 8.8 | 63 | 27 | 65 | 140 |
| 24-28 | 2.1 | ND | ND | ND | ND | 0.6 | ND | ND | 0.6 | 0.2 | 0.8 | ND | ND | ND | 52 | 28 | 8.5 | 58 | 24 | 57 | 130 |
| 28-32 | 2.2 | — | — | — | — | — | — | — | — | — | — | ND | ND | ND | 77 | 38 | 5.7 | 73 | 31 | 49 | 170 |
| 32-36 | 2.1 | — | — | — | — | — | — | — | — | — | — | 170 | ND | ND | 80 | 38 | 7.8 | 63 | 33 | 57 | 160 |
| 36-40 | 2.0 | — | — | — | — | — | — | — | — | — | — | ND | ND | ND | 88 | 37 | 9.4 | 58 | 29 | 55 | 150 |
| 40-44 | 2.0 | — | — | — | — | — | — | — | — | — | — | 1.4 | ND | 1.5 | 130 | 31 | 6.3 | 59 | 30 | ND | 180 |
| 44-48 | 2.1 | ND | ND | ND | ND | 0.6 | ND | 0.1 | 0.3 | 0.2 | 0.4 | 3.5 | ND | ND | 98 | 34 | 9.2 | 56 | 32 | 75 | 160 |
| 48-52 | 2.0 | — | — | — | — | — | — | — | — | — | — | 190 | ND | ND | 84 | 35 | 14.7 | 56 | 30 | 52 | 150 |
| 52-56 | 2.1 | ND | ND | ND | ND | 0.1 | ND | ND | 0.3 | 0.2 | 0.3 | 2.1 | ND | ND | 100 | 34 | 7.7 | 54 | 30 | 78 | 160 |
| 56-60 | 2.1 | ND | ND | ND | ND | 0.7 | ND | ND | 0.1 | 0.2 | 0.4 | 1.6 | ND | ND | 120 | 35 | 7.7 | 56 | 29 | 92 | 170 |
| 60-64 | 2.2 | | | | | | | | | | | | | | | | | | | | |
| 64-68 | 2.7 | | | | | | | | | | | | | | | | | | | | |
| 68-72 | 3.2 | | | | | | | | | | | | | | | | | | | | |
| 72-76 | 3.1 | | | | | | | | | | | | | | | | | | | | |
| 76-80 | 2.8 | ND | ND | ND | ND | 1.1 | ND | ND | 0.4 | 0.2 | 0.5 | 2.6 | 55.0 | ND | 270 | 77 | 4.5 | 96 | 39 | 84 | 220 |
| 80-88 | 3.1 | | | | | | | | | | | | | | | | | | | | |
| 88-96 | 3.7 | | | | | | | | | | | | | | | | | | | | |
| 96-104 | 12.6 | | | | | | | | | | | | | | | | | | | | |
| 104-112 | 3.3 | | | | | | | | | | | | | | | | | | | | |
| 112-120 | 3.3 | | | | | | | | | | | | | | | | | | | | |
| 120-128 | 6.5 | | | | | | | | | | | | | | | | | | | | |

ORGANIC COMPOUND CODES:

TOC---Total Organic Carbon
3B ---Anthracene
4B ---Benzo(a)Anthracene
13B---Bis(2-ethylhexyl)phthalate
18B---Chrysene
26B---di-n-Butylphthalate
31B---Fluoranthene
44B---Phenanthrene
45B---Pyrene

WATTS BAR RESERVOIR SEDIMENT CORE (022085)

| SAMPLE (cm) | Cs-137 (pCi/g) | CO-60 (pCi/g) | U-238 (pCi/g) | U-235 (pCi/g) | Ra-226 (pCi/g) |
|---|---|---|---|---|---|
| 0-2 | 10.9 ± 0.3 | 0.7 ± 0.1 | 2.0 ± 1.2 | ND | 1.2 ± 0.3 |
| 2-4 | 8.6 ± 0.3 | 0.8 ± 0.1 | ND | ND | 1.6 ± 0.2 |
| 4-6 | 7.3 ± 0.2 | 0.7 ± 0.1 | ND | ND | 1.2 ± 0.2 |
| 6-8 | 7.9 ± 0.1 | 0.7 ± 0.1 | ND | ND | 1.2 ± 0.2 |
| 8-10 | 6.7 ± 0.2 | 0.7 ± 0.1 | 0.4 ± 0.9 | 0.1 ± 0.1 | 1.3 ± 0.1 |
| 10-12 | 6.9 ± 0.1 | 0.5 ± 0.1 | ND | ND | 1.2 ± 0.1 |
| 12-14 | 6.7 ± 0.2 | 0.3 ± 0.1 | ND | ND | 0.9 ± 0.1 |
| 14-16 | 7.8 ± 0.2 | 0.3 ± 0.1 | ND | ND | 1.1 ± 0.1 |
| 16-18 | 8.3 ± 0.2 | 0.2 ± 0.1 | ND | ND | 1.2 ± 0.2 |
| 18-20 | 7.1 ± 0.1 | 0.2 ± 0.0 | ND | ND | 1.1 ± 0.1 |
| 20-22 | 10.5 ± 0.2 | 0.2 ± 0.1 | 3.2 ± 1.2 | 0.2 ± 0.1 | 1.1 ± 0.2 |
| 22-24 | 10.4 ± 0.1 | 0.3 ± 0.0 | 4.0 ± 1.3 | 0.1 ± 0.1 | 1.1 ± 0.1 |
| 24-26 | 12.8 ± 0.2 | 0.4 ± 0.1 | 3.4 ± 1.8 | 0.2 ± 0.1 | 1.2 ± 0.1 |
| 26-28 | 14.5 ± 0.2 | 0.4 ± 0.1 | 1.9 ± 0.9 | 0.1 ± 0.1 | 1.2 ± 0.1 |
| 28-30 | 20.7 ± 0.4 | 0.7 ± 0.1 | 6.3 ± 2.3 | ND | 1.1 ± 0.2 |
| 30-32 | 21.1 ± 0.3 | 0.5 ± 0.1 | 5.3 ± 1.2 | ND | 1.4 ± 0.2 |
| 32-34 | 23.6 ± 0.3 | 0.4 ± 0.1 | 2.3 ± 0.8 | ND | 1.0 ± 0.2 |
| 34-36 | 25.7 ± 0.4 | 0.5 ± 0.1 | 3.2 ± 0.9 | 0.2 ± 0.1 | 1.4 ± 0.2 |
| 36-38 | 31.4 ± 0.4 | 0.5 ± 0.1 | 6.2 ± 1.6 | ND | 1.7 ± 0.2 |
| 38-40 | 42.8 ± 0.5 | 0.4 ± 0.1 | 1.6 ± 1.0 | ND | 1.7 ± 0.2 |
| 40-44 | 71.4 ± 0.6 | 0.6 ± 0.1 | 5.9 ± 0.8 | ND | 0.9 ± 0.3 |
| 44-48 | 46.4 ± 0.5 | 0.6 ± 0.1 | 2.9 ± 1.1 | ND | 1.2 ± 0.3 |
| 48-52 | 31.3 ± 0.4 | 0.1 ± 0.1 | 6.2 ± 2.0 | ND | 1.3 ± 0.2 |
| 52-56 | 25.9 ± 0.4 | ND | 1.2 ± 0.8 | ND | 1.1 ± 0.2 |
| 56-60 | 14.4 ± 0.3 | ND | 4.5 ± 1.0 | ND | 1.1 ± 0.2 |
| 60-64 | 19.7 ± 0.3 | ND | 1.9 ± 0.9 | ND | 1.5 ± 0.2 |
| 64-68 | 13.7 ± 0.3 | ND | 1.9 ± 0.9 | 0.2 ± 0.1 | 1.2 ± 0.1 |
| 68-72 | 2.3 ± 0.1 | ND | 3.4 ± 1.0 | 0.2 ± 0.1 | 1.3 ± 0.1 |
| 72-76 | 0.7 ± 0.1 | ND | 1.5 ± 0.8 | ND | 1.3 ± 0.1 |
| 76-80 | 0.2 ± 0.1 | ND | ND | ND | 1.1 ± 0.1 |

WATTS BAR RESERVOIR SEDIMENT CORE (022085)

| SAMPLE | | ORGANICS (ug/g) | | | | | | | | | | METALS (ug/g) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (cm) | TOC (%) | PCB (1254) | PCB (1260) | 3B | 5B | 13B | 18B | 26B | 31B | 44B | 45B | Ag | As | Cd | Cr | Cu | Hg | Ni | Pb | Se | Zn |
| 0-4 | 2.6 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.4 | ND | ND | 27 | 43 | 3.1 | 42 | 15 | 130 | 120 |
| 4-8 | 2.5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | 11 | 0.8 | 28 | 34 | 1.7 | 40 | 27 | ND | 120 |
| 8-12 | 2.2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | 9.5 | 0.8 | 28 | 28 | 2.2 | 38 | 24 | ND | 110 |
| 12-16 | 2.0 | ND | ND | ND | ND | ND | ND | ND | 0.1 | ND | 0.2 | 0.9 | ND | ND | 27 | 21 | 3.9 | 34 | 18 | 130 | 91 |
| 16-20 | 2.0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | ND | ND | 28 | 22 | 2.8 | 30 | 23 | 35 | 80 |
| 20-24 | 2.2 | ND | ND | ND | ND | ND | ND | 0.2 | ND | ND | 0.1 | ND | ND | 0.5 | 30 | 18 | 2.2 | 28 | 22 | ND | 87 |
| 24-28 | 2.1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | 5.9 | 0.7 | 36 | 22 | 3.1 | 33 | 23 | ND | 100 |
| 28-32 | 2.3 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1.2 | ND | ND | 44 | 23 | 6.6 | 43 | 14 | 150 | 110 |
| 32-34 | --- | -- | -- | -- | -- | -- | - | -- | -- | -- | -- | ND | 6.1 | 0.6 | 49 | 37 | 5.9 | 42 | 26 | ND | 150 |
| 34-36 | --- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | ND | 0.7 | 51 | 33 | 6.3 | 43 | 26 | ND | 160 |
| 36-40 | 2.3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | ND | ND | 46 | 47 | 6.5 | 41 | 25 | ND | 120 |
| 40-44 | 2.6 | ND | ND | 0.2 | ND | 0.2 | ND | 0.1 | 0.4 | 0.1 | 0.5 | 1.5 | ND | ND | 51 | 30 | 25.0 | 58 | 20 | 190 | 130 |
| 44-48 | 2.7 | ND | ND | ND | ND | ND | ND | ND | ND | 0.2 | 0.2 | ND | ND | ND | 38 | 36 | 16.7 | 53 | 28 | 47 | 120 |
| 48-52 | 2.7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | 10 | 0.8 | 24 | 22 | 3.6 | 30 | 26 | ND | 100 |
| 52-56 | 2.7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | ND | 6.8 | ND | 28 | 15 | 1.3 | 30 | 26 | ND | 100 |
| 56-60 | 2.9 | ND | ND | ND | ND | 0.2 | ND | ND | 0.1 | 0.1 | 0.6 | ND | ND | ND | 22 | 13 | 1.0 | 27 | 13 | 140 | 80 |
| 60-64 | 2.9 | | | | | | | | | | | | | | | | | | | | |
| 64-68 | 2.9 | | | | | | | | | | | | | | | | | | | | |
| 68-72 | 2.3 | ND | ND | ND | ND | ND | ND | 0.2 | ND | 0.1 | 0.2 | ND | ND | ND | 29 | 27 | ND | 30 | 29 | 49 | 97 |
| 72-76 | 2.3 | | | | | | | | | | | | | | | | | | | | |
| 76-80 | --- | ND | ND | 5.6 | 3.8 | ND | 5.4 | ND | ND | 5.4 | 12.0 | ND | ND | 0.6 | 23 | 21 | ND | 17 | 130 | ND | 150 |

ORGANIC COMPOUND CODES:

- TOC---Total Organic Carbon
- 3B ---Anthracene
- 4B ---Benzo(a)Anthracene
- 13B---Bis(2-ethylhexyl)phthalate
- 18B---Chrysene
- 26B---di-n-Butylphthalate
- 31B---Fluoranthene
- 44B---Phenanthrene
- 45B---Pyrene

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