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Remedial Investigation/Feasibility Study for the Clinch River/Poplar Creek Operable Unit

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MASTER

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Appendix G

QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

G. QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT OF DATA

The Quality Assurance/Quality Control (QA/QC) Program for Phase 2 of the Clinch River Remedial Investigation (CRRI) was designed to comply with both Department of Energy (DOE) Order 5700.6C and Environmental Protection Agency (EPA) QAMS-005/80 (EPA 1980a) guidelines. QA requirements and the general QA objectives for Phase 2 data were defined in the Phase 2 Sampling and Analysis Plan (SAP) (DOE/OR/01-1111&D3)-Quality Assurance Project Plan, and scope changes noted in the Phase 2 Sampling and Analysis Plan Addendum-DOE/OR/01-1254&D1). The QA objectives for Phase 2 data were the following:

- Scientific data generated will withstand scientific and legal scrutiny.
- Data will be gathered using appropriate procedures for sample collection, sample handling and security, chain of custody (COC), laboratory analyses, and data reporting.
- Data will be of known precision and accuracy.
- Data will meet data quality objectives (DQOs) defined in the Phase 2 SAP.

The QA objective for all data collected during Phase 2 was, therefore, 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 development and implementation of a thorough data assessment process that included data evaluation, data quality indicators, sampling uncertainty, field quality control, analytical laboratory quality control, data and records management systems, and a QA oversight program of audits and surveillances.

One hundred and thirty-four sampling events were conducted for sediment and water. Separate contaminant studies on heron, mink, geese, and fish were also conducted. Approximately 4,400 inorganic, 3,000 organic, and 2,000 radiological samples were analyzed by ten laboratories during the Phase 2 site characterization. Matrices included sediment, water, fish, heron, mink, mayflies, geese and duck. In addition, over 500 pH, alkalinity, and total suspended particle determinations were conducted by CRERP staff. Toxicity and bioindicator measurements were also performed by Environmental Sciences Division (ESD) staff for the Clinch River Environmental Restoration Program..

The data were compiled by the laboratories into over 900 sample data packages that contained raw sample data and all quality control associated with each sample for most of the samples collected prior to July 1994. After July 1994, approximately 90% of the sediment and water data were reported as Level C or Level III data packages. Level C packages contained signed chain-of-custody forms, case narratives, sample results, and all quality control information such as calibration, spike, blank, and duplicate data. The only difference between the Level C (or III) and Level D (or IV) packages was that the Level D packages contained raw data, sample preparation records, and copies of pertinent logbook information. Sample results were also received electronically by the project data base manager and loaded into a large working data base.

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

G1. COMPLETENESS

The overall QA **completeness** goal for the program was to obtain valid analytical results for at least 90% of the samples collected during the program. Overall completeness for all Phase 2 media and analyses exceeded this goal. Less than one percent of the analyses were rejected. Rejected data occurred because of low spike recoveries and low sensitivity.

G2. PRECISION

Analysis of **laboratory replicates** provided an assessment of the **precision** associated with the laboratory method. Precision was expressed as relative percent difference (RPD) for inorganic and organic analyses. For the inorganic analyses performed by Lockheed for surface and pore water, approximately 62% of the duplicates had a mean relative percent difference (RPD) of <10%. Of the duplicates, 83% had a mean RPD of <20%. For the inorganic analyses performed by TMA-ARLI for sediment, approximately 48% of the duplicates had a mean RPD of <10%, while 70% had a mean RPD <20%. Mercury speciation analyses performed at Brooks Rand had an overall mean RPD of <10%. The duplicate error ratio (DER) was used to assess duplicate agreement for radiological analyses. The DER is the ratio of the absolute difference of duplicate results compared to the sum of the uncertainties for the results expressed as a percent. The DER should be less than one. For the ESD Radiological Analysis Laboratory that performed the gamma analyses, the DER was <0.3. For other radiological analyses performed at Oak Ridge Analytical Services, the DER was <0.4, except for gross alpha and gross beta where the DER was <0.8.

Because it includes both the field and laboratory variability, analysis of **field duplicates** provided a total assessment of the overall precision of the sample data . For sediment, 75% of the semivolatile field duplicates had a mean RPD between 20-40%. Of the pesticide/PCB field duplicates, 75% had a mean RPD greater than 40%. Of the inorganic field duplicates for sediment, 85% had a mean RPD<30%. Overall, 21% of the sediment field duplicates exceeded the 35% criteria. For filtered surface water, overall, 23% of the field duplicates exceeded the 20% criteria. Failure to meet criteria was most often attributed to antimony, boron, copper, or zinc. For total surface water, overall, 15% of the field duplicates exceeded the 20% criteria with aluminum, boron, copper, iron, and nickel showing low precision. For pore water, overall, 40% of the field duplicates exceeded 20%.

Evaluation of sampling precision may be determined from the difference between the overall precision and the analytical precision. The usefulness of the precision data is limited to samples that contain contaminants at concentrations above the method detection limit (DL). Also, the analytical process must be in statistical control or the estimates of precision will not be meaningful.

G3. ACCURACY

Accuracywas primarily evaluated in Phase 2 through holding times, blanks, calibrations, LCSs, matrix spikes, surrogate spikes, and performance evaluation samples. Percent recovery was used to express the common systematic error component of accuracy, bias.

Holding times were met for approximately 95% of the samples. Of the holding times that were missed, only 68 resulted in rejected data (sediment and water, mercury).

Blanks, both in the field and the analytical laboratory, were used to check for bias resulting from contamination. Blanks were treated the same as samples. No blank corrections were performed on the Phase 2 data. Aldrin, benzo(ghi)perylene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, and diethylphthalate were found in the method blanks that were analyzed with the surface water and pore water samples. Benzoic acid, 1,4-dichlorobenzene, 4-nitrophenol, butylbenzylphthalate, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, diethylphthalate, methoxychlor, pentachlorophenol, pyrene, and alpha-BHC were detected in some of the method blanks that were analyzed with the sediment samples. No significant contamination was found in the inorganic blanks. A few compounds were reported at levels less than the required detection limit.

Calibration data were used to estimate data variability whenever possible because analytical error could be introduced from variability in calibration constants, infrequent recalibration or over-calibration of the analytical system, and unstable calibration standards. Most of the calibrations met criteria. Several batches exhibited continuing calibration criterion outside the acceptance limits in the sediment semivolatile data. For ^{90}Sr analyses, two of the instrument performance assessments were not within acceptance criteria which resulted in flagged data.

Evaluation of the laboratory control samples showed that most met criteria. None of the exceptions resulted in rejected data. Boron recovery for some sample results failed to meet requirements because of the use of borosilicate glassware in the laboratory. Deviations occurred with the semivolatile water LCSs for 4-chloroaniline, 2,4-dinitrotoluene, hexachloroethane, and diethylphthalate. Since none of these compounds were detected in the samples, no qualification of the data was necessary.

Analytical, matrix, and surrogate spikes were used to assess accuracy also. Metals, anions, total kjeldahl nitrogen, and total organic carbon recoveries ranged from 80-100%. For sediment, average recoveries for acidic semivolatile compounds ranged from 40-90%, basic semivolatile compounds ranged from 50-90%, pesticide/PCB compounds ranged from 65-80%, and metals ranged from 15-100%. The lowest metal average recoveries were for antimony, cadmium, and selenium. For surface water and pore water, average recoveries for acidic semivolatile compounds ranged around 60%, basic semivolatile compounds ranged from 15-65%, and pesticide/PCB compounds ranged around 60-80%.

Average recoveries for the organic surrogates are summarized below:

	Sediment	Water	Pore water	Fish
2-chlorophenol-d4	76%			
phenol-d5	82%	63%	58%	
2-fluorophenol	79%	71%	64%	
2,4,6-tribromophenol	84%	85%	75%	
1,2-dichlorobenzene-d4	68%			
nitrobenzene-d5	73%	78%	75%	
2-fluorobiphenyl	83%	74%	72%	
terphenyl-d14	97%	82%	52%	
tetrachloro-m-xylene	87%	63%	48%	90%
decachlorobiphenyl	92%	67%	41%	90%

G4. REPRESENTATIVENESS

All measures taken to ensure that bias was not introduced into the sampling and analysis also contributed to sample representativeness. Measures such as proper preservation, use of standard analytical methods, adherence to appropriate holding times, and use of field and laboratory blanks, equipment rinsates, and proper containers were utilized so that the data would accurately reflect the analyte of interest at the environmental site.

G5. COMPARABILITY

The use of accepted methods and SOPs and participation in intralaboratory performance evaluation testing demonstrated comparability. Sample collection, preservation, storage, preparation, analysis, and reporting were performed consistently so that the end user could confidently compare data sets generated by different sampling events or different laboratories.

G5.1 Comparison of mercury results

Results for total mercury from two different laboratories were compared (Brooks Rand and Lockheed for surface water, Brooks Rand and TMA-ARLI for sediment). Sediment samples were splits from the same core, while surface water samples were collected at the same site, on the same date, at approximately the same time. Eleven surface water and 70 sediment sample pairs were available for comparison.

Results for total mercury from Lockheed for surface water were consistently higher than Brooks Rand results. The correlation coefficient (r) when all samples are included is relatively low (0.286). This low correlation is due primarily to two observations. When observation 10 is removed from consideration, r increases to 0.524, and when both observation 6 and 10 are removed, r increases to 0.875. Samples sent to Brooks Rand were collected by a specialized technique requested by the laboratory, in order to minimize contamination. The consistently higher mercury values from Lockheed may be a result of contamination during sample collection and processing.

Of the 70 sediment sample pairs compared, results from both laboratories were always lower than 13 mg/kg with five exceptions. Results from four of those pairs showed higher than average values from both laboratories (30 to 141 mg/kg). The fifth sample pair had a high result from TMA-ARLI (104 mg/kg) and an approximately average value from Brooks Rand (3 mg/kg). The correlation coefficient, r, for all sediment sample pairs is 0.477. When the five sample pairs discussed above were removed from consideration, sample results from both pairs were relatively consistent ($r = 0.881$).

G5.2 Comparison of Total and Dissolved Concentrations

The total analyte concentration is the concentration determined on an unfiltered samples following vigorous digestion. The dissolved analyte is defined as the analyte present in a representative water sample which passes through a 0.45 micron membrane filter. Dissolved concentration of an analyte must not exceed total concentration in a sample analyzed by the same analytical method. The relative difference is calculated as the percent of the difference between the dissolved and total concentrations divided by the total concentration. The difference was only computed when both the dissolved and total concentrations were greater than the detection limit. Most of the differences between the concentrations can be attributed to the error associated with approaching the detection limit for antimony, arsenic, chromium, copper, lead, molybdenum, nickel, uranium, vanadium, and zinc. Problems with boron may possibly be due to the use of borosilicate glass by the laboratory.

G6. SENSITIVITY

Sensitivity was achieved by requesting the lowest detection limits possible for each analysis, as well as meeting holding times and using the correct sample preservation. The ability to accurately report a contaminant of concern at or above the detection limits was a primary concern in evaluating false positives and false negatives. Early in the project, Brooks Rand failed to qualify data near the method detection limit. During evaluation of the data, the average of the trip blanks was used to qualify the data as detects or nondetects.

G7. CORRECTIVE ACTIONS

During the sampling and analysis process as well as the review process, problems were documented using a Programmatic Exception Report (PER) form (ER/CR-SOP1024). Approximately 400 PERs were filed containing ~850 individual exceptions. A FoxPro data base was used to track each exception and to provide responses back to the disposition team, composed of quality assurance staff, the Analytical Services Coordinator (ASC), the Data Base Manager, and other pertinent personnel. Each deficiency was tracked to closure by Clinch River personnel. Key words that summarized a type of quality problem were assigned to each exception to track quality control trends. The problems were futher categorized into internal or external problems to denote those items which were internal to the program and thus root cause could be addressed. Root cause was not pursued for those items categorized as external problems. Several types of problems were considered repairable during the review process. These included missing information, transcription errors, illegible information, missing chain-of-custody forms, errors in calculation, and missing or incorrect units.

Two major quality control problems identified in internal PERs were data package and field errors. Root causes listed most frequently were inattention to detail, mistakes in specifications, and procedural problems. Externally, the most frequent quality control problems were errors in data packages, electronic data, sample identifications and sample results/units. Although these problems were corrected with no long-term effects on the data quality, the errors did create scheduling conflicts and increased chances of error during the data assessment.

G8. QUALIFICATION OF THE DATA

During review of the field and analytical data, two sets of qualifiers were assigned to the data. The first set was assigned by the analytical laboratory, as required by each individual method. The second set was assigned by the data reviewers. The review qualifiers were also accompanied by one or more reason codes. Analytical results included the concentration of the analyte in the sample if it was present and measurable. When an analyte was not detected in a sample, the sample minimum quantitation limit for that particular sample was reported accompanied by a "U" suffix. When spectral data indicated the presence of an organic compound that met the identification criteria but the result was less than the sample quantitation limit, a "J" qualifier was assigned, indicating that the result was an estimated value. In data analyses, these "J" values were treated as measurable results.

The result qualifiers assigned by the laboratories, validators, and electronic screening were summarized into an overall qualifer for end users. Only qualifers which affected how the data are used were included in the overall qualifier. Under the risk assessment guidelines used for the project, data were either rejected, treated as nondetects, or used as reported. Additional data checking was performed as the data were summarized and evaluated for the health and ecological baseline risk assessments.

An end result use flag was also assigned to each data result. The use flag was either "Y" to symbolize that the data were usable or "N" for unusable data. Although rejected data was assigned an "N" for unusable, the primary reason for unusable data was duplication of sample results because of dilution, reanalysis, analysis by another method, or second column confirmation analysis for pesticides/PCBs.

An overall summary of the quality control problems found during data validation using the assigned reason codes shows that the predominant reasons for rejected results were poor spike recoveries and holding times.

G9. DATA REVIEW

The primary goal of the Clinch River Environmental Restoration Program was to ensure that the analysis of all these environmental samples produced data of known quality. According to EPA, "the quality of data is known when all components associated with its derivation are thoroughly documented, with such documentation being verifiable and defensible" (EPA 1990). To meet this goal, data used in this CRRI report were evaluated using the following techniques, as applicable: **field data review, electronic data verification, data inventory, contract compliance screening, electronic review, manual review, and Level C or D validation.** During each level of review, if problems were found which might affect the useability of the data, the sample results were qualified. The origination of the qualifier and the reason for qualifying the data were also documented. These qualifiers were condensed into one final useability code for the end user. The final phase of the evaluation which entailed assessing the contaminant data by location and risk used these final qualifiers and useability codes as indicators of the quality of the data.

For the **field data review**, a field data package containing all field sampling related documentation was assembled for each water and sediment sampling event . The field sampling related documentation included the weekly sampling schedule, the Field COCs, the Field Collection Task Map (FCTM), the Laboratory Processing Task Map (LPTM), the Sample Collection Information form, site maps or geographic positioning system data, field data forms, the Field Sampling Review Checklist, and copies of pertinent field logbook pages. An internal inventory and field data review was initially conducted by the sampling team leader according to ER/CR-SOP2020. Documentation of the internal inventory and review was also included in the field data package. Following the internal review, an independent assessment was performed by a field validator. The field validator was a person experienced in field sample collection who was not a member of the sampling team. Field data obtained during the sample collection event were assigned qualifiers by the field validator.

The first five sampling events for Phase 2 occurred in November 1993. Seventy-two PER indices were initiated which pertained to the sample collection and processing activities for these five sampling events. Twenty-four indices pertained to improper/missing signature or corrections, twenty-three pertained to missing data, six pertained to inadequate sample volume, six pertained to incorrect task maps, and four pertained to COC problems. The remaining nine indices pertained to six other quality control categories.

The remaining 126 sampling events for Phase 2 occurred after November 1993. Only 24 additional PER indices were initiated which pertained to sample collection and processing activities. For the five quality control categories which accounted for 63 of the 72 PER indices initiated for the first five sampling events, only 5 additional PER indices were initiated for the subsequent 126 sampling events. Seven PER indices pertained to field equipment failure, three PER indices pertained to calibration problems, and three PER indices pertained to inadequate equipment backup. The remaining 11 PER indices pertained to 10 other quality control categories. The considerable reduction of PER indices initiated for the last 126 sampling events versus the first five sampling events demonstrates the value of both a field sample collection documentation/field data validation review process and a program level exception documentation and resolution process for environmental restoration activities. As a result of the field data review, the sampling events were completely and consistently documented.

During the **electronic data verification**, an evaluation of the project data base was performed to ensure accountability, traceability, correctness, and completeness. Accountability checks included confirming that data collectors and generators were identified and reviewing data transfer and data entry documentation. Data base entries were cross checked with hard copy sources such as COCs, Sample Collection forms, data packages and data validation reports. Correctness checks involved verification of data transfer processes, double data entry, and comparison of data base values with the source. Completeness checks verified that all required descriptors for both samples and individual results were present, correct, and consistent with applicable plans and procedures, and/or Oak Ridge Environmental Information System (OREIS) formats. These checks reviewed locations, coordinates, sample ids, units, dates laboratory sample Ids, methods, parameter names, result formats, laboratory flags, and validation flags, among others.

Data inventory of all data packages was conducted to verify completeness and ensure that any missing deliverables could be obtained before the final report was compiled. Inventory was conducted according to procedure ER/CR-SOP1019.

A **manual review** of all data package batch narratives was conducted and summarized. These reviews were also used to flag data that did not meet criteria.

Contract compliance screening (CCS) was used initially for EPA Contract Laboratory Program (CLP) electronic deliverables to assess the adequacy of the electronic files. One hundred and twelve electronic deliverables were screened for potential formatting problems and CLP SOW compliance.

An **electronic review** of selected quality control information was conducted. Results of these checks were compared with other available information such as the CCS, inventory and validation. Data that did not meet criteria were flagged with the appropriate qualifiers and reason codes and the type of review was designated. Organic laboratory blank contamination for sediment and water samples was assessed electronically and the data were flagged according to the guidelines in ER/CR-SOP1020. Holding times, surrogates, matrix spikes, and detection limits were also evaluated for sediment and water data. Biota data were evaluated when available electronically.

Validation was conducted according to ER/CR-SOP1020 which was written to address EPA criteria, Clinch River data quality objectives as expressed in a given laboratory Statement of Work (SOW), and specific method requirements. Approximately 118 sample data packages were validated by an independent third-party subcontractor from the 900 data packages that were received. Subcontractor personnel performing the validation were required by the Clinch River ER Program SOW to be trained, experienced, and proven able to perform the review procedures. The Clinch River ER Program required, reviewed, and approved resumes and work training records. Data review deliverables for the validation consisted of the following:

- A data validation narrative summarizing by fraction the problems found that affected the data quality and the potential impact on the sample results. (Each narrative includes the name and signature of the data reviewer.)
- A completed checklist that detailed the review elements and QC problems
- Report forms for each sample with validation qualifers and reason codes assigned to each analyte result
- A list of data review qualifiers and their meanings for use in the data evaluation

After validation was completed, the subcontractor entered the validation qualifiers into the data base. Each qualifier was also accompanied by one or more reason codes that summarized the qualifier assignment as well as a code which identified the source of the qualifier.

G10. DATA MANAGEMENT SYSTEMS

A comprehensive Information Management System (IMS) was used to provide organization, integrity, security, traceability, and consistency of the data generated during Phase 2. Specifically, the IMS supported the project data lifecycle, including field sampling preparation, field measurements, sample tracking, laboratory analyses of environmental samples, data verification and validation, data consolidation and storage, and data transfer to OREIS, data analysis and interpretation, summarization and reduction of data, risk assessment calculations, data presentation, and data and document archival.

An ORACLE® data base was used to implement the IMS. Constraints were defined in the data base to ensure proper linkage of sample collection and analysis data and to enforce use of standardized codes. The data base resides on the Clinch River Project SPARC 10 workstation. The data base is protected from unauthorized access, deletion and modification by the ORACLE® security. Daily and weekly backups of the data base were performed and the weekly backup tapes were stored off-site.

Records generated by the program that are required to (1) provide a complete and accurate history of sample collection, analysis, and data reporting; (2) document conduct of program business; and (3) support any future legal or administrative actions that may be taken are retained in the project files. Similarly, records that furnish documentation or evidence of quality (e.g., program work plans and results of QA oversight activities) were designated QA records and added to the project files.

Records identified for Phase 2 sampling and analysis activities included project plans and approvals, field and laboratory notebooks, chain-of-custody and request-for-analysis forms, instrument listings for gamma spectroscopy, analytical laboratory data packages, and data validation summary reports.

A hard-copy repository is maintained in the Clinch River ER Program Document Management Center (DMC), which is located at ORNL, Building 1505. This repository and associated index data base provide for the organization, protection, retrievability, and accountability of project records. The indexing system provides sufficient information to permit identification of the record and the items or activities to which it applies.

A CERCLA administrative record file will be the recipient of officially designated documents.

G11. AUDITS AND SURVEILLANCES

Audits and surveillances were performed by DOE Oak Ridge Operations (DOE-ORO); Martin Marietta Energy Systems, Inc. Central QA; and the Energy Systems Environmental Restoration (ER) QA specialist who reviewed and evaluated the adequacy of field and laboratory performance and ascertained whether the QA/QC Plan was completely and uniformly implemented. Results of these audits and surveillances were documented and reported to management. Follow-up corrective actions were taken as needed. Implementation was monitored by the Clinch River QA specialist and verified by the auditing organization.

The chronology of Readiness Review Assessments, Audits and Surveillances was as follows:

March 23-25, 1993	93CRRI-Q1 Surveillance to assess the state of readiness for Phase-2 Biota Field Sampling and Analysis.
April 28, 1993	93CRRI-L1 Surveillance to determine the TVA-Chattanooga Environmental Chemistry Laboratory plans to document and track all corrective actions for internal and external problems associated with samples received from the CR-ERP.
April 30, 1993	93CRRI-Q2 Surveillance to assess the state of readiness for Phase-2 Sediment Field Sampling and Analysis(S&A) & Water Toxicity Testing.
May 26, 1993	93CRRI-Q3 Surveillance to assess the state of readiness for Phase-2 Expanded Water & Sediment Toxicity Field Sampling and Analysis.
June 23, 1993	93CRRI-M3 Surveillance to verify that Phase-2 Biota(fish) Field Sampling and Analysis is conducted in accordance with the Phase-2 S&A Plan & SOPs.
June 28–July 21, 1993	DOE-ER Annual CR-ER Program Audit to evaluate the overall effectiveness of the CR-RI in collecting data of sufficient quality for technically defensible site remediation decisions.
August 30, 1993	Readiness Assessment Meeting for Phase-2 of the CR-RI.
September 28, 1993	93CRRI-M4 Surveillance to monitor and assess Phase-2 Sediment Field Sampling.
October 26, 1993	93CRRI-M5 Surveillance to verify that Phase-2 Biota(fish) S&A done by the TVA-Norris Aquatic Biology Group is being accomplished in accordance with the CRRI-Phase-2 S&A Plan and SOPs.
November 18, 1993	93CRRI-M6 Surveillance conducted to verify that CR-ERP Phase-2 Expanded Water S&A Field Activities are being done in accordance with the CR-ERP Phase-2 S&A Plan and SOPs.
December 20, 1993	93CRRI-M7 Surveillance to verify that corrective actions for deficiencies identified in surveillance 93CRRI-M6 have been satisfactorily completed.
Deccember 15-16, 1993	DOE-ER CR-ERP Field Surveillance to evaluate the overall effectiveness of the CR-RI Phase-2 Sampling Program in collecting data of sufficient quality for technically defensible site remediation decisions.
February 24, 1994	94CRRI-M1 Surveillance to verify that Phase-2 Sample Management/Tracking and Related Documentation are being conducted according to CR-ERP Phase-2 guidelines and procedures.

February 24-25, 1994	94CRRI-M2 Surveillance to verify the Traceability of Records from Phase-2 Field S&A activities are being maintained according to applicable sections of the CR-ERP Phase-2 Technical Management Plan.
March 30, 1994	94CRRI-M3 Surveillance to determine the Status of Corrective Actions that are due for completion from past DOE-ER, MMES-ER, and other Phase-2 internal/project audits/surveillances.
April 25-29, 1994	94CRRI-M4 Surveillance to verify that Phase-2 Multi-Head Ballchek Sediment Core S&A is conducted in accordance with the CRRI Phase-2 S&A Plan, Sect. 3.3, and CR-ERP Work Aid WA-93-SW-10.
May 9-23, 1994	94CRRI-M5 Surveillance to verify that Field Sampling Activities for Other Biota(Blue Heron, Woodduck, & Contaminant Pathways in Food webs-MayFlies & Crayfish) is being conducted in accordance with the CR-ERP S&A Plan, Sect.3,4 and pertinent Phase-2 CR-ERP Biota procedure or work aid.
June 10, 1994	94CRRI-M6 Surveillance to verify that Phase-2 Deliverables from Subcontracted Analytical laboratories are being tracked to assure Phase-2 Task/SOW requirements and time frames are met.
July, 1994–	DOE-ER Annual CR-ER Program Audit.
August 26, 1994	94CRRI-M7 Surveillance to evaluate the effectiveness of the system being used to track all types(i.e., QC) of Phase-2 samples for the QA/QC report.
Sept. 28-29,1994	94CRRI-M8 Surveillance to evaluate the Phase-2 Data Validation results and assessment to date.
October 26, 1994	94CRRI-M9 Surveillance to verify that Phase-2 Biota(fish-Biology Survey) Field S&A is conducted in accordance with the Phase-2 CR-ERP S&A and SOPs.
Nov. 29-30, 1994	94CRRI-M10 Surveillance to verify that all CR-ERP Phase-2 Task Leaders can account for all,of their samples per requirements of Phase-2 S&A Plan, Addendum DOE/OR/01-1254&D1, Sect. 3.0.
December 19, 1994	94CRRI-M11 Surveillance to verify that all CR-ERP Phase-2 documentation and records are being maintained in a traceable manner to ensure the defensibility of all Phase-2 data.
January 27, 1995	95CRRI-M1 Surveillance to verify that all Phase-2 Deliverables from Subcontracted Analytical Laboratories, and Data Validation results are being completed and useability determined(per CR-ERP FY-95 milestone schedule for the RI/FS.
February 28, 1995	95CRRI-M2 Surveillance to determine if the Status and Schedule for the Preparation and Peer Review Process for the CR/Poplar Creek RI/FS Report has been established to ensure that all RI/FS sub-elements are completed in time to meet established dates.
March 30, 1995	95CRRI-M3 Surveillance to determine the Status of Corrective Actions that are due for completion from past DOE-ER, MMES-ER, and other internal/project audits/surveillances.

G12. STANDARD OPERATING PROCEDURES AND TRAINING

Whenever applicable, existing procedures were used for CRRI activities. Field sampling procedures from Kimbrough et al. (1990) were used, and many EPA Contract Laboratory Program (CLP) analytical procedures (field and laboratory) were specified. Procedures were developed to support technical and administrative activities of the CRRI when none existed. These activities included the following:

- Sampling processes
- Sample handling/custody
- Calibration of equipment used in obtaining samples and/or data
- Analytical processes
- Data reduction, validation, and reporting
- Internal QC checks
- Audits
- Surveillance and corrective action processes
- Specific routine functions required to assess data precision and completeness

The CRRI training program consisted of a training plan, which defined requirements for training frequency and trainer designation; a training needs assessment, which identified personnel to be trained; and the actual training on CRRI procedures. Training was completed as required in the appropriate SOP, and training records were maintained by the training coordinator for the CRRI. Generally, the extent of training was commensurate with the scope, complexity, and nature of the activity and the education, experience, and proficiency of the person.

G13. LESSONS LEARNED

Project Statements of Work

- Provide guidance/requirements in SOWs on how the laboratory should proceed if sample volume is insufficient to perform all requested analyses, including that the laboratory will be required to get guidance from CR-ERP as to which analyses are priority. This applies especially to biota samples, where volumes may vary depending on individual animals.

- Specify that the case narrative must list the IDs for samples reported in the package and must provide a cross-reference to laboratory sample IDs. Specify that any references to samples must include the project sample ID.

- Specify that the pages in the data package must be single-sided and on 8-1/2 x 11 paper and that notes should not be left on pages unless they are taped down so that they will go through the copier. (Response to TVA packages)

- In the future, the SOW should state that if the laboratory needs to report sample matrix/type other than as on COC (perhaps for software reasons), the laboratory should explain why in the case narrative (i.e., why the forms don't match COC). For example, if the sample matrix is listed as CART F on the COC and the laboratory had to report it as water due to software/program requirements, the case narrative should state that this occurred. (See PER-0228)

- All method numbers listed in SOWs should be verified before the SOW is final to ensure that the numbers referenced are for the desired method.

- Require that laboratories batch, analyze, and report no more than 20 samples in a batch. Check logins to ensure that no more than 20 are listed.

- Do not assign SDGs before samples are shipped. Track outgoing samples by the COC number. After the samples are logged in by the laboratory, track them by the SDG assigned by the laboratory.

- In results, laboratories sometimes discussed/referenced only pesticides or only PPCBs. Clarify the meaning of the acronym PPCB. (See response to PER-0093.)

- Resolve with Brooks Rand the question of the volume required for spikes. (Reference PER-0111.) They received what they requested but responded to PERs regarding batches of more than 20 samples by saying they had inadequate sample volume.

- Require the laboratory to more fully document the temperature and condition of cooler contents when they send confirmation of receipt of a shipment. Revise the sample login form to include a blank space for the laboratory to record temperature.

- To the extent possible, it is preferable to have only one SOW with a laboratory for like matrices and analyses (i.e., it would have been preferable to have SOWs 191 and 194 combined rather than separate.)

- To eliminate the possibility of misunderstanding, the SOWs with the laboratories should state that the due dates for deliverables are based on calendar days, not work days (i.e., 60 days means 60 calendar days, not 12 work weeks).

- Place more emphasis on and include specific instructions regarding how the laboratories should notify the project about problems, especially those discovered at receipt of samples.

APO Statements of Work

- Review of analytical laboratory SOWs needs to include a requirement that laboratories have back-up analytical equipment, parts, or access to back-up equipment in the event that primary equipment fails. (Ref. PER-94-CRRI-0108) (Suzanne Benson's file: 006769)

- The laboratory should prepare an EDD as part of the PE package. The ability of the laboratory to provide an acceptable EDD should be considered part of the qualification of the laboratory to provide services.

Field Data Validation

- Field validation proved to be very successful in identifying types of errors made at the beginning of field sample collection and processing. This enabled the field teams to proactively implement corrective actions that prevented recurrences of the errors.

- The proceduralized, real-time internal review by the sampling team of collection activities through examination of documentation precluded the need for programmatic exception reports.

Shipping

- The Coleman Sample Manager™ brand aluminum coolers proved to be more effective than the plastic coolers in consistently maintaining the samples at the desired temperature range of 4°C (+/- 2°) while in transit to the designated laboratory. Typically, these metal coolers were capable of maintaining the desired internal chamber temperature for one day longer than the plastic coolers.

- The metal coolers provided more protection for the glass sample containers, resulting in less breakage.

- For the first few months, glass sample containers were wrapped with plastic air-bubble packaging only once around the entire glass circumference, including the top and bottom. In response to the recurring problem of glass bottle breakage, sample containers were double wrapped with the bubble wrap material, and this significantly reduced instances of glass container breakage.

- Preparing coolers simultaneously for shipments to multiple analytical laboratories resulted in incorrect marking of the outside of one cooler, delivery to the wrong laboratory, and a two-day delay in delivery of samples to the correct laboratory. The temperatures of the affected samples were elevated above required preservation levels. To prevent this type of incident from recurring, whenever samples were shipped to two or more off-site laboratories on the same day, all shipping transactions were completed for one laboratory at a time.

- There was a total inventory of 25 coolers used for shipping Phase 2 samples to the various laboratories. This number was just barely adequate even under the scaled down volume of revised Phase 2 volume of sample collections. During each of the three separate "mega sampling events," the number of available coolers was less than adequate. CRERP should probably have had between 15 to 20 more coolers in order to have been able to consistently ship samples within one or two days after field collection rather than sometimes waiting three to four days to ship organic samples, and five to 8 days when shipping inorganic samples. Additionally, supplies of blue ice packs sometimes became a bigger issue than the coolers themselves during peak periods of shipping "mega sampling event" samples.

- Lockheed Analytical Services was the best of all the laboratories used during Phase 2 in returning coolers and ice pack supplies in a consistent, timely manner (i.e., return receipt usually within four days of leaving ORNL). The other out-of-state laboratories were slower, usually taking about ten to fourteen days for a cooler to return. There were several instances when the laboratory was contacted and faster turnaround times on returning CR-ERP coolers was requested. This resulted in only marginal, sporadic improvements. No consistent improvements were noticed. The only way to compensate for most of the laboratories being slow to return coolers would be to have more coolers and associated cooler supplies.

- Since the original sampling volume for Phase 2 was significantly scaled down, the available refrigerator storage space was always sufficient. The refrigerator storage space was sometimes a little tight, but nevertheless adequate. However, had there been no sample collection reduction for Phase 2, the existing refrigerator storage space would have been a problem. One large commercial TRUE™ refrigerator and two standard household-type refrigerators were used during Phase 2. Had the numbers of samples been collected as originally planned for Phase 2, one or more refrigerators would most likely have to have been procured and set up in the greenhouse.

- During Phase 2, leakage of water from sediments collected in the 8 oz. and 16 oz. plastic jars was a continuing problem even though there were internal adjustments to sample collection and processing. The root cause was determined to be excessive sediment on the threads of the sample jar even though CRERP personnel wiped the jar threads and lids. In the future, jars with wider openings will be used so that sediments can be put into the jars without getting grains of sample on the threads.

- Double bagging samples in plastic bags prevented liquid leaking out of the bags when sample containers broke or lids cracked during shipment.

- Include a temperature trip blank with shipments. Also include additional volume of chilled water in the cooler if only a few samples (i.e., 6-10) are shipped in a large cooler.

- During Phase 2, samples were wrapped the day before they were scheduled to be shipped from ORNL. This proved to be a good practice because it always allowed sufficient time to correct or compensate for any unplanned deviation or added work task associated with preparing a specific batch of samples for off-site shipment.

- Ensure that all samples, including biota samples, are shipped according to CRERP procedures or alternative procedures that have been reviewed and accepted by CRERP.

- Shipping work aids were written and implemented for preparation of required shipping records, sample tracking, and sample packaging and shipping. All three of these work aids proved to be very helpful.

- The use of a separate shipping folder for each day for each laboratory was very helpful.

- The establishment and use of a sample shipment checklist was very helpful to ensure a minimum number of errors or omissions when packing coolers and shipping to the associated analytical laboratory.

Data Package Receipt, Tracking, Handling

- For future projects, the data group assigned by the laboratory should be entered into the data base from the login faxed from the laboratory instead of when the data package is received.

- Improve review of the login for correct entry by the laboratory of sample ID, analysis, date received, etc.

- DMC photocopying errors indicate a need for upgraded photocopying equipment.

- In the future a space similar to that provided for the data base support staff would enable analytical services staff to work more efficiently. The space could also be used for the collection and maintenance of a project file.

- The use of colored folders was very helpful.

Data Base

- Do not start the project until the data base is ready.

- The use of data base-generated COC and SAR forms worked well. The project believes this approach contributed to quality by eliminating errors related to transcription, poor handwriting, or reproduction of handwritten COC or SAR forms.

- Consider supplying an electronic form of the COC to laboratories when samples are shipped. Having the laboratory use the electronic COC could eliminate transcription errors in IDs by the laboratory.

- Track all samples, including biota samples, in one data base.

- Use ORACLE rather than SAS for interactive data entry-type systems to avoid data base deadlock.

Electronic Data Deliverables

- The format of EDDs should be determined and communicated to the laboratory before the project begins.

- The laboratory should be required to demonstrate its ability to provide data in desired formats as part of qualification for the work.

- Memos transmitting EDDs to the Information Management Group should include the date the EDD was received.

- All copies of all disks should have the date received written on the label, including copies made by Information Management Group.

- Printing a list of files on diskette deliverables and taping the list to the diskette was a good idea.

- Lesson reinforced: All diskettes and data received by the project, including data received via modem, should be scanned for viruses.

- File EDDs and revised EDDs in diskette box holders by laboratory and SOW. After all diskettes are received, transfer to notebooks. This will enable all versions of a diskette to be filed together sequentially easily during the project. Don't attempt to submit EDDs to the DMC until the end of the project.

- Require the laboratories to submit a printed copy of the electronic files and verify in writing that the EDD has been checked against the hardcopy data package. Until no problems with the EDD exist, verify all electronic files against hardcopy packages.

Biota Samples

- Avoid the use of the following letters in sample IDs: "O," which may be incorrectly entered by the laboratory as a zero; "S," which may be entered as 5; "Z," which may be entered as 2; and "L" or

"I," which may be entered as 1. Handwritten zeroes should be crossed to avoid confusion with the letter "O."

- Ensure that biota samples are shipped according to CR-ERP procedures or alternative procedures that have been reviewed and accepted by CR-ERP.

- Generate Task Maps and COC and Sample Analysis Request forms for biota samples from the data base in the future.

Inventory

- Revise the inventory procedure, refining what is to be reviewed (e.g., CAS numbers?).

- Revise the inventory procedure to require that all handwritten PERs identify samples affected by the CRERP ID number, i.e., that the PER does just not say "a sample was _____" without identifying the sample by ID.

- Revise the inventory procedure to note that if a case narrative says all QC parameters were in control, the inventory specialist should take that to include calibration, continuing calibration, spikes, blanks, holding times.

- Revise inventory procedure to identify forms not required for a given analysis (e.g., Form 4 for tritium analyses, Form 11 for ICP/MS analyses.)

Validation

- Revise the validation procedure so that any detection limits that are below the method detection limits will be reviewed specifically for compliance to the SOW, not the method.

Programmatic Exception Reports

- Review and close PERs in a more timely manner.

- When items are identified as missing during inventory or validation, before contacting the laboratory review the hard copy original received from the laboratory to ensure that omission is not a project photocopying error.

- To avoid entering the same item twice in the PER tracking data base, write a program that will query the operator when a sample ID is entered and has already been entered once.

- Centralize the PER data base.

- Revise the PER procedure to lessen paperwork and redefine responsibilities.

Appendix H

BASIS FOR COST ESTIMATE

BASIS FOR COST ESTIMATE

Clinch River/Poplar Creek
Feasibility Study

ALTERNATIVE 2 (Institutional Controls and Advisories)

General Assumptions:

* The estimate has been prepared in Automated Estimating System (AES) format using the ERDEC94c.val standard value file for labor and escalation rates.
* Cost for deed restrictions, public advisories, and permit programs have been included in the estimated cost.
* A project contingency of 25 percent has been applied to this estimate due to the level of design at the feasibility study stage.
* Supporting activities and participants required for project management, planning, and engineering have been included based on historical data and best engineering judgement.
* Monitoring costs are included at $270,000 per year. This estimated cost is based on the monitoring plan for Lower Watts Bar.

Work Breakdown Structure (WBS):

Below is the WBS to the 4th level with associated participants.

WBS	Title	Participant	Title
2.0	Alternative 2		
2.1	Capital Cost		
2.1.1	Direct Cost		
2.1.1.1	Deed Restriction	Z001	Special
2.1.1.2	Public Advisories	Z001	Special
2.1.1.3	Permit Programs	Z001	Special
2.1.2	Indirect Cost		
2.1.2.1	RA Integration	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		SC01	Offsite Subcontractor
		TS01	Tech. Support Contractor
2.1.2.2	Remedial Design Work Plan	AE01	RD A/E
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor

WBS	Title	Participant	Title
2.1.2.3	Remedial Design Report	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor
		X035	OFC Env Compliance & Doc
2.1.2.4	Remedial Action Work Plan	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor
2.2.1	Monitoring and Maintenance		
2.2.1.2	Monitoring	C004	Analytical Services

Project Schedule:

Below is the assumed project schedule used to prepare the estimate.

Activity	Start		End
Remedial Design Work Plan	04/01/96		06/01/96
Remedial Design Report	06/01/96		12/01/96
Remedial Action Work Plan	12/01/96		02/01/97
Remedial Action	02/01/97		10/01/97
Monitoring and Maintenance	02/01/97	30 years	02/01/27

Reports:

The following AES reports are attached.

- Summary Report per WBS/Attribute/Participant
- Detail Report
- Life-Cycle Cost Analysis (Present Value)

SUMMARY REPORT
Project Number: 5301
CLINCH RIV/POPULAR CREEK ALT 2

Project ESO Number......N/A
Revision Number.........0
Last Update.............06/08/1995

Sort Order
1. WBS - Level 3
2. B/M Attribute
3. Participant

Approved by:

Project Estimator — Date 8/8/95

Estimating Manager — Date 8/8/95

Base Fiscal Year/Quarter: 95/3
STANDARD VALUE: C:\AES6.OF\ERDEC94C.val EXPIRES: 03/15/1996
ESTIMATE FILE: C:\AES6.OF\CRPCFS.Est 06/08/1995
SCHEDULE FILE: CRPCSCH
REPORT FILE: C:\AES6.OF\CRPCSUM.Out 06/08/1995 13:21:59

AES Version 6.0f

CLINCH RIV/POPULAR CREEK ALT 2

SUMMARY REPORT
$1 = $1000

06/08/1995

Arranged By: WBS / B/M Attribute / Participant Code

	Unescalated Material $	Unescalated Labor $	Unescalated Total $	Escalated Material $	Escalated Labor $	Escalated Total $
2.1.1 DIRECT COST						
2.1.1.1 DEED RESTRICTIONS						
Z001 SPECIAL	1	14	15	1	16	17
TOTAL DEED RESTRICTIONS	1	14	15	1	16	17
2.1.1.2 PUBLIC ADVISORIES						
Z001 SPECIAL	45	630	675	48	679	727
TOTAL PUBLIC ADVISORIES	45	630	675	48	679	727
2.1.1.3 PERMIT PROGRAMS						
Z001 SPECIAL	2	29	31	3	31	34
TOTAL PERMIT PROGRAMS	2	29	31	3	31	34
TOTAL DIRECT COST	48	673	721	52	726	778
2.1.2 INDIRECT COST						
2.1.2.1 RA INTEGRATION						
AE01 ARCHITECT-ENGINEER	0	3	3	0	3	3
C069 CENTRAL ENGINEERING	0	2	2	0	2	2
C087 ENVIRONMENTAL RESTORATION	0	60	60	0	64	64
SC01 OFFSITE SUBCONTRACT	0	7	7	0	7	7
TS01 TECH SUPPORT CONTRACTOR	0	5	5	0	5	5
TOTAL RA INTEGRATION	0	77	77	0	81	81
2.1.2.2 REMEDIAL DESIGN WORK PLAN						
AE01 ARCHITECT-ENGINEER	0	9	9	0	9	9
C087 ENVIRONMENTAL RESTORATION	0	3	3	0	3	3
MK67 MK-F DIRECTS ON FP	0	1	1	0	1	1
TS01 TECH SUPPORT CONTRACTOR	0	2	2	0	3	3
TOTAL REMEDIAL DESIGN WORK PLAN	0	15	15	0	16	16
2.1.2.3 REMEDIAL DESIGN REPORT						

CLINCH RIV/POPULAR CREEK ALT 2

SUMMARY REPORT
$1 = $1000

06/08/1995

Arranged By: WBS / B/M Attribute / Participant Code

	Unescalated Material $	Unescalated Labor $	Unescalated Total $	Escalated Material $	Escalated Labor $	Escalated Total $
2.1.2 INDIRECT COST						
2.1.2.3 REMEDIAL DESIGN REPORT						
AE01 ARCHITECT-ENGINEER	2	18	20	2	19	21
C069 CENTRAL ENGINEERING	0	3	3	0	4	4
C087 ENVIRONMENTAL RESTORATION	0	22	22	0	23	23
MK67 MK-F DIRECTS ON FP	0	5	5	0	6	6
TS01 TECH SUPPORT CONTRACTOR	0	2	2	0	3	3
X035 OFC ENV COMPLIANCE & DOC	0	1	1	0	1	1
TOTAL REMEDIAL DESIGN REPORT	2	51	53	2	56	58
2.1.2.4 REMEDIAL ACTION WORK PLAN						
AE01 ARCHITECT-ENGINEER	0	3	3	0	3	3
C069 CENTRAL ENGINEERING	0	1	1	0	1	1
C087 ENVIRONMENTAL RESTORATION	0	3	3	0	3	3
MK67 MK-F DIRECTS ON FP	2	8	10	2	8	10
TS01 TECH SUPPORT CONTRACTOR	0	1	1	0	1	1
TOTAL REMEDIAL ACTION WORK PLAN	2	16	18	2	16	18
TOTAL INDIRECT COST	4	159	163	4	169	173
2.2.1 MONITORING AND MAINTENANCE						
2.2.1.2 MONITORING						
C004 ANALYTICAL SERVICES	8100	0	8100	10030	0	10030
TOTAL MONITORING	8100	0	8100	10030	0	10030
TOTAL MONITORING AND MAINTENANCE	8100	0	8100	10030	0	10030
SUB - TOTAL	8152	832	8984	10086	895	10981
OVERHEAD	0	0	0	0	0	0
SUB - TOTAL	8152	832	8984	10086	895	10981
CONTINGENCY	2038	208	2246	2522	224	2746
GRAND TOTAL	10190	1040	11230	12608	1119	13727

DETAIL REPORT
Project Number: 5301
CLINCH RIV/POPULAR CREEK ALT 2

Project ESO Number......N/A
Revision Number.........0
Last Update.............06/08/1995

Sort Order
1. WBS - Level 9
2. B/M Attribute
3. Participant

Approved by: ______________________ 8/8/95
Project Estimator Date
______________________ 8/8/95
Estimating Manager Date

Base Fiscal Year/Quarter: 95/3
STANDARD VALUE: C:\AES6.0F\ERDEC94C.val EXPIRES: 03/15/1996
ESTIMATE FILE: C:\AES6.0F\CRPCFS.Est 06/08/1995
SCHEDULE FILE: CRPCSCH
REPORT FILE: C:\AES6.0F\CRPCDEL.Out 06/08/1995 13:07:37

AES Version 6.0f

CLINCH RIV/POPULAR CREEK ALT 2

Creation Date 03/13/1995
Revision Number ... 0

Estimating Job Number .. 5301-1

Project Estimator.. DH BOLLING
WBS .... 2.1.1.1 DEED RESTRICTIONS
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.1 DEED RESTRICTIONS
Discipline .... 0 OTHER
B/M Title .... DEED RESTRICTIONS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Project Engineer .... S BROOKS
Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.1 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	LEGAL REPRESNTATIVE TO IMPLIMENT DEED RESTRICTIONS	Matl.	120.00	HRS	10.00	1,200	
		Labor	120	LR	120.00	14,400	15,600

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	1,200	14,400	15,600
TOTAL	1,200	(hrs. 120) 14,400	15,600

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.1.2 PUBLIC ADVISORIES
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.2 PUBLIC ADVISORIES
Discipline .... O OTHER
B/M Title .... PUBLIC ADVISORIES
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.2 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TDEC PUBLIC ADVISORIES FOR FISH CONSUMPTION AND WATER CONTACT (ALLOWANCE OF 420 HRS/YR & 1500/YR)	Matl. Labor	30.00 12,600	YRS X	1,500.00 50.00	45,000 630,000	675,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	45,000	630,000	675,000
TOTAL	45,000	(hrs. 12,600) 630,000	675,000

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.1.3 PERMIT PROGRAMS
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.3 PERMIT PROGRAMS
Discipline .... O OTHER
B/M Title .... PERMIT PROGRAMS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.3 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TVA AND THE ACOE CO-MANAGERS OF THE WATERWAY WILL MODIFY AS REQUIRED RESTRICITIONS ON DREDGING.	Matl. Labor	240.00 240	HR LR	10.00 120.00	2,400 28,800	31,200

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	2,400	28,800	31,200
TOTAL	2,400	(hrs. 240) 28,800	31,200

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.6 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ER A/E TITLE III (MINIMUM EFFORT)	Matl.	1.00	LOT	0.00	0	
		Labor	40	ER	75.00	3,000	3,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	3,000	3,000
TOTAL	0	(hrs. 40) 3,000	3,000

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... O OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.7 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM TITLE III (MINIMUN EFFORT)	Matl. Labor	1.00 40	LOT A1	0.00 57.70	0 2,308	2,308

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	2,308	2,308
TOTAL	0	(hrs. 40) 2,308	2,308

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.8 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM PROJECT MANAGEMENT (1 FTE)	Matl.	8.00	MONTHS	0.00	0	
		Labor	1,384	A1	43.00	59,512	59,512

BILL OF MATERIAL SUMMARY	Material	Labor		Total Cost M + L
TOTAL DIRECT	0		59,512	59,512
TOTAL	0	(hrs. 1,384)	59,512	59,512

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... SC01 OFFSITE SUBCONTRACT
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.5 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	INDEPENDENT CERTIFICATION OF RA	Matl.	1.00	LOT	0.00	0	
		Labor	120	IC	55.00	6,600	6,600

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	6,600	6,600
TOTAL	0	(hrs. 120) 6,600	6,600

WBS .... 2.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.4 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR MONITORING OF RA TO INSURE COMPLIANCE	Matl. Labor	80.00 80	HRS TS	0.00 60.89	0 4,871	 4,871

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	4,871	4,871
TOTAL	0	(hrs. 80) 4,871	4,871

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.10 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	RD A/E PLANNING/COORDINATION (DOES THE REPORT)	Matl.	1.00	LOT	0.00	0	
		Labor	120	ER	75.00	9,000	9,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	9,000	9,000
TOTAL	0	(hrs. 120) 9,000	9,000

WBS .... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.12 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT	Matl.	1.00	LOT	0.00	0	
		Labor	60	A1	43.00	2,580	2,580

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	2,580	2,580
TOTAL	0	(hrs. 60) 2,580	2,580

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.11 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PLANNING (MINIMUM EFFORT)	Matl.	20.00	HRS	0.00	0	
		Labor	20	MR	57.68	1,154	1,154

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		0		1,154	1,154
TOTAL INDIRECT	14.00%	0	14.00%	162	162
TOTAL		0	(hrs. 20)	1,316	1,316

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.9 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTERFACE	Matl.	1.00	LOT	0.00	0	
		Labor	40	TS	60.89	2,436	2,436

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	2,436	2,436
TOTAL	0	(hrs. 40) 2,436	2,436

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.14 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PREPARE PLAN AND SPECS	Matl.	1.00	LOT	2,000.00	2,000	
		Labor	240	ER	75.00	18,000	20,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	2,000	18,000	20,000
TOTAL	2,000	(hrs. 240) 18,000	20,000

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.16 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM DESIGN AND PROJECT	Matl.	1.00	LOT	0.00	0	
	LIAISON	Labor	60	A1	57.70	3,462	3,462

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	3,462	3,462
TOTAL	0	(hrs. 60) 3,462	3,462

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.17 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT (1 FTE)	Matl.	520.00	HRS	0.00	0	
		Labor	520	A1	43.00	22,360	22,360

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	22,360	22,360
TOTAL	0	(hrs. 520) 22,360	22,360

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.18 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PLANNING	Matl.	1.00	LOT	0.00	0	
		Labor	80	MR	57.68	4,614	4,614

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		0		4,614	4,614
TOTAL INDIRECT	14.00%	0	14.00%	646	646
TOTAL		0	(hrs. 80)	5,260	5,260

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.13 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	40	TS	60.89	2,436	2,436

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	2,436	2,436
TOTAL	0	(hrs. 40) 2,436	2,436

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... X035 OFC ENV COMPLIANCE & DOC
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.15 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENVIR. COMPLIANCE INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	20	A1	48.02	960	960

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	960	960
TOTAL	0	(hrs. 20) 960	960

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.20 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ER A/E INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	40	ER	75.00	3,000	3,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	3,000	3,000
TOTAL	0	(hrs. 40) 3,000	3,000

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.23 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERAGY SYSTEM PROJECT LIAISON	Matl.	1.00	LOT	0.00	0	
		Labor	20	A1	57.70	1,154	1,154

BILL OF MATERIAL SUMMARY	Material	Labor		Total Cost M + L
TOTAL DIRECT	0		1,154	1,154
TOTAL	0	(hrs. 20)	1,154	1,154

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.22 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT	Matl.	1.00	LOT	0.00	0	
		Labor	60	A1	43.00	2,580	2,580

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	2,580	2,580
TOTAL	0	(hrs. 60) 2,580	2,580

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.21 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PREPAIRING WORK PLAN	Matl.	1.00	LOT	1,500.00	1,500	
		Labor	120	MO	57.59	6,911	8,411

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		1,500		6,911	8,411
TOTAL INDIRECT	14.00%	210	14.00%	968	1,178
TOTAL		1,710	(hrs. 120)	7,879	9,589

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.19 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTIGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	20	TS	60.89	1,218	1,218

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	1,218	1,218
TOTAL	0	(hrs. 20) 1,218	1,218

CLINCH RIV/POPULAR CREEK ALT 2

WBS .... 2.2.1.2 MONITORING
Cost Code .... 7100 SURVEILLANCE & MAINTENANCE
Participant .... C004 ANALYTICAL SERVICES
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.2.1.2 MONITORING
Discipline .... 0 OTHER
B/M Title .... MONITORING
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CRPCFS.Est 6-08-95 1:06p

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.24 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MONITORING WILL BE BETTER DEFINED ONCE THE MONITORING PLAN FOR WATTS BAR IS COMPLETED. (WE ARE USING AN ALLOWANCE OF 270,000 PER YEAR FOR THIS ESTIMATE)	Matl. Labor	30.00 0	YRS	270,000.00 0.00	8,100,000 0	8,100,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	8,100,000	0	8,100,000
TOTAL	8,100,000	(hrs. 0) 0	8,100,000

CLINCH RIV/POPULAR CREEK ALT 2

Disciplines
O: OTHER

Total Labor Hours: 16,084

COST SUMMARY

COST SUMMARY	Material	Labor	Total Cost M + L
Line Item Cost	8,152,100	831,356	8,983,456
Total Sales Tax	0		0
SUBTOTAL	8,152,100	831,356	8,983,456
Total Indirect	210	1,776	1,986
SUBTOTAL	8,152,310	833,132	8,985,442
Overhead	0	0	0
SUBTOTAL	8,152,310	833,132	8,985,442
Contingency	2,038,078	208,283	2,246,361
SUBTOTAL	10,190,388	1,041,415	11,231,803
Market Adjustment			0
TOTAL			11,231,803

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* N I S T  B L C C - D E T A I L E D  L C C  A N A L Y S I S (version 4.20-95)*
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PART I - INITIAL ASSUMPTIONS AND COST DATA

Project alternative: ALT-2
Run date: 09-08-1995 10:56:33
Run type: Federal Analysis--Projects Subject to OMB A-94
Comment: ALT 2 CLINCH RIV/POPLAR CREEK
Input data file: CRPCALT2.DAT, last modified: 09-08-1995/10:56:22
LCC output file: CRPCALT2.LCC, created: 09-08-1995/10:56:23
Base Date of Study: OCT 1995
Service Date: SEP 1997
Study period: 30.00 years (OCT 1995 through SEP 2025)
Plan/constr. period: 1.92 years (OCT 1995 through AUG 1997)
Service Period: 28.08 years (SEP 1997 through SEP 2025)
Discount rate: 7.0% Real (exclusive of general inflation)
End-of-year discounting convention

INITIAL CAPITAL ASSET COSTS (NOT DISCOUNTED)
(ADJUSTED FOR PRICE CHANGES DURING PLAN/CONST. PERIOD, IF ANY)

	YEAR (Beginning)	Cost Phasing	Yearly Cost	Total Cost
	OCT 1996	14.0%	$242	
	OCT 1997	86.0%	$1,484	
AT SERVICE DATE:	SEP 1998	0.0%	$0	
TOTAL INITIAL CAPITAL ASSET COSTS				$1,725

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PART II - LIFE-CYCLE COST ANALYSIS
Discount Rate = 7.0% Real (exclusive of general inflation)

PROJECT ALTERNATIVE: ALT-2 RUN DATE: 09-08-1995/10:56:33

	PRESENT VALUE (1996 DOLLARS)	ANNUAL VALUE (1996 DOLLARS)
CASH REQUIREMENTS AS OF SERVICE DATE:		
DURING CONSTRUCTION	$1,628	$131
AT SERVICE DATE	$0	$0
SUBTOTAL	$1,628	$131
OPERATING, MAINTENANCE & REPAIR COSTS:		
NON-ANNUALLY RECURRING COSTS	$4,447	$358
SUBTOTAL	$4,447	$358
RESALE VALUE OF ORIG CAPITAL COMPONENTS	$0	$0
RESALE VALUE OF CAPITAL REPLACEMENTS	$0	$0
TOTAL LIFE-CYCLE PROJECT COST	$6,074	$490

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BASIS FOR COST ESTIMATE

Clinch River/Poplar Creek
Feasibility Study

ALTERNATIVE 3 (Source Containment)

General Assumptions:

* The estimate has been prepared in Automated Estimating System (AES) format using the ERDEC94c.val standard value file for labor and escalation rates.
* Cost for deed restrictions, public advisories, and permit programs have been included in the estimated cost.
* A project contingency of 25 percent has been applied to this estimate due to the level of design at the feasibility study stage.
* Supporting activities and participants required for project management, planning, and engineering have been included based on historical data and best engineering judgement.
* Monitoring costs are included at $270,000 per year. This estimated cost is based on the monitoring plan for Lower Watts Bar.

Work Breakdown Structure (WBS):

Below is the WBS to the 4th level with associated participants.

WBS	Title	Participant	Title
3.0	Alternative 2		
3.1	Capital Cost		
3.1.1	Direct Cost		
3.1.1.1	Deed Restriction	Z001	Special
3.1.1.2	Public Advisories	Z001	Special
3.1.1.3	Permit Programs	Z001	Special
3.1.1.4	Resource Surveys	C087	Environmental Restoration
		TS01	Tech. Support Contractor
3.1.1.5	Source Containment	MK51	MK-F FP Subcontractor
		MK66	MK-F Indirect on FP
		MK67	MK-F Directs on FP
3.1.2	Indirect Cost		
3.1.2.1	RA Integration	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		SC01	Offsite Subcontractor
		TS01	Tech. Support Contractor

WBS	Title	Participant	Title
3.1.2.2	Remedial Design Work Plan	AE01	RD A/E
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor
3.1.2.3	Remedial Design Report	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor
		X035	OFC Env Compliance & Doc
3.1.2.4	Remedial Action Work Plan	AE01	RD A/E
		C069	Central Engineering
		C087	Environmental Restoration
		MK67	MK-F Directs on FP
		TS01	Tech. Support Contractor
3.2.1	Monitoring and Maintenance		
3.2.1.2	Monitoring	C004	Analytical Services

Project Schedule:

Below is the assumed project schedule used to prepare the estimate.

Activity	Start		End
Remedial Design Work Plan	04/01/96		10/01/96
Remedial Design Report	10/01/96		10/01/97
Remedial Action Work Plan	10/01/97		04/01/98
Remedial Action	04/01/98		04/01/02
Monitoring and Maintenance	04/01/98	30 years	04/01/28

Reports:

The following AES reports are attached.

- Summary Report per WBS/Attribute/Participant
- Detail Report
- Life-Cycle Cost Analysis (Present Value)

SUMMARY REPORT
Project Number: 5301
CLINCH RIV/POPLAR CREEK ALT 3

Project ESO Number......N/A
Revision Number.........1
Last Update.............09/08/1995

Sort Order
1. WBS - Level 3
2. B/M Attribute
3. Participant

Approved by: _______________ 8/8/95
Project Estimator Date
_______________ 9/8/95
Estimating Manager Date

Base Fiscal Year/Quarter: 95/4
STANDARD VALUE: C:\AES6.0F\ERDEC94C.val EXPIRES: 03/15/1996
ESTIMATE FILE: C:\AES6.0F\CR\ALT3.Est 09/08/1995
SCHEDULE FILE: ALT3
REPORT FILE: C:\AES6.0F\CR\ALT3SUM.Out 09/08/1995 09:37:34

AES Version 6.0f

CLINCH RIV/POPLAR CREEK ALT 3

SUMMARY REPORT
$1 = $1000

09/08/1995

Arranged By: WBS / B/M Attribute / Participant Code

	Unescalated Material $	Unescalated Labor $	Unescalated Total $	Escalated Material $	Escalated Labor $	Escalated Total $
3.1.1 DIRECT COST						
2.1.1.1 DEED RESTRICTIONS						
Z001 SPECIAL	1	14	15	1	15	16
TOTAL DEED RESTRICTIONS	1	14	15	1	15	16
2.1.1.2 PUBLIC ADVISORIES						
Z001 SPECIAL	45	630	675	48	674	722
TOTAL PUBLIC ADVISORIES	45	630	675	48	674	722
2.1.1.3 PERMIT PROGRAMS						
Z001 SPECIAL	2	29	31	3	31	34
TOTAL PERMIT PROGRAMS	2	29	31	3	31	34
2.1.1.4 RESOURCE SURVEYS						
C087 ENVIRONMENTAL RESTORATION	150	0	150	161	0	161
TS01 TECH SUPPORT CONTRACTOR	150	0	150	161	0	161
TOTAL RESOURCE SURVEYS	300	0	300	322	0	322
2.1.1.5 SOURCE CONTAINMENT						
MK51 MK-F OAK RIDGE FPSC	228	211	439	244	226	470
MK66 MK-F INDIRECTS ON FP	64	0	64	69	0	69
MK67 MK-F DIRECTS ON FP	1	75	76	2	80	82
TOTAL SOURCE CONTAINMENT	293	286	579	315	306	621
TOTAL DIRECT COST	641	959	1600	689	1026	1715
3.1.2 INDIRECT COST						
2.1.2.1 RA INTEGRATION						
AE01 ARCHITECT-ENGINEER	0	20	20	0	21	21
C069 CENTRAL ENGINEERING	0	23	23	0	24	24
C087 ENVIRONMENTAL RESTORATION	0	45	45	0	48	48
SC01 OFFSITE SUBCONTRACT	0	7	7	0	8	8

CLINCH RIV/POPLAR CREEK ALT 3

SUMMARY REPORT
$1 = $1000

09/08/1995

Arranged By: WBS / B/M Attribute / Participant Code

	--------- Unescalated ----------			---------- Escalated -----------		
	Material $	Labor $	Total $	Material $	Labor $	Total $
3.1.2 INDIRECT COST						
2.1.2.1 RA INTEGRATION						
TS01 TECH SUPPORT CONTRACTOR	0	16	16	0	17	17
TOTAL RA INTEGRATION	0	111	111	0	118	118
2.1.2.2 REMEDIAL DESIGN WORK PLAN						
AE01 ARCHITECT-ENGINEER	0	34	34	0	35	35
C087 ENVIRONMENTAL RESTORATION	0	13	13	0	13	13
MK67 MK-F DIRECTS ON FP	0	8	8	0	8	8
TS01 TECH SUPPORT CONTRACTOR	0	7	7	0	8	8
TOTAL REMEDIAL DESIGN WORK PLAN	0	62	62	0	64	64
2.1.2.3 REMEDIAL DESIGN REPORT						
AE01 ARCHITECT-ENGINEER	2	153	155	2	159	161
C069 CENTRAL ENGINEERING	0	17	17	0	18	18
C087 ENVIRONMENTAL RESTORATION	0	25	25	0	26	26
MK67 MK-F DIRECTS ON FP	0	9	9	0	10	10
TS01 TECH SUPPORT CONTRACTOR	0	7	7	0	8	8
X035 OFC ENV COMPLIANCE & DOC	0	4	4	0	4	4
TOTAL REMEDIAL DESIGN REPORT	2	215	217	2	225	227
2.1.2.4 REMEDIAL ACTION WORK PLAN						
AE01 ARCHITECT-ENGINEER	0	9	9	0	9	9
C069 CENTRAL ENGINEERING	0	3	3	0	4	4
C087 ENVIRONMENTAL RESTORATION	0	10	10	0	11	11
MK67 MK-F DIRECTS ON FP	1	37	38	1	39	40
TS01 TECH SUPPORT CONTRACTOR	0	7	7	0	8	8
TOTAL REMEDIAL ACTION WORK PLAN	1	66	67	1	71	72
TOTAL INDIRECT COST	3	454	457	3	478	481
3.2.1 MONITORING AND MAINTENANCE						
2.2.1.2 MONITORING						
C004 ANALYTICAL SERVICES	8100	0	8100	9943	0	9943
TOTAL MONITORING	8100	0	8100	9943	0	9943
TOTAL MONITORING AND MAINTENANCE	8100	0	8100	9943	0	9943

CLINCH RIV/POPLAR CREEK ALT 3

SUMMARY REPORT
$1 = $1000

09/08/1995

Arranged By: WBS / B/M Attribute / Participant Code

	Unescalated Material $	Unescalated Labor $	Unescalated Total $	Escalated Material $	Escalated Labor $	Escalated Total $
SUB - TOTAL	8744	1413	10157	10635	1504	12139
OVERHEAD	0	0	0	0	0	0
SUB - TOTAL	8744	1413	10157	10635	1504	12139
CONTINGENCY	2186	353	2539	2658	376	3034
GRAND TOTAL	10930	1766	12696	13293	1880	15173

DETAIL REPORT
Project Number: 5301
CLINCH RIV/POPLAR CREEK ALT 3

Project ESO Number......N/A
Revision Number.........1
Last Update.............09/08/1995

Sort Order
1. WBS - Level 9
2. B/M Attribute
3. Participant

Approved by:

Project Estimator — Date 9/8/95

Estimating Manager — Date 9/8/95

Base Fiscal Year/Quarter: 95/4
STANDARD VALUE: C:\AES6.0F\ERDEC94C.val EXPIRES: 03/15/1996
ESTIMATE FILE: C:\AES6.0F\CR\ALT3.Est 09/08/1995
SCHEDULE FILE: ALT3
REPORT FILE: C:\AES6.0F\CR\ALT3DEL.Out 09/08/1995 09:20:17

AES Version 6.0f

CLINCH RIV/POPLAR CREEK ALT 3

Creation Date 03/13/1995
Revision Number ... 1

Estimating Job Number .. 5302-10

Project Estimator.. DH BOLLING
WBS .... 3.1.1.1 DEED RESTRICTIONS
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.1 DEED RESTRICTIONS
Discipline .... O OTHER
B/M Title .... DEED RESTRICTIONS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Project Engineer .... S BROOKS
Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.1 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	LEGAL REPRESENTATIVE TO IMPLIMENT DEED RESTRICTIONS	Matl. Labor	120.00 120	HRS LR	10.00 120.00	1,200 14,400	15,600

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	1,200	14,400	15,600
TOTAL	1,200	(hrs. 120) 14,400	15,600

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.2 PUBLIC ADVISORIES
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.2 PUBLIC ADVISORIES
Discipline .... 0 OTHER
B/M Title .... PUBLIC ADVISORIES
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.2 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TDEC PUBLIC ADVISORIES FOR FISH CONSUMPTION AND WATER CONTACT (ALLOWANCE OF 420 HRS/YR & 1500/YR)	Matl. Labor	30.00 12,600	YRS X	1,500.00 50.00	45,000 630,000	675,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	45,000	630,000	675,000
TOTAL	45,000	(hrs. 12,600) 630,000	675,000

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.3 PERMIT PROGRAMS
Cost Code .... 6100 REMEDIAL ACTION
Participant .... Z001 SPECIAL
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.3 PERMIT PROGRAMS
Discipline .... 0 OTHER
B/M Title .... PERMIT PROGRAMS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.3 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TVA AND THE ACOE CO-MANAGERS OF THE WATERWAY WILL MODIFY AS REQUIRED RESTRICTIONS ON DREDGING.	Matl. Labor	240.00 240	HR LR	10.00 120.00	2,400 28,800	31,200

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	2,400	28,800	31,200
TOTAL	2,400	(hrs. 240) 28,800	31,200

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.4 RESOURCE SURVEYS
Cost Code .... 2100 REMEDIAL INVESTIGATION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.4 RESOURCE SURVEYS
Discipline .... 0 OTHER
B/M Title .... RESOURCE SURVEYS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.5 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
	*WETLAND MITIGATION/RESTORATION - ASSUME 5:1 REPLACEMENT, OFF-SITE, IN KIND, 5 ACRES						
1 -A	MITIGATION PLAN & OVERSIGHT	Matl.	1.00	LOT	75,000.00	75,000	
		Labor	0		0.00	0	75,000
2 -A	RESTORATION	Matl.	1.00	LOT	75,000.00	75,000	
		Labor	0		0.00	0	75,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	150,000	0	150,000
TOTAL	150,000	(hrs. 0) 0	150,000

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.4 RESOURCE SURVEYS
Cost Code .... 2100 REMEDIAL INVESTIGATION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.4 RESOURCE SURVEYS
Discipline .... 0 OTHER
B/M Title .... RESOURCE SURVEYS
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... S Subcontractor
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.4 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
	*WETLAND MITIGATION/RESTORATION - ASSUME 5:1 REPLACEMENT, OFF-SITE, IN KIND, 5 ACRES						
1 -A	MITIGATION PLAN & OVERSIGHT	Matl.	1.00	LOT	25,000.00	25,000	
		Labor	0		0.00	0	25,000
2 -A	RESTORATION	Matl.	1.00	LOT	25,000.00	25,000	
		Labor	0		0.00	0	25,000
	ARCHEOLOGICAL SITES - ASSUME PHASE I SURVEYS FOR CONTAINMENT AREAS						
3 -A	PHASE I	Matl.	1.00	LOT	100,000.00	100,000	
		Labor	0		0.00	0	100,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	150,000	0	150,000
TOTAL	150,000	(hrs. 0) 0	150,000

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.5 SOURCE CONTAINMENT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK51 MK-F OAK RIDGE FPSC
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.5 SOURCE CONTAINMENT
Discipline .... 0 OTHER
B/M Title .... SOURCE CONTAINMENT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.6 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
	MOB & DEMOB						
1 -A	ASSUME CONTRACTOR WOULD HAVE TO MOVE AND SETUP EQUIPMENT AT EVERY 500' INTERVALS; ASSUME 6 PIECES OF EQUIPMENT @ $200 EA TIME PER PCS = 1200	Matl.	4.00	TIMES	1,200.00	4,800	
		Labor	0		0.00	0	4,800
2 -A	ASSUME CONSTRUCTION OF LAYDOWN AREA, 1 PER MILE ON BOTH SIDES OF WATER	Matl.	2.00	EACH	7,000.00	14,000	
		Labor	126	X	16.00	2,016	16,016
	SITE PREPARATION						
	INSTALL EROSION CONTROL MEASURES						
3 -A	HAY BALES W/ STAKES	Matl.	800.00	EA	2.00	1,600	
		Labor	200	L	16.65	3,330	4,930
4 -A	SILT FENCE W/ WOOD STAKES	Matl.	2,200.00	LF	0.38	836	
		Labor	37	L	16.65	616	1,452
5 -A	TRENCH FOR SILT FENCE TOE	Matl.	2,200.00	LF	0.13	286	
		Labor	26	OP	23.70	616	902
6 -A	BACKFILL BY HAND SILT FENCE TOE	Matl.	2,200.00	LF	0.11	242	
		Labor	33	L	16.65	549	791
7 -A	POLY SHEETING FOR TEMPORARY COVER	Matl.	1,600.00	SF	0.91	1,456	
		Labor	32	L	16.65	533	1,989
	REMOVE, LOAD & HAUL VEGETATION AND ROOT SYSTEM, (2125 CY INCL. 25% SWELL)						
8 -A	D-4 DOZER	Matl.	90.00	HRS	21.87	1,968	
		Labor	90	OP	23.70	2,133	4,101

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
9 -A	CASE 580 BACKHOE	Matl.	90.00	HRS	10.93	984	
		Labor	90	OP	23.70	2,133	3,117
10 -A	12 CY DUMP TRUCK (ASSUME 1 HR CYCLE TIME)	Matl.	90.00	HRS	30.00	2,700	
		Labor	90	TD	18.05	1,624	4,324
11 -A	SPOTTERS	Matl.	90.00	HRS	0.00	0	
		Labor	180	L	16.65	2,997	2,997
12 -A	PROOF ROLL SITE	Matl.	4,900.00	SY	0.60	2,940	
		Labor	157	OP	23.70	3,721	6,661
13 -A	REPAIR SOFT SPOTS (15% OF TOTAL AREA @ 6" DEEP)	Matl.	125.00	CY	10.00	1,250	
		Labor	0		0.00	0	1,250
14 -A	REMOVE SILT FENCE AND HAYBALES	Matl.	2,200.00	LF	0.00	0	
		Labor	59	L	16.65	982	982
15 -A	HAUL TO ONSITE CONSTRUCTION DEBRIS LANDFILL	Matl.	40.00	HRS	30.00	1,200	
		Labor	40	TD	18.05	722	1,922
16 -A	CASE 580 BACKHOE	Matl.	2,200.00	LF	0.08	176	
		Labor	15	OP	23.70	356	532
17 -A	SEED & MULCH ADJACENT DISTURBED AREAS BY HAND	Matl.	0.50	ACRES	2,500.00	1,250	
		Labor	0		0.00	0	1,250
	CAP CONSTRUCTION						
	ANCHOR TRENCH 18 CY/HR						
18 -A	CAT 215 TRACHOE	Matl.	20.00	HRS	36.64	733	
		Labor	20	OP	23.70	474	1,207
19 -A	SPOTTER	Matl.	20.00	HRS	0.00	0	
		Labor	20	L	16.65	333	333
20 -A	BACKFILL TRENCH BY HAND AFTER LINER & GEOTEXTILE FABRIC IS INSTALLED	Matl.	377.00	CY	0.00	0	
		Labor	422	L	16.65	7,026	7,026

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
	RIP RAP LAYER - 2' THICK						
21 -A	PURCHASE RIP RAP DELIVERED	Matl.	4,760.00	TONS	10.00	47,600	
		Labor	0		0.00	0	47,600
22 -A	PLACE RIP RAP W/ 215 TRACHOE	Matl.	3,111.00	CY	14.18	44,114	
		Labor	1,204	OP	23.70	28,535	72,649
23 -A	PLACE RIP RAP BY HAND	Matl.	3,111.00	CY	0.00	0	
		Labor	4,816	L	16.65	80,186	80,186
	CAP CONSTRUCTION						
24 -A	GEOTEXTILE FABRIC, MIRAFI 1160N	Matl.	12,222.00	SY	1.90	23,222	
		Labor	122	L	16.65	2,031	25,253
25 -A	60 MIL HDPE LINER	Matl.	6,111.00	SY	2.30	14,055	
		Labor	1,100	L	16.65	18,315	32,370
26 -A	FORKTRUCK FOR STAGING MATERIAL	Matl.	3.00	MONTHS	1,500.00	4,500	
		Labor	633	OP	23.70	15,002	19,502
27 -A	TESTING OF WELD SEAMS	Matl.	1.00	LOT	5,000.00	5,000	
		Labor	0		0.00	0	5,000
28 -A	CLEAN UP	Matl.	1.00	LOT	0.00	0	
		Labor	100	L	16.65	1,665	1,665

CLINCH RIV/POPLAR CREEK ALT 3

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		174,912		175,895	350,807
SALES TAX		14,868			14,868
SUBTOTAL		189,780		175,895	365,675
TOTAL INDIRECT	20.00%	37,956	20.00%	35,179	73,135
TOTAL		227,736	(hrs. 9,612)	211,074	438,810

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.5 SOURCE CONTAINMENT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK66 MK-F INDIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.5 SOURCE CONTAINMENT
Discipline .... O OTHER
B/M Title .... SOURCE CONTAINMENT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.8 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-FERGUSON INDIRECTS ON FP (14%)	Matl.	460.00	K$	140.00	64,400	
		Labor	0		0.00	0	64,400

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL INDIRECT	64,400	0	64,400
TOTAL	64,400	(hrs. 0) 0	64,400

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.1.5 SOURCE CONTAINMENT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.1.5 SOURCE CONTAINMENT
Discipline .... 0 OTHER
B/M Title .... SOURCE CONTAINMENT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.7 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	CONSTRUCTION MANAGEMENT (1 FTE FOR .5 YRS)	Matl.	0.50	YRS	0.00	0	
		Labor	1,040	MC	57.68	59,987	59,987
2 -A	HOME OFFICE SUPPORT	Matl.	0.50	YRS	2,500.00	1,250	
		Labor	100	MO	57.59	5,759	7,009

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		1,250		65,746	66,996
TOTAL INDIRECT	14.00%	175	14.00%	9,204	9,379
TOTAL		1,425	(hrs. 1,140)	74,950	76,375

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... O OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.11 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ER A/E TITLE III (1/4 FTE FOR .5 YRS)	Matl.	0.50	YRS	0.00	0	
		Labor	260	ER	75.00	19,500	19,500

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	19,500	19,500
TOTAL	0	(hrs. 260) 19,500	19,500

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.12 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM TITLE III (1/4 FTE FOR .5 YRS)	Matl.	0.50	YRS	0.00	0	
		Labor	260	A1	57.70	15,002	15,002
2 -A	ENERGY SYSTEM CONSTRUCTION SUPPORT 1/8 FTE FOR .5 YRS	Matl.	0.50	YRS	0.00	0	
		Labor	130	A1	57.70	7,501	7,501

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	22,503	22,503
TOTAL	0	(hrs. 390) 22,503	22,503

WBS .... 3.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.13 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM PROJECT MANAGEMENT (1 FTE FOR .5 YRS)	Matl.	0.50	YRS	0.00	0	
		Labor	1,040	A1	43.00	44,720	44,720

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	44,720	44,720
TOTAL	0	(hrs. 1,040) 44,720	44,720

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... SC01 OFFSITE SUBCONTRACT
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... O OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site .... O
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.10 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	INDEPENDENT CERTIFICATION OF RA 1/8 FTE FOR .5 YRS	Matl.	0.50	YRS	0.00	0	
		Labor	130	IC	55.00	7,150	7,150

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	7,150	7,150
TOTAL	0	(hrs. 130) 7,150	7,150

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.1 RA INTEGRATION
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.1 RA INTEGRATION
Discipline .... 0 OTHER
B/M Title .... RA INTEGRATION
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.9 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR MONITORING OF RA TO INSURE COMPLIANCE 1/4 FTE FOR .5 YRS	Matl. Labor	0.50 260	YRS TS	0.00 60.89	0 15,831	15,831

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	15,831	15,831
TOTAL	0	(hrs. 260) 15,831	15,831

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.15 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	RD A/E PLANNING/COORDINATION (DOES THE REPORT)	Matl. Labor	1.00 450	LOT ER	0.00 75.00	0 33,750	33,750

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	33,750	33,750
TOTAL	0	(hrs. 450) 33,750	33,750

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.17 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT	Matl.	1.00	LOT	0.00	0	
		Labor	300	A1	43.00	12,900	12,900

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	12,900	12,900
TOTAL	0	(hrs. 300) 12,900	12,900

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.16 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PLANNING	Matl.	120.00	HRS	0.00	0	
		Labor	120	MR	57.68	6,922	6,922

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		0		6,922	6,922
TOTAL INDIRECT	14.00%	0	14.00%	969	969
TOTAL		0	(hrs. 120)	7,891	7,891

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.2 REMEDIAL DESIGN WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.2 REMEDIAL DESIGN WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.14 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTERFACE	Matl.	1.00	LOT	0.00	0	
		Labor	120	TS	60.89	7,307	7,307

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	7,307	7,307
TOTAL	0	(hrs. 120) 7,307	7,307

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.19 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PREPARE PLAN AND SPECS	Matl.	1.00	LOT	2,000.00	2,000	
		Labor	2,040	ER	75.00	153,000	155,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	2,000	153,000	155,000
TOTAL	2,000	(hrs. 2,040) 153,000	155,000

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.21 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM DESIGN AND PROJECT LIAISON	Matl.	1.00	LOT	0.00	0	
		Labor	300	A1	57.70	17,310	17,310

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	17,310	17,310
TOTAL	0	(hrs. 300) 17,310	17,310

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.22 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT (1 FTE)	Matl.	570.00	HRS	0.00	0	
		Labor	570	A1	43.00	24,510	24,510

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	24,510	24,510
TOTAL	0	(hrs. 570) 24,510	24,510

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... O OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.23 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PLANNING	Matl.	1.00	LOT	0.00	0	
		Labor	140	MR	57.68	8,075	8,075

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		0		8,075	8,075
TOTAL INDIRECT	14.00%	0	14.00%	1,131	1,131
TOTAL		0	(hrs. 140)	9,206	9,206

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.18 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	120	TS	60.89	7,307	7,307

BILL OF MATERIAL SUMMARY	Material	Labor		Total Cost M + L
TOTAL DIRECT	0		7,307	7,307
TOTAL	0	(hrs. 120)	7,307	7,307

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.3 REMEDIAL DESIGN REPORT
Cost Code .... 6100 REMEDIAL ACTION
Participant .... X035 OFC ENV COMPLIANCE & DOC
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.3 REMEDIAL DESIGN REPORT
Discipline .... 0 OTHER
B/M Title .... REMEDIAL DESIGN REPORT
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.20 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENVIR. COMPLIANCE INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	80	A1	48.02	3,842	3,842

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	3,842	3,842
TOTAL	0	(hrs. 80) 3,842	3,842

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... AE01 ARCHITECT-ENGINEER
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.25 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ER A/E INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	120	ER	75.00	9,000	9,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	9,000	9,000
TOTAL	0	(hrs. 120) 9,000	9,000

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C069 CENTRAL ENGINEERING
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.28 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	ENERGY SYSTEM PROJECT LIAISON	Matl.	1.00	LOT	0.00	0	
		Labor	60	A1	57.70	3,462	3,462

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	3,462	3,462
TOTAL	0	(hrs. 60) 3,462	3,462

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... C087 ENVIRONMENTAL RESTORATION
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.27 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	PROJECT MANAGEMENT	Matl. Labor	1.00 240	LOT A1	0.00 43.00	0 10,320	10,320

BILL OF MATERIAL SUMMARY	Material	Labor		Total Cost M + L
TOTAL DIRECT	0		10,320	10,320
TOTAL	0	(hrs. 240)	10,320	10,320

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... MK67 MK-F DIRECTS ON FP
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... O OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.26 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MK-F PREPARING WORK PLAN	Matl.	1.00	LOT	1,000.00	1,000	
		Labor	570	MO	57.59	32,826	33,826

BILL OF MATERIAL SUMMARY	Material		Labor		Total Cost M + L
TOTAL DIRECT		1,000		32,826	33,826
TOTAL INDIRECT	14.00%	140	14.00%	4,596	4,736
TOTAL		1,140	(hrs. 570)	37,422	38,562

CLINCH RIV/POPLAR CREEK ALT 3

WBS .... 3.1.2.4 REMEDIAL ACTION WORK PLAN
Cost Code .... 6100 REMEDIAL ACTION
Participant .... TS01 TECH SUPPORT CONTRACTOR
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.1.2.4 REMEDIAL ACTION WORK PLAN
Discipline .... 0 OTHER
B/M Title .... REMEDIAL ACTION WORK PLAN
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.OF\ERDEC94C.val
Estimate File ..... C:\AES6.OF\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.24 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	TECH. SUPPORT CONTRACTOR INTEGRATION	Matl.	1.00	LOT	0.00	0	
		Labor	120	TS	60.89	7,307	7,307

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	0	7,307	7,307
TOTAL	0	(hrs. 120) 7,307	7,307

WBS .... 3.2.1.2 MONITORING
Cost Code .... 7100 SURVEILLANCE & MAINTENANCE
Participant .... C004 ANALYTICAL SERVICES
Level of Estimate . P Planning/Feasibility Estimate
B/M Attribute ..... 2.2.1.2 MONITORING
Discipline .... 0 OTHER
B/M Title .... MONITORING
Receiving Site .... OTHER
Cross-Cut Code .... 01-01-06 RA/MANAGEMENT/ACT/CONSTR
Standard Value File C:\AES6.0F\ERDEC94C.val
Estimate File ..... C:\AES6.0F\CR\ALT3.Est 9-08-95 9:19a

Building/Area .... SITE
Plant Site 0
Contracting Type .... G General
Funding Type .... EXPENSE
Source Site .... OTHER
Discipline Estimator ... DH BOLLING
Quantity Take-Off By ... DH BOLLING
Trace Number 0.1.29 0

Expiration Date: 03/15/1996

Item	Description	MATL. / LABOR	Quantity / Hours	Unit / Craft	Unit Price / Rate	Total Material / Total Labor	Total Cost M + L
1 -A	MONITORING IS BASED ON THE MONITORING PLAN FOR WATTS BAR (WE ARE USING AN ALLOWANCE OF 270,000 PER YEAR FOR THIS ESTIMATE)	Matl. Labor	30.00 0	YRS	270,000.00 0.00	8,100,000 0	8,100,000

BILL OF MATERIAL SUMMARY	Material	Labor	Total Cost M + L
TOTAL DIRECT	8,100,000	0	8,100,000
TOTAL	8,100,000	(hrs. 0) 0	8,100,000

CLINCH RIV/POPLAR CREEK ALT 3

Disciplines
O: OTHER

Total Labor Hours: 31,142

COST SUMMARY

COST SUMMARY	Material	Labor	Total Cost M + L
Line Item Cost	8,627,762	1,362,383	9,990,145
Total Sales Tax	14,868		14,868
SUBTOTAL	8,642,630	1,362,383	10,005,013
Total Indirect	102,671	51,079	153,750
SUBTOTAL	8,745,301	1,413,462	10,158,763
Overhead	0	0	0
SUBTOTAL	8,745,301	1,413,462	10,158,763
Contingency	2,186,325	353,366	2,539,691
SUBTOTAL	10,931,626	1,766,828	12,698,454
Market Adjustment			0
TOTAL			12,698,454

* *

N I S T B L C C - D E T A I L E D L C C A N A L Y S I S (version 4.20-95)

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PART I - INITIAL ASSUMPTIONS AND COST DATA

Project alternative: ALT-3
Run date: 09-08-1995 11:02:35
Run type: Federal Analysis--Projects Subject to OMB A-94
Comment: ALT 3 CLINCH RIV/POPLAR CREEK
Input data file: CRPCALT3.DAT, last modified: 09-08-1995/11:00:32
LCC output file: CRPCALT3.LCC, created: 09-08-1995/11:00:33
Base Date of Study: OCT 1995
Service Date: SEP 1997
Study period: 30.00 years (OCT 1995 through SEP 2025)
Plan/constr. period: 1.92 years (OCT 1995 through AUG 1997)
Service Period: 28.08 years (SEP 1997 through SEP 2025)
Discount rate: 7.0% Real (exclusive of general inflation)
End-of-year discounting convention

INITIAL CAPITAL ASSET COSTS (NOT DISCOUNTED)
(ADJUSTED FOR PRICE CHANGES DURING PLAN/CONST. PERIOD, IF ANY)

	YEAR (Beginning)	Cost Phasing	Yearly Cost	Total Cost
	OCT 1996	11.0%	$360	
	OCT 1997	89.0%	$2,909	
AT SERVICE DATE:	SEP 1998	0.0%	$0	
TOTAL INITIAL CAPITAL ASSET COSTS				$3,269

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PART II - LIFE-CYCLE COST ANALYSIS
Discount Rate = 7.0% Real (exclusive of general inflation)

PROJECT ALTERNATIVE: ALT-3 RUN DATE: 09-08-1995/11:02:35

	PRESENT VALUE (1996 DOLLARS)	ANNUAL VALUE (1996 DOLLARS)
CASH REQUIREMENTS AS OF SERVICE DATE:		
DURING CONSTRUCTION	$3,079	$248
AT SERVICE DATE	$0	$0
SUBTOTAL	$3,079	$248
OPERATING, MAINTENANCE & REPAIR COSTS:		
NON-ANNUALLY RECURRING COSTS	$4,408	$355
SUBTOTAL	$4,408	$355
RESALE VALUE OF ORIG CAPITAL COMPONENTS	$0	$0
RESALE VALUE OF CAPITAL REPLACEMENTS	$0	$0
TOTAL LIFE-CYCLE PROJECT COST	$7,487	$603

* *

Appendix I

SELECTION OF PROCESS OPTIONS

1. SELECTION OF REPRESENTATIVE PROCESS OPTIONS

This chapter contains a description of technologies and process options retained from the first screening step, technical applicability, for further evaluation in terms of their implementability, effectiveness, and cost. One (or more) representative process option is selected and carried forward for further evaluation to represent the other process options in the technology group. This limits the number of options used in alternative development, but it allows flexibility for reevaluating the other options at the proposed plan, the ROD, or the remedial design stages. Options that are extremely difficult to implement, do not offer significantly improved protection, or are very expensive, will not be used for remedial alternative development.

Fish consumption and exposures to shallow (upper 15 cm exposed at winter pool) sediments are the main threats to human health identified that could reasonably occur. Exposure to deep (covered year round under water) sediments is an unlikely scenario. Deep sediment action technologies may become necessary if, for example, pathways of concern (linked to deep sediments) emerge that elevate human health or ecological risks to unacceptable levels. For this reason, applicable technologies and process options will be discussed with regard to effectiveness, implementability, and cost when possible with respect to deep sediments and retained as contingent options. However, selection of representative process options will not be determined on the basis of deep sediment criteria at this time.

A summary of the technologies retained from the first screening in Figure 8.1, Section 8.2 for site applicability are presented in Table I.1. Each process option is briefly described as to its site, contaminant, and remedial effectiveness, implementability, and cost. Representative process options for various technologies are indicated by **bold type**. The remaining process options are shown in shaded boxes. Following Table I.1 is a detailed discussion of technical aspects of site-applicable retained options, including effectiveness, implementability, cost, and selection of representative technologies.

1.1 NO ACTION

This general response action does not initiate remedial action and assumes that present security measures that limit access are not maintained. Short- or long-term monitoring is also excluded. Although this scenario may not reflect current conditions, the purpose of the no action alternative is to provide a baseline for comparison with other alternatives, as required by the NCP.

Table I.1. Technology and process option screening summary

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
No action	None	**Not applicable**	Will offer no additional protection	None	None
Institutional controls and advisories	Access use and restrictions	**Deed restrictions**	Effective in restricting activities on adjacent property owned by DOE which may be released for unrestricted use	Implementable for DOE-owned property	Negligible costs
		Public advisories	Effective in alerting people to fish consumption limits/prohibitions or water contact	Implementable and currently managed by TDEC	Negligible costs
		Permit program	Effective at restricting sediment-disturbing activities such as dredging	Implementable, in place, and currently administered jointly by COE, TDEC, and TVA	Negligible costs
		Land purchase/ condemnation	Effective in placing contaminated property under DOE control	Not currently necessary; no private properties identified with unacceptable contaminant levels	No current associated costs
		Physical barriers	Effective in limiting access to affected areas	Not difficult to implement	Medium capital; low O&M
	Maintenance and monitoring	**Monitoring**	Effective in detecting contaminant input changes to the system, human availability, or bioavailability	Not difficult to implement	Low capital; low O&M
		Surveillance and maintenance	Effective in ensuring other implemented options continue to perform as needed	Not difficult to implement	Low capital; medium O&M
Source containment	Capping (horizontal barriers)	**Armorform**	Effective initially for shallow sediment capping, but has an uncertain long-term reliability; not effective for deep sediments	Difficult to implement; will require large amounts of construction equipment, site preparation, and erosion/fugitive dust management during site preparation and cap construction phases	High capital; medium O&M

Table I.1. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
		Geomembrane cap	Effective for shallow sediment capping with good life expectancy, durability, and reliability; not effective for deep sediments	Difficult to implement; will require large amounts of construction equipment, site preparation, and erosion/fugitive dust management during site preparation and cap construction phases	High capital; low O&M
		Clean sediment	Effective for deep sediment capping, but may be subject to same erosion that removed original sediments and biotic intrusion	Difficult to implement; will potentially require periodic replacement of eroded sediments and is also susceptible to biotic intrusion	Medium capital; low O&M
Removal	Excavation	Mechanical	Effectively removes source material from shallow sediment areas; low effectiveness in submerged conditions	Difficult to implement; will require critical timing to execute removal during window of opportunity at winter pool	High capital; low O&M
	Dredging	Mechanical dredges	Effective in removal of source material under submerged conditions; removes material at high densities	Difficult to implement due to potentially increased levels of turbidity	High capital; medium O&M
		Hydraulic dredges	Effective in removal of source material under submerged conditions; removes material at relatively low densities	Difficult to implement; considerable amounts of water will require separation and potentially need treatment before disposal	High capital; medium O&M
		Pneumatic dredges	Effective in removal of source material under submerged conditions; removes material at high densities	Impractical for shallow areas	High capital; medium O&M

Table I.1. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
Turbidity minimization	Water turbidity minimization	Silt curtains	Effectively contains fugitive sediment; effectiveness may diminish as curtains may respond to fluctuations of moving water	Difficult to install, particularly over large areas; impermeable material reacts to changes in water levels and may break; may require frequent inspections for breaks	Low capital; low O&M
		Silt screens	Effectively contains fugitive sediment; effectiveness depends on filter mesh size and degree of turbidity	Difficult to implement, particularly over large areas; mesh material allows water to pass, but excessive turbidity can clog the material and cause breakage; may require frequent inspections for breaks	Low capital; low O&M
Ex situ treatment	Physicochemical	Chemical extraction/ soil washing	Effective in separating contaminants associated with fine sediment from coarse sediment	Implementability is poor because site sediments are predominantly fine silts and clays; volume reduction minimal	Medium capital; low to medium O&M
		Solidification/ stabilization	Effective in reducing mobility of certain contaminants to acceptable levels	Implementable for certain contaminants (e.g., arsenic); potentially reduces leachability to WAC levels	Medium capital; low O&M
		Chemical-precipitation/ flocculation	Effectively transforms dissolved ions in solution to a solid form causing changes in electrostatic charge and ion flocculation	Difficult to justify new treatment facilities, unless existing on-site facilities cannot treat waste water effluent from drained sediment	Medium capital; low to medium O&M
		Ion exchange	Effective in capturing contaminant ions in water by exchanging them with "donor" ions	Difficult to justify new treatment facilities, unless existing on-site facilities cannot treat waste water effluent from drained sediment	Medium capital; low to medium O&M

Table I.1. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
	Thermal	Incineration	Effectively removes volatiles (including mercury) from solids at high temperatures	Difficult; air emissions compliance limits off gas contaminants	High capital; high O&M
		Thermal desorption	Effectively removes volatiles (including mercury) from solids at low temperatures	Comparatively easy as low temperatures do not breach air emission limits for off gasses	Medium capital; low O&M
		Pyrolysis	Effectively removes volatiles (including mercury) from solids at low temperatures	Difficult; air emissions compliance limits off gas contaminants	Medium capital; low O&M
		Infrared thermal	Effectively removes volatiles (including mercury) from solids at low temperatures	Difficult; air emissions compliance limits off gas contaminants	Medium capital; low O&M
	Dewatering	Belt filter press	Effectively dewaters sediment slurry; may require several operating units to dewater large volumes	Implementable, but gravity drainage in sloping dewatering pad is simpler, more cost-effective means to accomplish same task	High capital; medium O&M
		Settling ponds	Effective in dewatering sediment slurry with high water content; not effective for slurry with high solids content	Minimal amounts of water removed during shallow sediment removal render settling ponds impractical; potentially viable in dredging scenario with large quantities of sediment removed at low solids densities	Medium capital; medium O&M
		Fly ash	Effective in absorbing small amounts of free water	Implementable, but increased volumes of treated material raise disposal costs	Low capital; low O&M

Table I.1. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
		Sloping dewatering pad	Effectively dewaters excavated sediment or sediment slurry with relatively high solids content	Somewhat difficult during site preparation and construction phase, but very low maintenance using gravity drainage and evaporation to dewater sediments	Medium capital; low O&M
Disposal	On-site sediment/ disposal	**ORNL Interim Waste Management Facility**	Effective disposal area, but may have volume limitations and WAC considerations	Potentially difficult due to WAC and landfill capacity; does not accept mixed waste	High capital; medium O&M
		Y-12 Plant Landfill VI or VII	Effective, but may have volume limitations and WAC considerations	Implementable, but would have to comply with WAC and TDEC approval	Low capital; low O&M
		Beneficial reuse	Effective for use as aggregate for roadway/runway fill, if release of the material is acceptable as is or with treatment	Difficult to implement; release of material may present certain liabilities; also needs a roadway/ runway in construction ready to receive material	High capital; medium O&M
		Reclamation/ recycling	Potentially effective; recovery of contaminants for recycling requires high concentrations to be worthwhile	Unrealistic to cost-effectively recover economic concentrations with any value	High capital; medium O&M
	Off-site sediment/ disposal	**Envirocare**	Effective for disposition of untreated mixed waste	Potentially difficult due to transport distance	High capital; medium O&M
		NTS	Effective for disposition of defense-related LLW	Potentially difficult due to WAC; accepts only defense-related waste; does not accept mixed waste	High capital; medium O&M

Table I.1. (continued)

General response action	Remedial technology	Process options	Effectiveness	Implementability	Cost
	Water disposal	**Y-12 Plant West End Treatment Facility**	Effective for treatment and disposal of contaminated water removed from dewatered sediments	Implementable; consultation with wastewater treatment officials needed to schedule wastewater criteria and delivery timetable; potentially more cost-effective than construction of new facilities	High capital; medium O&M
	Waste transportation	**Trucks**	Effective in transporting material in and around on-site areas, but may require precautionary measures to avoid leakage of wet sediment	Implementable; trucks readily available, but precautions regarding leakage are largest concern to assess	Low capital; low O&M
		Rail	Effective for shipments to the western United States	Implementable for shipments of waste material over very long distances (e.g., Envirocare or NTS)	Medium capital; low O&M

COE = U.S. Army Corps of Engineers
DOE = U.S. Department of Energy
LLW = low-level radioactive waste
NTS = Nevada Test Site
O&M = operation and maintenance

ORNL = Oak Ridge National Laboratory
TDEC = Tennessee Department of Environment and Conservation
TVA = Tennessee Valley Authority
WAC = waste acceptance criteria

1.2 INSTITUTIONAL CONTROLS AND ADVISORIES

Institutional controls include access and use restrictions and maintenance and monitoring. These actions can be used alone or in combination with other technologies to reduce the risk of exposure to contamination to acceptable levels. The objectives of access and use restrictions are: (1) prevent prolonged exposure to contaminants, (2) control future development and disturbance of the OU, and (3) prevent destruction of any engineered remedial actions.

1.2.1 Access and Use Restrictions

Covenants are legal restrictions and notifications placed on property deeds that notify a potential buyer of the limitations on the use of affected property. They are legally binding limitations that can prevent development or other alterations of the property that could increase the health risk of contaminants. Covenants are useful where contaminants lie on DOE property at depth and where release of the property can reasonably be expected in the future. For example, use of contaminated sediment or soil for agriculture, landfilling, or other excavation type activities could be prohibited. Irrigation for agricultural purposes may also be excluded or limited depending on water quality.

Published and posted fish consumption, water contact, and/or water consumption advisories provide warnings concerning limitations on fish consumption, dermal contact with surface water, and consumption of surface water. Agricultural uses of surface water may be considered for advisory protection for such uses as limits on recommended livestock watering quantities or irrigation of food crops in certain areas. Some advisories are already in place in a number of waterways in the region, including Clinch River and Poplar Creek for fish consumption limits and/or water contact.

COE, TDEC, and TVA must issue a permit before sediment-disturbing activities in the affected area are allowed, whether for maintenance of minimum navigable channel depths, use as aggregate, or for any other similar activity.

Land purchase/condemnation is the acquisition of property that is not owned or within the control of DOE and is affected by unacceptable levels of contaminants released by DOE. This option may be considered in order to place the property under DOE administrative control. In the event that the affected portion of the property presents an unacceptable health hazard and neither purchase nor any other means of risk reduction can be agreed on by the property owner and DOE, then condemnation of some or all of the affected property may become necessary in order to place the property under DOE control and thereby restrict access to it. Currently, no property outside of DOE property has been identified with contaminants with ECR above 1.0 ×

10^{-4} or HI > 1.0 in shallow sediments. No deep sediment contamination has been identified on private property. Deep sediments lie in main channel areas managed by TVA and COE and would not be available for purchase.

Physical barriers include, but are not limited to, erected fences or similar barricades around the perimeter of a contaminated area that limits access to a site. To maintain and/or enhance effectiveness of the fence, an active, periodic patrol, warning signs, and an active public information program is recommended. The warning signs in fenced areas may offer site-specific information tailored to the area which contains information over and above the routine warnings currently in place regarding fish consumption and water contact.

1.2.1.1 Effectiveness

All of the access and use restrictions can be effective in long-term management of contaminants if sustained and managed properly.

1.2.1.2 Implementability

All of the access and use restrictions can be implemented with minimal difficulty.

1.2.1.3 Cost

All access and use restriction process options are comparatively inexpensive relative to active remedial process options outlined in Sections I.1 through I.7, except land purchase/ acquisition which would vary according to size and land value.

1.2.1.4 Selection of representative process option(s)

All access and use restriction process options will be carried forward as representative process options, except land purchase/condemnation. Currently, no private property has been identified as having contaminated shallow sediment with unacceptable risk. Redistribution of contaminants may elevate risk on private property to unacceptable levels, at which time land purchase/condemnation may be reevaluated for implementation.

1.2.2 Maintenance and Monitoring

Long-term monitoring of contaminant levels in water, sediment, and biota is used primarily to identify changes in conditions, evaluate the effectiveness of the chosen remedial action, determine whether adjustments or additional process options are needed, and determine whether existing or future receptors are threatened. Short-term monitoring, with frequent sampling, may be used to identify changes that arise due to planned sediment-disturbing activities, such as dredging or during implementation of remedial actions where release of potential contaminants from sediment could occur. More frequent monitoring would allow for timely detection of contaminants and subsequent appropriate measures implemented. Examples of OU monitoring include:

- Surface sediment grab samples used in determining the nature and extent of contaminants in sediment. They can serve both as a measure of existing site conditions as it relates to isolating areas targeted for remedial action and as a means of detection in condition changes, such as redistribution of, or, new sources of contaminants.

- Biological samples taken of aquatic, benthic, and piscivorous organisms used to characterize effects from contaminants, which are useful in documenting and evaluating site conditions.

- Surface water samples taken to monitor the water quality at various points along the OU. Monitoring the water can detect new sources or changes in existing sources, which can verify that controls placed on the OU or remedial actions are performing satisfactorily to keep contaminants immobilized.

Routine surveillance and maintenance would include physical site surveys and maintenance, as needed, to verify and ensure the integrity of any engineered controls or devices (e.g., caps or fences). These process options are used to ensure or verify that the objectives have been and continue to be met. They are all implementable. The cost of maintenance and monitoring activities depends on their scope, frequency, and duration, which in turn, depends on the remedial action alternative selected.

The effectiveness of this response depends on its continued implementation. Access restrictions are subject to change in political jurisdiction, legal interpretations, and regulatory enforcement, and require maintenance of physical barriers.

1.2.2.1 Effectiveness

Both of the maintenance and monitoring process options can be effective in long-term management of wastes if instituted and managed properly.

1.2.2.2 Implementability

Both of the maintenance and monitoring process options can be implemented with minimal difficulty.

1.2.2.3 Cost

Both maintenance and monitoring process options are comparatively inexpensive.

1.2.2.4 Selection of representative process option(s)

All monitoring and surveillance and maintenance process options are effective, implementable, and cost little. All are carried forward as representative process options for assembly into remedial alternative actions.

1.3 SOURCE CONTAINMENT

OU-applicable containment technologies include capping. This technology isolates the source of contamination, which remains in place, from human contact or migration to the environment.

1.3.1 Capping (horizontal barriers)

Capping technology is intended to: (1) minimize release of near-shore contaminants by wind or water erosion, (2) isolate shallow sediments from contact by humans or biota, and (3) potentially cover deep sediments should they be uncovered by scouring or similar means. Capping technologies consist of Armorform, geomembrane, and clean sediment covers.

The construction of a cap or cover near or on shore would involve secondary technologies such as clearing, grubbing, erosion control, waste compaction, and regrading before placement of the cap. In general, capping is performed when an extensive quantity of waste materials at a site precludes excavation, costs to remove the material are prohibitive, and/or more extensive remediation is not warranted based on site risks. The rationale that risks are low may be relevant for the use of caps for certain Clinch River/Poplar Creek OUs. The main disadvantages of capping are the need for long-term maintenance and uncertain design life. Caps must be periodically inspected for settlement, erosion, and intrusion by animals and deep-rooted vegetation.

Armorform is a double layer woven fabric engineered exclusively to serve as a form for casting concrete erosion control revetments and linings. Armorform is placed on the bottom of a waterway and filled with clean mortar. The permeable panels retain solids and allow excess water to escape as the solids harden into a concrete structure. Its use in deep water would be extremely costly and the life expectancy low. Armorform requires a considerable amount of time to install and will require periodic inspections and maintenance to ensure that cap integrity remains intact.

Geomembrane cap construction places an impermeable layer of synthetic material which is placed over contaminated sediments. It is covered by a filter fabric which protects the geomembrane from the layer of riprap that is placed on top of the filter fabric. The entire cap is secured by an anchor trench approximately 0.3 m (1 ft) wide by 0.6 m (2 ft) deep. The trench runs parallel to the waterway and may be backfilled with clean sediment, concrete, or riprap. The riprap will offer good protection from wind and water erosion, as well as, increase shoreline stability and also decrease availability of contaminants.

Clean sediment can be used to cap contaminated sediments in the deep channel areas. Isolation of contaminated sediments may be necessary where cleaner overlying sediments are thin or non-existent. Clean sediment can be dumped in large quantities from barges over areas in deep water or placed by equipment such as a backhoe in confined or shallow areas.

1.3.1.1 Effectiveness

For shoreline capping, the geomembrane cap is more effective in the long-term because reliability and stability are greater than that of Armorform. Armorform reliability is expected to diminish comparatively quickly as the concrete ages and cracks, weakening the overall stability of the cap. The geomembrane riprap cover would withstand most stresses and, if necessary, replacement of any riprap cover can be done more easily and quickly than replacement of concrete casts. For deep sediments, neither Armorform nor geomembrane caps are considered effective in submerged conditions and reliability of these options would be uncertain.

Clean sediment placed over contaminated deep sediment would be effective although protection may be short-lived because any area where contaminants are exposed due to erosion will likely continue eroding any added sediment. Replenishment of clean sediment may be necessary for this option to remain effective. Biotic action may also compromise the integrity of this cap in either deep or shallow areas.

1.3.1.2 Implementability

Implementability of either an Armorform or a geomembrane cap will be difficult, but feasible for shallow sediments. Both would require extensive amounts of construction from site preparation to cap construction to closure. Implementation of these would not be technically feasible in deep sediments.

Implementability of placing clean sediment over deep sediments is feasible, but area, depth, and water speed in which sediment cover is needed governs the level of difficulty. Implementation would probably be best when water is lower and speeds are slowed. This minimizes the amount of clean sediment drift away from the area intended for coverage.

1.3.1.3 Cost

Costs for Armorform or geomembrane cap installation will be high. Significant amounts of site preparation and cap construction will require heavy equipment to clear brush and river debris. Armorform may be somewhat higher in materials costs due to the specialized nature of the forms and may require more frequent inspections and potentially more maintenance costs. Geomembrane cap material is comparatively cheaper, but requires somewhat more labor to place two layers of geotextile, geomembrane, and carefully placed riprap on top. Inspection frequency would be comparatively less for the geomembrane cap as erosion resistance and stability are considered to be better than Armorform; therefore, inspection costs would be less.

Clean sediment costs are moderately high. Sediment itself is relatively cheap depending on the amount needed. Initial placement costs of the sediment will vary according to the area intended for coverage. Large areas, mainly in the open channel, will be covered comparatively quickly and efficiently from barge dumping as most of the sediment covers the bottom by gravity settling. However, costs will increase due to the amount of sediment being used and the use of multiple barges to carry the material from the clean sediment source to its final destination. Small isolated coverages will require typically less sediment, but generally more labor to place the material.

1.3.1.4 Selection of representative process option(s)

Implementability and cost for Armorform or the geomembrane cap are roughly the same, but uncertain performance of the Armorform makes it less desirable. The geomembrane cap is selected as the representative process option for capping shallow sediments, based on greater reliability and durability at comparable cost.

Placement of clean sediment over deep sediments is not chosen at this time as a representative process option due to uncertain reliability, but is site-applicable and retained as a contingent action mainly for deep sediments.

1.4 REMOVAL

Removal technologies include mechanical excavation and mechanical, hydraulic, and pneumatic dredging of contaminated sediments. These technologies may be used in combination with a dewatering treatment (Sect. 1.6.4), other ex situ treatments (Sects. 1.6.1–3), and/or disposal technology (Sect. 1.7).

1.4.1 Excavation

Mechanical excavation, as discussed in this document, is the physical removal of sediment typically using machinery (e.g., backhoes, trackhoes, front-end loaders, bulldozers, clamshells, and draglines). Some units may be mounted on rubber tires (backhoes) that can be used for fast excavations on stable working surfaces. Other track-mounted units (trackhoes and bulldozers) can be used in areas where slippery traction may hinder mobility of tire-mounted types. A general excavation sequence might be as follows.

1. Construct site access (haul roads, etc.), avoiding any wetlands destruction or threatened or endangered plant or animal species destruction.

2. Prepare the site, including silt fences for run-on diversion and runoff control.

   Scrape sediment to a predetermined depth using a backhoe, trackhoe, front-end loader, or similar device.

3. Load sediment into lined trucks.

4. Transport material to an appropriate treatment area or disposal facility.

5. Cover open, incomplete excavations with a tarp to inhibit precipitation and potential erosion.

6. Replacement of sediment is probably unnecessary, but seeding and mulching disturbed areas above summer pool is recommended.

1.4.2 Dredging

Dredges remove sediment covered by water by dislodging sediment, lifting the sediment, and either transporting it directly to shore or to a temporary staging point (e.g., a barge) pending transport to shore. Three basic types of dredges are effective at removing contaminated sediments: mechanical, hydraulic, and pneumatic.

Mechanical dredges dislodge the sediment using mechanical equipment and dig the sediment as the means for removal. The principal advantage of this type dredge is that the density of the removed material is at or near the same as its in situ density which means that less water is carried with the sediment and that smaller volumes of water would potentially require treatment. Types of mechanical dredges include: bucket wheel dredges, clamshell dredges, and closed-bucket clamshell dredges.

Hydraulic dredges pump sediment in a slurry formed by suctioning the sediment. Some hydraulic dredges use mechanical agitation to loosen the sediment to a sufficient density so that it can be lifted and pumped. Slurry is typically transported across floating or pontoon-supported pipelines to shore. Examples of hydraulic dredges include plain suction, cutterhead, dustpan, hopper, and mud cat.

Pneumatic dredges operate principally by the motive force supplied by compressed air to dislodge the sediment which then is transported by pump to shore. The pneuma pump and the airlift dredge are types of pneumatic dredges.

1.4.2.1 Effectiveness

Mechanical excavation would be very effective at removing shallow sediments during winter pool. Other than at winter pool, mechanical excavation remains effective at removing the sediment although greater levels of turbidity will be generated and require stricter control over fugitive sediment. Careful handling of the saturated material would be necessary to prevent leaks or spills.

Mechanical and hydraulic dredges are effective in dredging shallow or deep sediments. Each is a proven process option type that has been implemented at other sites to remove contaminated sediments under various conditions. Pneumatic dredges are not effective in shallow conditions. Efficiency of pneumatic dredges increases with water depth, making pneumatic dredges potentially well-suited for deep sediment removal. Dredging, in general, can be somewhat more advantageous in that sediment can be removed through piping to shore facilities, effectively reducing the amount of potential worker exposure.

1.4.2.2 Implementability

Implementability of mechanical excavation in shallow sediments during winter pool is good compared to dredging. The added water recovered and the greater level of engineering controls necessary to contain fugitive sediment makes dredging more difficult to implement than excavation.

Some mechanical dredges can recover at or near in situ densities, but a certain amount of water contained in sediment pore space will be recovered along with the contaminated sediment and may be considered a waste stream that requires additional treatment and/or disposal. Hydraulic dredges operate in either shallow or deep sediment, but remove large amounts of water along with the sediment to form the slurry, which only increases the amount of water to potentially treat. Pneumatic dredges do not operate efficiently in shallow conditions and are considered implementable only in deep water where it is reported to remove sediment with a high solids content.

1.4.2.3 Cost

Costs for removal, in general, will be high for capital expenditure and operations costs for either excavation or dredging. Neither technology has a clear cost advantage.

1.4.2.4 Selection of representative process option(s)

Mechanical excavation is selected as the representative process option to remove contaminated shallow sediments based on greater ease of implementability and because there is typically less water to potentially recover and treat or dispose than with dredging.

Mechanical, hydraulic, and/or pneumatic dredges are site applicable, but are more difficult to use in removing contaminated shallow sediment. Each will be retained on a contingent basis for potential future reevaluation and implementation, particularly for deep sediment removal.

1.5 TURBIDITY MINIMIZATION

During removal or containment actions, sediments may be resuspended in the surface water, transported downstream, and deposited on the sediment surface where it can become available to biota or humans. Turbidity minimization technologies can mitigate the adverse effects of sediment resuspension.

1.5.1 Water Turbidity Minimization

Turbid water minimization limits the amount of fugitive sediment resulting from other remedial actions. Isolation and capture of this sediment diminishes potential risks that may have otherwise risen due to increases of available contaminants leaving the active work site.

Silt curtains are impervious barriers that extend vertically from the water surface to a specified depth. Flexible nylon-reinforced polyvinyl chloride (or similar) fabric forms the barrier and is maintained in a vertical position by flotation segments at the top and a ballast chain (for weight) along the bottom. Tension cables are built into the curtain just below the flotation segment and repeated at some distance(s) below the flotation segment to reinforce the curtain against currents and other hydrodynamic forces. Anchor lines hold the curtain in place in circular or arc-shaped fashion. Silt curtain effectiveness is dependant on the degree of suspended silt behind the barrier, curtain configuration, mooring, and especially the hydrodynamics of the system.

Silt screens are synthetic geotextile fabrics that allow water to pass through small openings in the fabric yet retain the silt. Mesh size of the material determines the size of particles that can pass. Typical mesh sizes are 70–100 United States standard sieve. The advantage silt screens have over silt curtains is that they can be extended to the bottom sediment. It is suspended at the top by a line of floats and anchored to the bottom. Excess material is installed and allowed to drape at the bottom. This will allow the slack to be taken up during water level rises without stressing the fabric. The mesh size selection must be small enough to capture the smallest size target particle, yet not clog and reduce water flow. Clogged screens may not properly respond to fluctuations in flow rate or water level and may break.

1.5.1.1 Effectiveness

Silt screens and silt curtains are effective in retaining fugitive sediments during sediment-disturbing (e.g., dredging) operations. These process options are not effective for containment or excavation actions because these are conducted when shallow sediments are subaerially exposed.

1.5.1.2 Implementability

Implementability of silt curtains or screens would be moderately difficult to install and to inspect and maintain for breaks in the material, which would allow potentially contaminated material to escape.

1.5.1.3 Cost

Costs for these process options will be relatively high and will depend on the area to be effectively isolated, and inspection and repairs.

1.5.1.4 Selection of representative process option(s)

Since both process options are not effective for other than submerged conditions, dredging was not selected as a representative process option, and mechanical excavation is based on removal of shallow sediments exposed at winter pool water level, these will not be selected as representative process options. Either silt curtains or silt screens or both are considered effective, implementable, and cost-effective when used for dredging or similar submerged sediment-disturbing activities and will be retained on a contingent basis.

1.6 EX SITU TREATMENT

Treatment is used to reduce volume, mobility, or toxicity of a waste. The treatment technologies remaining after the initial technical applicability screening include physicochemical treatment, thermal treatment, and dewatering.

1.6.1 Physicochemical

A significant number of technically applicable sediment physicochemical treatment process options exist, including: chemical extraction/soil washing, solidification/stabilization, dehalogenation, precipitation/flocculation, and ion exchange.

Chemical extraction/soil washing targets contaminants sorbed onto sediment particles which tend to associate with fine particles. Soil washing separates these from the coarser particles in an aqueous-based system. The wash water may be augmented with a surfactant, pH adjustment, or chelating agent to help remove organics or heavy metals, including radionuclides. This technology offers potential for leaching out contaminants from coarse-grained sediments. The wash fluids and fine-grained sediments are residuals that may need further treatment and/or disposal. Clean coarse-grained sediments can be returned to the site. Soil washing will not be carried forward because large amounts of fine-grained sediment in the OU will not significantly reduce the amount of waste material to be either additionally treated or disposed of.

Solidification/stabilization can do one or more of the following: improve the handling and physical nature of the sediments, as in free water sorption; decrease the surface area of the waste mass across which transfer or loss of contaminants can occur; and limit the solubility of any hazardous constituents in the waste. Solidification technology adds a reagent to transform the sediments into a solid. Liquid or semi-solid waste tends to become solidified, thus improving the handling and physical nature of the material. Solidification encapsulates the waste into a structurally stable solid. Solidification is achieved by either decreasing the surface area of the waste or surrounding the waste in an impervious capsule. The contaminated sediment is mixed with water and a binding agent and allowed to cure into a solidified mass. Stabilization reduces the mobility of a contaminant by converting COC(s) into less mobile or toxic forms. Wastes that leach heavy metals or other contaminants can be stabilized to immobilize the hazardous contaminants. Although the contaminant is immobilized, the waste may maintain its original physical nature and handling characteristics. Stabilization/solidification can be accomplished by the use of cement-based materials, pozzulanic-based materials (silicon dioxide), thermoplastic, and organic polymer materials.

Chemical precipitation/flocculation is a process in which dissolved chemical species, such as toxic metals, are transformed into a solid phase for removal. This process is primarily used for the removal of metals. It decreases the solubility of the contaminants either by pH adjustment or by adding chemicals which effectively reduce the electrostatic repulsion inherent in ions, thus causing them to come together due to their net attractive surface charges. The ORR facilities have the system for treating contaminated water.

Ion exchange is an ex situ volume and toxicity reduction process to remove ionic species, principally inorganics, from aqueous waste streams. Ion exchange is based on the use of specifically formulated resins and natural inorganic materials that have an exchangeable ion bound to the resin with a weak ionic bond. If the electrochemical potential of the ion to be recovered (contaminant) is greater than that of the exchangeable ion, the exchange ion goes into solution and the contaminant ion binds to the resin.

1.6.1.1 Effectiveness

Chemical extraction/soil washing is effective if there is a high amount of coarse-grained material. Large amounts of coarse material will be removed and render a small amount of fine silt and clay with most or all of the contamination.

Solidification/stabilization will effectively reduce the mobility of inorganic contaminants and improve disposal options.

Water may be treated with ion exchange or chemical precipitation/flocculation effectively. Inorganics are the main contaminants in sediment that elevate risk to unacceptable levels. Any leachable portion of these that emanate from dewatering sediment may alter the water quality sufficiently to preclude discharge to the reservoir. Treatment with an ion exchanger for these contaminants may be necessary before other potential treatment steps (for water-borne contaminants that may have been acceptable in sediment, but not in water) or discharge to the reservoir.

No specific consideration was given for effectiveness in physicochemical treatment options applied to deep sediment contaminants, although those described previously (among others) may apply.

1.6.1.2 Implementability

Chemical extraction/soil washing would be difficult to implement. It is anticipated that much of the site sediment will have a mixture of sands, silts, and clays, of which this process can treat, but unless there is a significantly high proportion of sand in the OU, treatment with this process will yield little in the way of volume reduction.

Stabilization/solidification would be moderately difficult to implement. Only those contaminants that cannot be treated to reduce concentrations by other options and would cause WAC failure for potential disposal sites can be segregated and stabilized to reduce leachability and thus be more acceptable to landfill WACs. The difficulty lies mainly in the amount of handling the sediment may require to segregate the material suitable for this option.

Chemical precipitation/flocculation and ion exchange can be implemented by constructing a dedicated on-site facility to treat the water specifically from site sediments. However, the possibility for this in light of already constructed operating facilities at all three plants seems unlikely. Nevertheless, volumes or specific contaminants not within the capabilities of any of these treatment facilities may prompt the construction of a dedicated facility or upgrade of existing facilities to treat this water.

No specific consideration was given for implementability in physicochemical treatment options applied to deep sediment contaminants, although those described previously (among others) may apply.

1.6.1.3 Cost

Costs for all of the physicochemical treatments described above will be high. All have high capital costs and high operating cost. Chemical precipitation/flocculation and ion exchange treatment facilities constructed specifically for the water from sediment is probably not cost effective considering the treatment facilities already in place.

1.6.1.4 Selection of representative process option(s)

Stabilization/solidification is selected as a representative process option for its implementability and its effectiveness in reducing inorganic contaminant mobility. This option will reduce leachability for metals in sediment, particularly arsenic in McCoy Branch Embayment without overwhelmingly increasing waste volume for the entire waste stream. Volume increases will occur for the sediment to which the process is applied, but proper analysis and sediment waste stream segregation will reduce the amount of material requiring stabilization treatment. Also, some moisture in the sediment will not cause the option to become ineffective. Cement slurry will be added to the sediment and solidify the mass anyway.

Chemical extraction/soil washing was not selected as a representative process option because the reduction in volume is not believed to be significant enough to be cost effective. Potentially, little volume reduction would occur and the residual material, whatever its volume, would possibly require additional treatment such as stabilization/solidification before disposal.

Chemical precipitation/flocculation and ion exchange are not selected as representative process options. Both are site applicable and will be retained on a contingent basis, but existing facilities (see Sect. 1.7.2, water disposal) are more appropriate means of wastewater treatment at this time.

1.6.2 Thermal treatment

Thermal treatment uses elevated temperatures to destroy, detoxify, or physically stabilize hazardous wastes. The most site applicable thermal treatment is low-temperature thermal desorption (thermal desorption). Other thermal treatments were considered initially, but thermal desorption is the mitigating action chosen because mercury is present in portions of Poplar Creek at concentrations that may present unacceptable risk, and, when removed may fail TCLP analysis. Failure of TCLP will potentially limit the number of disposal options as discussed later in section 1.7.1.

Incineration is the incinerating of incomplete combustion, volatile, or off-gases in a device commonly referred to as an afterburner. A number of alternative incineration processes are available: fluidized bed, circulating bed combuster, high-temperature slagging and rotary kiln. Fluidized bed and rotary kiln are the more widely available processes and have been used to treat hazardous materials.

Thermal desorption is a low-temperature means of removing volatile mercury (and many organic compounds, if present) from sediments. The system consists of a furnace in which the volatile mercury is desorbed from the waste feed. Desorbed organics and mercury are removed from the furnace by a purge gas and collected by a physical/chemical treatment or are destroyed in an afterburner.

Pyrolysis is the destruction of organic material in the absence of oxygen at a high temperature to reduce toxic organic constituents to elemental gas and water. The absence of oxygen allows separation of the waste into an organic fraction (gas) and an inorganic fraction (salts, metals, particulates) as char material.

Infrared thermal is a commercially available destruction process option that thermally ruptures the chemical bonds of molecules in the absence of oxygen and at high temperatures to reduce toxic organics to elemental gas and water.

1.6.2.1 Effectiveness

Incinerators have a high destruction efficiency and are effective in treating mixed solid residues. Thermal desorption is very effective at removal of mercury contaminants from solid media (soils and sediments). Pyrolysis is also effective in the destruction of PCBs. Infrared thermal is also an effective treatment for other wastes containing halogenated and nonhalogenated organics, including PCBs. All the thermal processes are more effective than other physicochemical process options for destroying organic contaminants.

1.6.2.2 Implementability

Implementability of thermal desorption is moderately difficult. Construction of a facility to process the material will require a high level of effort to install the primary equipment and support equipment needed to treat the sediment. However, the option operates at low temperature, thus air emissions permits would not normally be necessary because no off-gas contaminants would occur. Implementability is very good compared to other thermal treatments that operate at high temperatures and would likely require more strict operation controls to meet emissions standards.

1.6.2.3 Cost

Cost for any of the identified thermal treatments will be high, principally from initial capital costs. O&M cost are comparable to other ex situ treatments.

1.6.2.4 Selection of representative process option(s)

Thermal desorption is selected as a representative process option for its effectiveness at reducing mercury concentrations. It is more cost efficient than most ex situ treatment options requiring specialized equipment to process contaminated sediment, and has the advantage over other thermal treatments in that meeting air emissions requirements for this option are less difficult due to low-temperature operation. This process option is more than 99 percent efficient in removing volatile organic compounds from soil.

1.6.3 Dewatering

The primary purpose of this process is to reduce the moisture content of slurries or sludges to expedite the handling and to prepare the material for further treatment or disposal. The water generated during dewatering may contain contaminants and suspended solids, and wastewater treatment may be necessary.

A belt filter press processes sediment slurry into sediment cakes by squeezing the water from the slurry as it passes across a rolling belt. Sediment is then more easily managed for any further treatment and/or disposal. Anticipated sediment volumes may require multiple units to process large volumes of sediment.

Settling ponds are constructed areas intended for impoundment of sediment/water slurry. Slurry is allowed to collect and by gravity, solids settle out of the water column. Collection of the water and separated sediment make each medium transportable and treatable. Settling ponds are useful when solids content of slurry is low.

Fly ash can be added to absorb free water in sediment slurry. Fly ash combines with the water to make the material easier to handle, transport, and dispose. Disposal (and most other treatment) criteria will necessitate the absence of free water in the material before waste acceptance. Fly ash does not reduce contaminant leachability.

A sloping dewatering pad is constructed sufficiently large enough to handle the volumes of sediment anticipated during implementation of sediment removal by excavation and/or dredging. It would be constructed such that drainage flow is directed toward the collection trench. A perimeter berm would be constructed around the facility to prevent wastewater leaving or run-on entering the facility. Water draining from the sediment will be collected in the trench and then pumped to temporary holding tanks. The net effect is two waste streams, each of which is easier to characterize and handle than previously as a mixture.

1.6.3.1 Effectiveness

Belt filter presses are effective at actively removing free water from supersaturated sediments. Depending on the volume of sediment to dewater, the process could require several units running in parallel to continually process the sediment. The higher the water content the less efficient the process becomes, including longer process times.

Settling ponds are effective for sediment slurry separation where there is a high water content requiring separation from the solids. Effectiveness for the minimal amounts of water removed during excavation would make this option unsuitable.

Addition of fly ash is effective in absorbing small amounts of free water. Supersaturated sediment is probably not effectively treated by solely adding fly ash. Volume increases are such that the amount of fly ash needed to absorb large amounts of water will prohibitively raise the volume of total material to be disposed.

Sloping dewatering pads are effective at allowing natural processes to dewater sediment. Gravity drainage and evaporation would remove most or all the free water. Proper construction can effectively restrain contamination migration from the pad.

1.6.3.2 Implementability

A belt filter press is commercially available, but several units may be required to dewater the sediment in a reasonable period of time.

Settling ponds are site applicable, but anticipated volumes of water/sediment slurry are probably not large enough (when excavated) to necessitate implementation of settling ponds which are perhaps most suitable for slurries with generally low solids content.

Fly ash is easily implemented, especially for the anticipated amounts of water brought in by excavating sediment; implementation for high water content sediment would be considerably more difficult.

Sloping dewatering pads would have a somewhat high initial difficulty in construction of the pad, but long-term operation difficulty would be very small because the dewatering process is basically passive.

1.6.3.3 Cost

Capital cost and O&M cost for belt filter presses will be high.

Land acquisition and construction of settling ponds will cause this option to be costly. Actual costs will depend largely on the expected solids content of the sediment slurry being recovered, the time for a slurry to separate adequately, and the area needed to stage the slurry while it separates.

Fly ash will increase the volume of the material to be treated or disposed, raising the costs for both. Contaminated material that meets WAC of potential disposal sites without treatment(s) to reduce contaminant concentrations, mobility, etc. may be treated with only fly ash and sent directly to the disposal facility with modest increases of volume. Material that requires some form of treatment other than free water removal will cost significantly more to treat the additional volume and may be considered cost prohibitive.

Costs for a sloping dewatering pad will largely be initial capital costs. Operation costs for only the pad will be minor for maintenance of the pad. Treatment costs are very low because sunlight, air, and gravity dewater the sediment naturally.

1.6.3.4 Selection of representative process option(s)

Sloping dewatering pad is the selected dewatering treatment option. Operation of the pad is simple and cost effective. Belt filter presses are more costly to operate and maintain. Expected water from excavation of shallow sediment is low, which precludes settling ponds. Fly ash is effective at binding with the small amounts of expected free water, but it does not reduce contaminant leachability, and any further treatment(s) or disposal costs will rise due to increased volumes.

1.7 DISPOSAL

1.7.1 On-Site Sediment Disposal

This action provides long-term containment and/or isolation of contaminated dredged material, or by using specific treatment methods, the sediment could be beneficially reused if it meets applicable regulatory requirements.

Based on the limited existing data, the primary COC (in shallow sediments) in Poplar Creek appears to be mercury and in McCoy Branch Embayment it is arsenic. Data also indicate the presence of other inorganics in both areas. Reach 2 has also been identified with PCB contamination in shallow sediments. Characterization of dewatered sediment is imperative to determine the proper handling and disposal method. Radiological surveys and analysis as well as TCLP analysis needs to be performed.

The following discusses the general on-site/off-site disposal options for the sediment. It should be noted that as more specific characterization data become available, some of the disposal options presented will not be available due to potential contaminants and/or inability of the waste to meet disposal facility WAC.

With regard to on-site disposal options, it is very unlikely that a new disposal facility (cell) will be designed, constructed, and operated for Clinch River/Poplar Creek sediments only. Regulatory design criteria, volume, and cost are all factors which make implementation of this option difficult. The cost of developing the cell outweighs the anticipated volume of sediment to be disposed of. Also, regulatory drivers (i.e., land disposal restrictions, waivers, and special waste permits) necessitate additional administrative burdens that will potentially increase costs, further decreasing feasibility.

The ORNL IWMF at Solid Waste Storage Area (SWSA) 6 only accepts SLLW. The Clinch River/Poplar Creek sediments may be potentially RCRA regulated. Treatment for removal of the potential RCRA components would be necessary before disposal at SWSA 6. This may prove very expensive. More importantly, an inhibiting factor for sediment disposal at SWSA 6 is capacity. Currently the number of tumulus pads available at the disposal facility will not hold the approximate 30,000 yd^3 of sediment. Characterization of the sediment and coordination with ORNL waste management would be necessary before this option is feasible.

Two on-site/off-site beneficial reuse options for the sediment that will likely be screened out are using the sediments as roadway/runway fill and reclamation/recycling of the contaminants within the sediment. The difficulty with using the sediments for roadway/runway fill is primarily adherence to DOE's "no-RAD added" policy. Shipping sediments off-site to be used for commercial purposes may place a liability burden on DOE. Logistics limitations may also apply. Staging and storage difficulties may arise if there is not a new roadway/runway under construction.

Reclamation/recycling of the contaminated sediments simply is not cost effective. To treat the sediment to recover the available mercury would be very expensive. The amount of sediment estimated for disposal would probably not yield enough pure mercury for resale or use.

1.7.1.1 Effectiveness

Storing treated sediments at the ORNL IWMF would be effective at reducing site risks to humans and ecological receptors. Availability of this option will ultimately determine the precise location for storage or disposal of sediments. The effectiveness of this option is as effective as any appropriately engineered storage/disposal facility with respect to reducing site risks. Currently this facility is the only one identified as potentially available.

Beneficial reuse is effective at reducing site risks at the OU, but could potentially elevate risks elsewhere. Liability of contaminants under the DOE no-RAD added policies would probably supersede advocation of reusing sediments as roadway/runway aggregate. If radiological surveys and laboratory analysis confirm the material has only background levels of radionuclides and risks from these or other contaminants is acceptable, then the option could be effective at reducing site risks and sparing unnecessary landfilling.

Reclamation of contaminants from sediments and recycling them for economical reuse can be effective at reducing site risks from contaminants.

1.7.1.2 Implementability

The ORNL IWMF will be difficult to implement, but no more so than any other potential on-site disposal option. Implementability for this option or any on-site disposal option is probably the most implementable as compared to off-site disposal options, based on transportation requirements and costs, and especially elevated disposal costs.

The beneficial reuse implementability is hampered most by policy concerns over radionuclide content and disbursing liability to relatively uncontrolled areas.

Implementability of reuse/recycling is unrealistic. Contaminant concentrations are too low for economic recovery.

1.7.1.3 Cost

Cost for disposal at the ORNL IWMF (or any other on-site facility) will be high, but likely less than any off-site disposal options.

Cleanup criteria for release of the sediment for use as fill aggregate is likely more stringent than that for only putting the material into an engineered facility such as a landfill, which will drive up treatment costs potentially into cost-prohibitive status.

Recovery of contaminants at currently known site concentrations will cost more to recover the material than the material is economically worth.

1.7.1.4 Selection of representative process option(s)

The ORNL IWMF (or an alternate on-site surrogate) is chosen as the representative on-site sediment disposal process option. Neither of the other two site applicable process options are very plausible, mainly based on low degree of implementability and comparatively high cost.

1.7.2 Off-site Sediment Disposal

An off-site disposal option that could be very expensive to implement is shipping the sediments to the Envirocare of Utah, Inc. (Envirocare) facility. This site is permitted to accept, store, and dispose of DOE-generated Class A mixed waste. Consideration of this facility is restrained by the fact that costs to transport and dispose of untreated mixed waste is very high. Minimal treatment must involve dewatering because Envirocare will not accept waste with free liquids.

A second off-site disposal option is the Nevada Test Site (NTS). This site does not accept mixed, hazardous, or toxic waste. It only accepts low-level radioactive waste (LLW). Characterization would have to prove that the sediment is only LLW and is also the result of production of defense-related components. This may be difficult to prove based on the numerous reaches and areas exhibiting contaminated sediment. Additional containerization and transportation costs will significantly inhibit the feasibility of this option.

1.7.2.1 Effectiveness

Either off-site disposal option is effective in reducing risks from OU contaminants in sediment. Both options are located in arid climates which will reduce potential risks from leachable contaminants after disposal as well.

1.7.2.2 Implementability

The Envirocare facility option is implementable. An agreement between DOE and Envirocare has been struck that establishes facility acceptance of ORR mixed wastes, which potentially may eliminate certain treatment steps other than dewatering, reducing potential treatment costs.

The NTS facility only accepts LLW that has been proven to be the result of releases contributable to the production of defense-related components. Implementability of this option is very doubtful. Multiple sources of contaminants to this OU, most of which are not directly related to defense component production, will probably disqualify NTS as a potential option.

1.7.2.3 Cost

Envirocare is expensive. Off-site disposal in general is very costly. Off-site mixed waste disposal is even more so. However, a certain amount of cost savings may be attributed to being able to forego treatment of the sediment (other than dewatering, which Envirocare WAC explicitly states no free liquids).

Likewise, NTS is expensive. Since it does not accept mixed waste, treatment for certain RCRA metal contaminants may be necessary before acceptance by the facility.

1.7.2.4 Selection of representative process option(s)

Envirocare is the selected representative off-site sediment disposal process option primarily for its ability to accept mixed waste. Risks to the OU are reduced and residual risks at the disposal facility are low due to climate and low potential for leaching. NTS is probably not implementable due to contaminant historical requirements and qualifications, and, on-site disposal of LLW can be implemented easier.

1.7.3 Water Disposal

Based on the existing limited data, only one disposal option has been identified for the disposal of the wastewaters obtained from the dewatering of the sediments. The West End Treatment Facility at the Y-12 Plant has been earmarked as the designated location. This is contingent on characterization results of the wastewaters and whether the treatment facility will be able to meet its National Pollutant Discharge Elimination System (NPDES) effluent limits. Consultation with facility officials is necessary to determine wastewater and facility limitations as well as scheduling amounts and delivery times.

1.7.3.1 Effectiveness

The treatment facility is effective in removing the potential contaminants detected in OU sampling that may occur in drainage from removed sediments. Effectiveness will remain good assuming contaminant types and concentrations remain in the treatability range of the facility.

1.7.3.2 Implementability

Implementability of treating water at this facility is good, so long as the facility is aware of the anticipated volumes requiring treatment, can meet its NPDES limits, and the contaminant profile remains consistent. Consistency of concentrations of existing contaminants are not anticipated to vary significantly, or, new contaminants to appear that are out of the treatment abilities of the facility. If these situations arise, a pre-treatment for these added contaminants or an alternate treatment facility may be necessary before final disposal.

1.7.3.3 Cost

Costs for this facility are anticipated to be good. Generally on-site treatments are less expensive than off-site treatment or disposal.

1.7.3.4 Selection of representative process option(s)

The Y-12 Plant West End Treatment Facility is selected as a representative process option. Effectiveness for OU contaminants currently identified is good. Implementability can be good, but communication with the facility is important in coordinating wastewater delivery and ensuring the facility can meet its NPDES effluent requirements.

1.7.4 Waste Transportation

Trucks can be used to haul saturated or dewatered sediment. Sediment being sent for dewatering would have the trucks lined to prevent leakage. Sediment not requiring treatment, once dewatered, can also be transported on site by truck.

Water derived from dewatering the sediment that fails to meet criteria for release back to the reservoir can be hauled to the West End Treatment Facility by tanker truck or have smaller polyethylene tanks loaded on flat-bed trucks to haul, depending on volume.

Rail transport of dewatered sediment can be used to send untreated sediment to Envirocare in Utah in B-25 boxes. If the sediment is treated and meets NTS WAC, then the material may be sent to Las Vegas, Nevada, by rail and on to NTS by truck. U.S. Department of Transportation (DOT) requirements for rail transport are that the material be packaged in "strong tight" containers specified in 49 CFR 173.

1.7.4.1 Effectiveness

Truck transportation is good for hauling material around the ORR site to any of the on-site storage/disposal facilities.

1.7.4.2 Implementability

Implementability may be difficult for either truck transport or rail transport. A primary consideration is the transport of the sediment to the dewatering pad for free water removal. Leakage from saturated sediments may be a health hazard to the public and must be avoided. Access road construction to individual areas for trucks to enter and exit will diminish ease of implementability due to the level of construction needed to access some of these areas at the site. Rail transport will require the same access roads to get the sediment out of individual sites, lining of trucks, and dewatering of sediment. Moreover rail transport will necessitate the material be brought to a suitable area with a railroad spur where the material can be packaged and loaded for transport. Water transport would be easily implemented assuming the infrastructure built for trucks to access the dewatering pad are in place.

1.7.4.3 Cost

Transport costs for on-site transport via trucks is comparatively low. Transport of saturated sediment will likely incur the highest portion of costs due to the necessary precautions added to prevent spills or leakage. On-site transport costs of dewatered sediment is expected to be relatively low. Based on existing contaminant data for shallow sediments, dewatered material should be considered stable because leakage of liquids would no longer pose a threat. Spillage of solids would be avoided, but could be managed with relative ease. Water transport cost is also considered to be low. Rail transport will be relatively high. The distance to be shipped and DOT requirements for shipping mixed waste increase costs for rail transport.

1.7.4.4 Selection of representative process option(s)

Trucks for sediment and water transport on site, and, rail transport for sediment unsuitable for on-site storage or disposal are selected as representative process options. All of which are implementable and effective. Depending on the disposal option selected, cost can range from low for on-site trucking to high for rail transport off site.

Appendix J

LISTS OF ORR BIOTA

Table J1. List of the dominant and common plant species and their wetland indicator classifications (Reed 1988) identified during wetland surveys of selected areas along the Clinch River and its tributaries

COMMON NAME	SCIENTIFIC NAME	REGIONAL INDICATOR[a]
TREES		
American elm	*Ulmus americanus*	FACW
Bald cypress	*Taxodium distichum*	OBL
Black willow	*Salix nigra*	OBL
Box elder	*Acer negundo*	FACW
Cottonwood	*Populus deltoides*	FAC+
Green ash	*Fraxinus pennsylvanica*	FACW
Hackberry	*Celtis occidentalis*	FACU
Loblolly pine	*Pinus taeda*	FAC
Red maple	*Acer rubrum*	FAC
Slippery elm	*Ulmus rubra*	FAC
Swamp white oak	*Quercus bicolor*	FACW+
Sweetgum	*Liquidambar styriciflua*	FAC
Sycamore	*Platanus occidentalis*	FACW-
Tulip poplar	*Liriodendron tulipifera*	FAC
Winged elm	*Ulmus alata*	FACU+
SHRUBS		
Buttonbush	*Cephalanthus occidentalis*	OBL
Elderberry	*Sambucus canadensis*	FACW-
False indigobush	*Amorpha fruticosa*	FACW
Privet	*Ligustrum vulgare*	not listed
Silky dogwood	*Cornus amomum*	FACW+
Smooth alder	*Alnus serrulata*	FACW+
VINES		
American potato-bean	*Apios americana*	FACW
Hog peanut	*Amphicarpaea bracteata*	FAC
Japanese honeysuckle	*Lonicera japonica*	FAC-
Poison ivy	*Toxicodendron radicans*	FAC
FERNS		
Sensitive fern	*Onoclea sensibilis*	FACW

Table J1 (continued)

COMMON NAME	SCIENTIFIC NAME	REGIONAL INDICATOR[a]
GRASSES		
Fowl manna grass	*Glyceria striata*	OBL
Indian sea-oats	*Chasmanthium latifolium*	FAC-
Microstegium	*Eulalia viminea*	FAC+
Rice cutgrass	*Leersia oryzoides*	OBL
Virginia wild rye	*Elymus virginicus*	FAC
SEDGES AND RUSHES		
Grass-leaf rush	*Juncus marginatus*	FACW
Soft rush	*Juncus effusus*	FACW+
Green bulrush	*Scirpus atrovirens*	OBL
Leafy bulrush	*Scirpus polyphyllus*	OBL
Woolgrass	*Scirpus cyperinus*	OBL
Blunt broom sedge	*Carex tribuloides*	FACW+
Fox sedge	*Carex vulpinoidea*	OBL
Frank's sedge	*Carex frankii*	OBL
Fringed sedge	*Carex crinita*	OBL
Sallow sedge	*Carex lurida*	OBL
Smooth sheath sedge	*Carex laevavaginata*	OBL
Stalk-grain sedge	*Carex stipata*	OBL
Many-flower flatsedge	*Cyperus lancastriensis*	FAC
Straw-color flatsedge	*Cyperus strigosa*	FACW
Yellow flatsedge	*Cyperus flavescens*	OBL
Blunt spikerush	*Eleocharis obtusa*	OBL
Creeping spikerush	*Eleocharis palustris*	OBL
HERBACEOUS SPECIES		
American germander	*Teucrium canadense*	FACW-
Arrowleaf tearthumb	*Polygonum sagittatum*	OBL
Broad-leaf arrowhead	*Sagittaria latifolia*	OBL
Bugleweed	*Lycopus virginicus*	OBL
Bushy St. John's-wort	*Hypericum densiflorum*	FACW-
Canada wood-nettle	*Laportea canadensis*	FACW
Cardinal flower	*Lobelia cardinalis*	OBL
Cattail	*Typha latifolia*	OBL
Creeping jennie	*Lysimachia nummularia*	FACW+
Curly dock	*Rumex crispus*	FAC
Cut-leaved water horehound	*Lycopus americanus*	OBL
Dotted smartweed	*Polygonum punctatum*	FACW+
Dotted St John's-wort	*Hypericum punctatum*	FAC
False nettle	*Boehmeria cylindrica*	FACW+
Goldenglow	*Rudbeckia laciniata*	FACW

Table J1 (continued)

COMMON NAME	SCIENTIFIC NAME	REGIONAL INDICATOR[a]
Green dragon	*Arisaema dracontium*	FACW
Halberd-leaved rosemallow	*Hibiscus laevis*	OBL
Honewort	*Cryptotaenia canadensis*	FAC+
Ironweed	*Vernonia noveboracensis*	FAC+
Jewelweed	*Impatiens capensis*	FACW
Lance leaf frog-fruit	*Phyla lanceolata*	FACW+
Lance-leaf loosestrife	*Lysimachia lanceolata*	FAC
Late-flowering thoroughwort	*Eupatorium serotinum*	FAC
Marsh bedstraw	*Galium tinctorium*	FACW
Mistflower	*Conoclinium coelestinum*	FAC
Seedbox	*Ludwigia* sp.	OBL
Slender St. John's-wort	*Hypericum mutilum*	FACW
Smooth hedge-nettle	*Stachys tenuifolia*	FACW-
Spotted joe-pye weed	*Eupatoriadelphus maculatus*	FACW-
Spotted water hemlock	*Cicuta maculata*	OBL
Spreading dayflower	*Commelina diffusa*	FACW
Square-stemmed monkeyflower	*Mimulus ringens*	OBL
Swamp milkweed	*Asclepias incarnata*	OBL
Swamp smartweed	*Polygonum hydropiperoides*	OBL
Swamp rosemallow	*Hibiscus moscheutos*	OBL
Three-lobe beggar-ticks	*Bidens tripartita*	OBL
Virginia knotweed	*Polygonum virginianum*	FAC
Water pimpernel	*Samolus parviflorus*	OBL
White avens	*Geum canadense*	FAC
Wingstem	*Verbesina alternifolia*	FAC

NOTES:

[a] Regional Indicators are from Reed, P.B., 1988. National List of Plant Species That Occur in Wetlands: Tennessee. USFWS Biological Report NERC-88/18.42.

The indicator classification is based on the frequency with which a species occurs in a wetland habitat.

Indicator	Percent Occurrence in Wetlands (in percent)
OBL (Obligate)	>99%
FACW (Facultative Wetland)	67–99
FAC (Facultative)	34–66
FACU (Facultative Upland)	1–33
UPL (Upland)	< 1

Table J2. Rare and endangered plants on the Oak Ridge Reservation[a].

Common Name	Scientific Name	Status[b]	Location[c]
Spreading False-Foxglove	*Aureolaria patula*	ST and FC	- Campbell Bend Bluffs - Poplar Creek Cliffs - Health Physics Research Reactor Lake Bluffs - Melton Dam Bluffs - White Cedar Area
Appalachian Bugbane	*Cimicifuga rubifolia*	ST and FC	- Campbell Bend Bluffs - Bull Bluff - North Hickory Creek Bend Bluffs
Pink Lady-Slipper	*Cypripedium acaule*	SE	
Tall Larkspur	*Delphinium exaltatum*	SE and FC	- McCoy Branch Embayment
Northern Bush-Honeysuckle	*Diervilla lonicera*	ST	- White Cedar Area
Branching Whitlow-Grass	*Draba ramosissima*	SSC	
Nuttall's Waterweed	*Elodea nuttalli*	SSC	
Mountain Witch-Alder	*Fothergilla major*	ST	
Golden Seal	*Hydrastatis canadensis*	ST	- Raccoon Creek (mile) - Rainy Knob Bluff, Freels Bend
Butternut	*Juglans cinerea*	ST and FC	- Melton Dam Bluffs
Short-Headed Rush	*Juncas brachycephalus*	SSC	
Canada Lily	*Lilium candense*	ST	
Fen Orchid	*Liparis loeselii*	SE	
American Ginseng	*Panax quinquefolius*	ST	
Tubercled Rein-Orchid	*Platanthera flava var herbiola*	ST	
Purple Fringeless Orchid	*Platanthera peramoena*	ST and FC	

Table J2 (continued)

Common Name	Scientific Name	Status[b]	Location[c]
Careys Saxifrage	*Saxifraga careyana*	SSC	- North Hickory Creek Bend Bluffs - South Hickory Creek Bend Bluffs - Tower Shielding Bluffs - Rainy Knob Bluff, Freels Bend - Copper Ridge Outcrop
Lesser Ladies'- Tresses	*Spiranthes ovalis*	SSC	
A Sedge	*Carex oxylepis var pubescens*	SSC	
Heavy Sedge	*Carex gravida*	SSC	
Pale Green Orchid	*Platanthera flava var herbiola*	ST	
Michigan Lily	*Lilium michiganese*	ST	

[a] *Source:* Pounds, L.R., P.D. Parr, and M.G. Ryon. 1993. Resource Management Plan for the Oak Ridge Reservation, Volume 30: Oak Ridge National Environmental Research Park Natural Areas and Reference Areas—Oak Ridge Reservation Environmentally Sensitive Sites Containing Special Plants, Animals, and Communities. ORNL/NERP-8.

[b] ST = State listed as Threatened
SE = State listed as Endangered
SSC= State listed as Special Concern
FC = Federal Candidate for listing as Threatened or Endangered.

[c] Location specified if occured along the Clinch River or Poplar Creek.

Table J3. Terrestrial[a] animal species on the Oak Ridge Reservation

Common Name	Trophic Category[b]	Special Status[c]
	Birds	
Gadwall	AqH	
Common Gallinule	AqH	
Mallard	AqH	
Pintail	AqH	
Tundra Swan	AqH	
Blue-Winged Teal	AqH	
American Widgeon	AqH	
Bufflehead	AqI	
Black Duck	AqI	
Ruddy Duck	AqI	
Common Goldeneye	AqI	
Pied-Billed Grebe	AqI	
Lesser Scaup	AqI	
Green-Winged Teal	AqI	
Black Tern	AqI	
Carolina Chickadee	ArI	
Brown Creeper	ArI	
Yellow-Billed Cuckoo	ArI	
Yellow-Shafted Flicker	ArI	
Golden-Crowned Kinglet	ArI	
Ruby-Crowned Kinglet	ArI	
Red-Breasted Nuthatch	ArI	
White-Breasted Nuthatch	ArI	
Baltimore Oriole	ArI	
Orchard Oriole	ArI	
American Redstart	ArI	
Yellow-Bellied Sapsucker	**ArI**	**INM**
Scarlet Tanager	ArI	
Summer Tanager	ArI	
Tufted Titmouse	ArI	
Red-Eyed Vireo	ArI	
Solitary Vireo	ArI	
White-Eyed Vireo	ArI	
Yellow-Throated Vireo	ArI	
Bay-Breasted Warbler	ArI	
Black and White Warbler	ArI	
Black-Throated Green Warbler	ArI	
Blackburnian Warbler	ArI	
Blackpoll Warbler	ArI	
Blue-Winged Warbler	ArI	
Cape May Warbler	ArI	
Cerulean Warbler	ArI	
Chestnut-Sided Warbler	ArI	
Hooded Warbler	ArI	

Table J3 (continued)

Common Name	Trophic Category[b]	Special Status[c]
	Birds (cont.)	
Magnolia Warbler	ArI	
Myrtle Warbler	ArI	
Parula Warbler	ArI	
Pine Warbler	ArI	
Prairie Warbler	ArI	
Prothonotary Warbler	ArI	
Tennessee Warbler	ArI	
Worm-Eating Warbler	ArI	
Yellow Warbler	ArI	
Yellow-Throated Warbler	ArI	
Downy Woodpecker	ArI	
Hairy Woodpecker	ArI	
Pileated Woodpecker	ArI	
Red-Bellied Woodpecker	ArI	
Red-Headed Woodpecker	**ArI**	**INM**
Yellowthroat	ArI	
Eastern Bluebird	FI	
Chuck-Will's-Widow	FI	
Acadian Flycatcher	FI	
Great Crested Flycatcher	FI	
Least Flycatcher	FI	
Blue-Gray Gnatcatcher	FI	
Eastern Kingbird	FI	
Purple Martin	FI	
Common Nighthawk	FI	
Eastern Phoebe	FI	
Bank Swallow	FI	
Barn Swallow	FI	
Cliff Swallow	FI	
Rough-Winged Swallow	FI	
Chimney Swift	FI	
Whip-Poor-Will	FI	
Eastern Wood-pewee	FI	
Red-Winged Blackbird	GI	
Catbird	GI	
Brown-Headed Cowbird	GI	
Cattle Egret	GI	
Common Egret	GI	
Killdeer	GI	
Horned Lark	GI	
Eastern Meadowlark	GI	
Mockingbird	GI	
Ovenbird	GI	
American Robin	GI	

Table J3 (continued)

Common Name	Trophic Category[b]	Special Status[c]
	Birds (cont.)	
Spotted Sandpiper	GI	
Common Snipe	GI	
Starling	GI	
Brown Thrasher	GI	
Gray-Cheeked Thrush	GI	
Hermit Thrush	GI	
Louisiana Water Thrush	GI	
Swainson's Thrush	GI	
Wood Thrush	GI	
Kentucky Warbler	GI	
Swainson's Warbler	GI	
American Woodcock	GI	
Bewick's Wren	**GI**	**ST, FC**
Carolina Wren	GI	
House Wren	GI	
Winter Wren	GI	
Golden Eagle	**LC**	**SE**
Peregrine Falcon	**LC**	**FE, SE**
Northern Harrier	**LC**	**ST**
Broad-Winged Hawk	LC	
Cooper's Hawk	**LC**	**ST**
Red-Shouldered Hawk	**LC**	**INM**
Red-Tailed Hawk	LC	
Sharp-Shinned Hawk	**LC**	**ST**
Sparrow Hawk	LC	
Barn Owl	**LC**	**INM**
Barred Owl	LC	
Great Horned Owl	LC	
Screech Owl	LC	
Loggerhead Shrike	LC	
Black Vulture	**LC**	**INM**
Turkey Vulture	LC	
Bobwhite	LH	
Red Crossbill	LH	
Mourning Dove	LH	
Rock Dove	LH	
Purple Finch	LH	
American Goldfinch	LH	
Canada Goose	LH	
Ruffed Grouse	LH	
Ruby-Throated Hummingbird	LH	
Slate-Colored Junco	LH	
Pine Siskin	LH	

Table J3 (continued)

Common Name	Trophic Category[b]	Special Status
	Birds (cont.)	
Bachman's Sparrow	**LH**	**SE, FC**
Chipping Sparrow	LH	
Field Sparrow	LH	
Fox Sparrow	LH	
Grasshopper Sparrow	**LH**	**ST**
Henslow's Sparrow	**LH**	**FC**
House Sparrow	LH	
Lark Sparrow	**LH**	**INM**
Song Sparrow	LH	
Swamp Sparrow	LH	
Vesper Sparrow	**LH**	**INM**
White-Throated Sparrow	LH	
Wild Turkey	LH	
Cedar Waxwing	LH	
Indigo Bunting	LO	
Common Canvasback	LO	
Cardinal	LO	
Yellow-Breasted Chat	LO	
American Coot	LO	
Common Crow	LO	
Ring-Necked Duck	LO	
Wood Duck	LO	
Common Grackle	LO	
Blue Grosbeak	LO	
Evening Grosbeak	LO	
Rose-Breasted Grosbeak	LO	
Blue Jay	LO	
Redhead	LO	
Rufous-Sided Towhee	LO	
Bald Eagle	**P**	**SE, FE**
Double-Crested Cormorant	**P**	**INM**
Bonaparte's Gull	P	
Herring Gull	P	
Ring-Billed Gull	P	
Black-Crowned Night Heron	**P**	**INM**
Great Blue Heron	P	
Green Heron	P	
Belted Kingfisher	P	
Common Loon	P	
Common Merganser	P	
Hooded Merganser	P	
Red-Breasted Merganser	P	
Osprey	**P**	**SE**

Table J3 (continued)

Common Name	Tophic Category[b]	Special Status[c]
Mammals		
Big Brown Bat	FI	
Eastern Small-Footed Bat	**FI**	**FC, INM**
Evening Bat	FI	
Gray Bat	**FI**	**FE, SE**
Hoary Bat	FI	
Indiana Bat	**FI**	**FE, SE**
Little Brown Bat	FI	
Rafinesque's Big-Eared Bat	**FI**	**FC, INM**
Red Bat	FI	
Silver-Haired Bat	FI	
Keen's Myotis	FI	
Eastern Pipistrelle	FI	
Eastern Mole	GI	
Least Shrew	GI	
Long-Tailed Shrew	**GI**	**FC, INM**
Masked Shrew	**GI**	**INM**
Short-Tailed Shrew	GI	
Smokey Shrew	**GI**	**INM**
Southeastern Shrew	**GI**	**INM**
Spotted Skunk	GI	
Stripped Skunk	GI	
Bobcat	LC	
Feral Cat	LC	
Cougar[d]	**LC**	**FE**
Coyote	LC	
Feral Dog	LC	
Red Fox	LC	
Mink	LC	
River Otter[e]	**LC**	**ST**
Long-Tailed Weasel	LC	
Beaver	LH	
Eastern Chipmunk	LH	
Eastern Cottontail	LH	
White-Tailed Deer	LH	
Gray Squirrel	LH	
Southern Flying Squirrel	LH	
Woodchuck	LH	
Eastern Woodrat	**LH**	**INM**
Gray Fox	LO	
Muskrat	LO	
Opossum	LO	
Raccoon	LO	
Southern Bog Lemming	**SH**	**INM**
Eastern Harvest Mouse	SH	

Table J3 (continued)

Common Name	Trophic Category[b]	Special Status[c]
	Mammals (cont.)	
Meadow Vole	SH	
Pine Vole	SH	
White-Footed Mouse	SO	
Deer Mouse	SO	
Golden Mouse	SO	
Hispid Cotton Rat	SO	
Rice Rat	SO	
Meadow Jumping Mouse	**SO**	**INM**
Woodland Jumping Mouse	**SO**	**INM**
House Mouse	SO	
Norway Rat	SO	
	Amphibians and Reptiles	
Pond Slider	AqH	
Cumberland Slider	**AqH**	**INM**
Yellow-Bellied Turtle	AqH	
Bronze Frog	AqI	
Bullfrog	AqI	
Leopard Frog	AqI	
Northern Cricket Frog	AqI	
Pickerel Frog	AqI	
Wood Frog	AqI	
Hellbender	**AqI**	**FC,**
INM		
Mudpuppy	AqI	
Northern Red Salamander	AqI	
Spring Salamander	AqI	
Three-Lined Salamander	AqI	
Map Turtle	AqI	
Gray Tree Frog	ArI	
Spring Peeper Frog	ArI	
Upland Chorus Frog	ArI	
Fence Lizard	ArI	
Green Anole	ArI	
Rough Green Snake	ArI	
Broadhead Skink	GI	
Five-Lined Skink	GI	
Ground Skink	GI	
Six-Line Racerunner	**GI**	**INM**
Slender Glass Lizard	**GI**	**INM**
Tennessee Cave Salamander	**GI**	**FC, ST**
Green Salmander	GI	FC, INM

Table J3 (continued)

Common Name	Trophic Category[b]	Special Status[c]
	Amphibians and Reptiles (cont.)	
Red-Backed Salamander	GI	
Slimy Salamander	GI	
Spotted Salamander	GI	
Brown Snake	GI	
Eastern Crowned Snake	GI	
Eastern Worm Snake	GI	
Northern Ringneck Snake	GI	
Red-Bellied Snake	GI	
American-Toad	GI	
Eastern Marrow-Mouthed Toad	GI	
Eastern Spadefoot Toad	GI	
Fowler's Toad	GI	
Black King Snake	LC	
Black Rat Snake	LC	
Corn Snake	LC	
Eastern Hognose Snake	LC	
Eastern Milk Snake	LC	
Garter Snake	LC	
Mole Snake	LC	
Northern Black Racer	LC	
Northern Copperhead	LC	
Northern Pine Snake	**LC**	**FC, ST**
Scarlet Snake	LC	
Timber Rattlesnake	LC	
Eastern Spiny Softshell Turtle	LC	
Snapping Turtle	LC	
Stinkpot Turtle	LC	
Striped-Neck Musk Turtle	LC	
Eastern Box Turtle	LO	
Eastern Painted Turtle	LO	
Northern Water Snake	P	
Queen Snake	P	

[a]Include water associated animals capable of moving on land.
[b]AqI = aquatic invertebrate feeder; ArI = arboreal invertebrate feeder; FI = flying insectivore; GI = ground invertebrate feeder; LC = predators and scavengers with ORR-wide populations; LH = herbivores with ORR-wide populations; LO = omnivores with ORR-wide populations; P = piscivores; SH = herbivores with populatons restricted to source OU-scale; SO = omnivores with populations restricted to source OU-scale.
[c]FC = candidate for federal listing; FE = federally listed as endangered; INM = state listed as in need of management; SE = state listed as endangered; ST = state listed as threatened.
[d] Reported sightings, but probably does not occur regularly.
[e] Not yet sighted on the ORR, but introduced to area streams, and suitable habitat exists on the ORR.