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Energy Systems Environmental Restoration Program
Y-12 Environmental Restoration Program

Remedial Investigation Work Plan for Chestnut Ridge Operable Unit 1 (Chestnut Ridge Security Pits) at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

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QAMS-005/80 LOCATOR PAGE

The criteria listed below are outlined in the U.S. Environmental Protection Agency document *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005/80, 1983). QAMS-005/80 is the standard used for specific quality assurance/quality control activities to meet data quality objectives. All the QAMS-005/80 criteria apply to site monitoring and measurement activities.

QAMS-005/80 Criterion	CDM Federal Reference (Section No.)
Title Page	Title Page
Table of Contents	Contents (p. iii)
Introduction	QAPjP (Sect. 7.1)
Project Description	Work Plan (Chaps. 1 and 2)
Project Organization and Responsibility	QAPjP (Sect. 7.2)
QA Objectives	QAPjP (Sect. 7.3)
Sampling Procedures	QAPjP (Sect. 7.4)
Custody	QAPjP (Sect. 7.5)
Equipment Calibration Procedures	QAPjP (Sect. 7.6)
Analytical Procedures	QAPjP (Sect. 7.8)
Data Reduction, Validation, and Reporting	QAPjP (Sects. 7.9 and 7.11)
QC Checks	QAPjP (Sect. 7.10)
Performance and System Audits	QAPjP (Sect. 7.12)
Preventive Maintenance	QAPjP (Sect. 7.7)
Data Assessment Procedures	QAPjP (Sect. 7.3)
Corrective Action Procedures	QAPjP (Sect. 7.13)
Quality Assurance Reports	QAPjP (Sect. 7.14)

NQA-1 LOCATOR PAGE

The following 18 elements are outlined in ASME NQA-1 1989 edition, *Quality Assurance Program Requirements for Nuclear Facilities* (ASME 1989). NQA-1 is the primary U.S. Department of Energy Quality Assurance Program standard. Some of the 18 NQA-1 elements are not applicable to this investigation.

NQA-1 Element	CDM Federal Reference (Section No.)
QA Program	CDM Federal QA Manual (Part I)
Organization	QAPjP (Chap. 7)
Design Control	QAPjP (Sects. 7.1 through 7.16)
Procurement Document Control	CDM Federal QA Manual (QP 8.0 and 9.0)
Instructions, Procedures, Drawings	SOPs (ESH/Sub/87-21706/1)
Document Control	QAPjP (Sect. 7.5)
Control of Purchased Items and Services	CDM Federal QA Manual (QP 8.0 and 9.0)
Identification and Control of Items	QAPjP (Sect. 7.5)
Control of Processes	CDM Federal QA Manual (QP 18.0)
Inspection	QAPjP (Sect. 7.12)
Test Control	CDM Federal QA Manual (QP 15.0)
Control of Measuring and Test Equipment	SOPs (ESH/Sub/87-21706/1); Lab QA Plan/Analytical Procedures
Handling, Storage, and Shipping	SOPs (ESH/Sub/87-21706/1)
Inspection, Test, and Operating Status	SOPs (ESH/Sub/87-21706/1)
Control of Nonconforming Items	QAPjP (Sect. 7.13.1)
Corrective Action	QAPjP (Sect. 7.13.2)
Quality Assurance Records	QAPjP (Sect. 7.14)
Audits	QAPjP (Sect. 7.12.1)

ACRONYMS AND INITIALISMS

ARAR	applicable or relevant and appropriate requirement
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
bls	below land surface
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
COC	contaminant of concern
CRSP	Chestnut Ridge Security Pits
CSM	conceptual site model
DOE	U.S. Department of Energy
DOE-ORO	U.S. Department of Energy Oak Ridge Operations Office
DOT	U.S. Department of Transportation
DQO	data quality objective
EFPC	East Fork Poplar Creek
Energy Systems	Martin Marietta Energy Systems, Inc.
EPA	U.S. Environmental Protection Agency
ER	Environmental Restoration
ERA	Ecological Risk Assessment
ESD	Environmental Sciences Division
ESP	Environmental Surveillance Procedure
FCRF	Field Change Request Form
FFA	Federal Facilities Agreement
FS	feasibility study
HHRA	Human Health Risk Assessment
IDW	investigation-derived waste
MCL	maximum contaminant limit
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
MSL	mean sea level
NEPA	National Environmental Policy Act
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment
OREIS	Oak Ridge Environmental Information System
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
OU	operable unit
OVA	organic vapor analyzer
PA	Preliminary Assessment
PARCC	precision, accuracy, representativeness, completeness, and comparability
PPE	personal protective equipment
PRG	preliminary remediation goal

QA	quality assurance
QAPjP	Quality Assurance Project Plan
QC	quality control
QPP	Quality Program Plan
RA	Remedial Action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act of 1976
RD	remedial design
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SI	site investigation
SOP	standard operating procedure
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBD	to be determined
TCL	Target Compound List
TDEC	Tennessee Department of Environment and Conservation
TDHE	Tennessee Department of Health and Environment
TDS	total dissolved solids
TOC	total organic carbon
TRC	Technical Review Committee
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WAG	waste area grouping
WQP	water quality parameter

EXECUTIVE SUMMARY

The Oak Ridge Y-12 Plant, located within the Oak Ridge Reservation (ORR), is owned by the U.S. Department of Energy (DOE) and managed by Martin Marietta Energy Systems, Inc. (Energy Systems). The ORR contains both hazardous and mixed waste sites that are subject to regulations promulgated under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), amended in 1986 by the Superfund Amendments and Reauthorization Act.

Under RCRA guidelines and requirements from the Tennessee Department of Environment and Conservation (TDEC), the Y-12 Plant initiated investigation and groundwater monitoring of various sites within its boundaries. The entire ORR was placed on the National Priorities List (NPL) of CERCLA sites on November 21, 1989. Following CERCLA guidelines, a site initially is investigated by a Preliminary Assessment/Site Investigation (PA/SI). If the PA/SI suggests that a Remedial Investigation (RI) is necessary, an RI is conducted to define the nature and extent of contamination, to evaluate the risks to the public health and the environment, and to determine the available alternatives for a Feasibility Study (FS) of potential remedial actions.

The Oak Ridge Y-12 Plant includes ~800 acres near the northeast corner of the Reservation and adjacent to the city of Oak Ridge. The U.S. Army Corps of Engineers built the Y-12 Plant in 1943 as part of the Manhattan Project. The plant is a manufacturing and developmental engineering facility that produced components for various nuclear weapons systems and provides engineering support to other Energy Systems facilities. More than 200 contaminated sites created by past waste management practices have been identified at the Y-12 Plant. Many of the sites have been grouped into operable units (OUs) based on priority and on investigative and remediation requirements.

This RI Work Plan specifically addresses Chestnut Ridge OU 1, which consists of the Chestnut Ridge Security Pits (CRSP).

The CRSP are located ~800 ft southeast of the central portion of the Y-12 Plant atop Chestnut Ridge, which is bounded to the northwest by Bear Creek Valley and to the southeast by Bethel Valley. Operated from 1973 to 1988, the CRSP consisted of a series of trenches used for the disposal of classified hazardous and nonhazardous waste materials. Disposal of hazardous waste materials was discontinued in December 1984, while nonhazardous waste disposal ended on November 8, 1988.

An RI is being conducted at this site in response to CERCLA regulations. The overall objectives of the RI are to collect data necessary to evaluate the nature and extent of contaminants of concern (COC), support an ecological risk assessment (ERA) and a human health risk assessment (HHRA), support the evaluation of remedial alternatives, and ultimately develop a Record of Decision for the site.

The purpose of this work plan is to outline RI activities necessary to define the nature and extent of suspected contaminants at Chestnut Ridge OU 1. Potential migration pathways also will be investigated. Data collected during the RI will be used to evaluate the overall risk posed to human health and the environment by OU 1.

In order to fill data gaps and supplement and confirm existing data, additional site characterization data are needed in the following areas: site hydrogeology, groundwater quality, surface and subsurface soil contamination, and ecological characterization. The site investigation will specifically include

- collecting groundwater samples for chemical analyses (from 12 existing monitoring wells surrounding the CRSP and 1 existing monitoring well from a background location in the same geologic group) twice during the investigation as representative of wet and dry weather periods,
- collecting subsurface soil samples using the Geoprobe for chemical analyses,
- conducting wetlands and endangered species habitat surveys,
- collecting surface soil samples for chemical and grain size analyses,
- conducting a spring and seep survey to identify potential monitoring locations for design of the dye tracer study,
- designing and conducting a dye tracer study to elucidate the hydrology of Chestnut Ridge,
- collecting spring/seep and sediment samples from locations identified by the dye tracer study as hydrologically associated with the CRSP,
- collecting earthworm samples for chemical analyses if areas of surface soil contamination are found adjacent to the pits,
- conducting plant and earthworm toxicity testing if areas of surface soil contamination are found adjacent to the pits, and
- conducting aquatic toxicity testing with daphnids and fathead minnow larvae at spring and/or seep locations if contaminants are found there.

The groundwater characterization data will be used to establish COC for the groundwater pathway. The soil characterization data will be used to identify COC in on-site (near-site) soils and to provide information on the nature and extent of soil contamination. The spring and seep survey/sampling and the dye tracer study will be used to estimate groundwater flow characteristics and to determine whether contaminated groundwater is discharging to surface waters or at ground surface within the watershed. The biological/ecological data will specifically be used to evaluate aquatic and terrestrial risk pathways for biota and man. Existing data on the volume and types of waste in the pits available in the waste inventory will be used for source characterization; the cap on the pits will not be sampled or breached in any way during this investigation. The integrity of the cap will be evaluated during the RI. All of these data are needed to determine exposure points and pathways for the ERA and HHRA, to establish locations/extent of contamination for development of remedial alternatives in the FS, and to evaluate potential treatment/process alternatives.

1. INTRODUCTION

This document outlines the activities necessary to conduct a Remedial Investigation (RI) of the Chestnut Ridge Security Pits (CRSP) at the Oak Ridge Y-12 Plant. The CRSP, also designated Chestnut Ridge Operable Unit (OU) 1, is one of four OUs along Chestnut Ridge on the Oak Ridge Reservation (ORR). The purpose of the RI is to collect data to

- evaluate the nature and extent of known and suspected contaminants,
- support an Ecological Risk Assessment (ERA) and a Human Health Risk Assessment (HHRA),
- support the feasibility study in the development and analysis of remedial alternatives, and
- ultimately, develop a Record of Decision (ROD) for the site.

This chapter summarizes the regulatory background of environmental investigation on the ORR and the approach currently being followed and provides an overview of the RI to be conducted at the CRSP. Subsequent chapters provide details on site history, sampling activities, procedures and methods, quality assurance (QA), health and safety, and waste management related to the RI.

1.1 REGULATORY INITIATIVE

The Oak Ridge Y-12 Plant, located within the ORR, is owned by the U.S. Department of Energy (DOE) and managed by Martin Marietta Energy Systems, Inc. The ORR contains both hazardous and mixed waste sites that are subject to regulations promulgated under the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), amended in 1986 by the Superfund Amendments and Reauthorization Act.

Under RCRA guidelines and requirements from the Tennessee Department of Environment and Conservation (TDEC), the Y-12 Plant initiated investigation and groundwater monitoring of various sites within its boundaries. The entire ORR was placed on the National Priorities List (NPL) of CERCLA sites on November 21, 1989. Following CERCLA guidelines, initially, a site is investigated by a Preliminary Assessment (PA)/Site Investigation (SI). If the PA/SI suggests that an RI is necessary, an RI is conducted to define the nature and extent of contamination, evaluate the risks to the public health and the environment, and determine the available alternatives for a Feasibility Study (FS) of potential remedial actions.

DOE, the U.S. Environmental Protection Agency (EPA), and TDEC negotiated a Federal Facility Agreement (FFA) in response to the NPL placement of the ORR. The FFA was developed for compliance pursuant to CERCLA, RCRA, the National Environmental Policy Act (NEPA), and the National Contingency Plan. A common goal of the parties that

entered into the FFA is to ensure that past releases from operations and waste management at ORR are thoroughly investigated and that appropriate remedial action is taken for the protection of human health and the environment.

The general purposes of the FFA are to establish a framework and schedule for development, implementation, and monitoring of response actions on the ORR in accordance with applicable guidance and policy; to coordinate responses under CERCLA and RCRA to maximize flexibility and preclude redundant activity; to minimize duplication of analytical and investigative work; to ensure quality of data management; and to expedite response actions with minimal delay.

1.2 ORR ENVIRONMENTAL RESTORATION PROGRAM

DOE established the Environmental Restoration (ER) Program to plan and implement the investigation and remediation of the ORR (and other DOE facilities) in cooperation with the parties to the FFA. A fundamental goal in the implementation of the program is that remedial action be emphasized. The goal acknowledges that no investigatory process can resolve all uncertainties and that remedial actions must be able to accommodate deviation from original hypotheses after they are initiated. This approach to the process of investigation and remediation promotes early remedy selection, flexibility for the remedial action, and contingencies to account for new data obtained during investigation of the sites. Removal actions will be implemented, as necessary, to protect human health and the environment from an imminent short-term threat. Interim remedial actions may also be implemented if the site warrants quick stabilization or risk reduction.

The parties to the FFA divided the ORR into waste area groupings (WAGs)/OUs that are prioritized to obtain effective and rapid investigation and cleanup. Characterization of WAGs and OUs are planned on the basis of optimizing field sampling and maximizing the use of existing data. Using the framework of WAGs and OUs, the ER Program is following some guidelines that shape the overall approach for the remediation of the ORR. First, emphasis is placed on the integration of ongoing activities and historical information concerning the sites. Second, activities of other major programs on the ORR are to be coordinated and integrated with the ER Program to ensure that adequate resources are available, that data are provided in a consistent format, and that technical issues and remediation technologies are communicated throughout the ER Program. Third, remedial action schedules for OUs can be revised by consent of the FFA parties. Fourth, as the investigations proceed, OUs may be redefined or reprioritized with the consent of the FFA parties. Finally, waste minimization and the prevention of recontamination will be emphasized in all investigations.

The lead agency for the investigations and remedial actions on the ORR is the DOE Oak Ridge Operations Office (DOE-ORO). The duties of the lead agency include overseeing and managing ORR remedial actions pursuant to the FFA, serving as the primary contact and coordinator with regulators for implementing the FFA, and ensuring the availability of resources required to implement the ORR Site Management Plan, DOE/OR-1001/R2 (Energy Systems 1992b). EPA and TDEC are working together within the terms of the FFA to initiate remedial action work and to provide regulatory oversight.

The ER Division of Energy Systems is the integrating contractor for the DOE ER Program. The primary function of the integrating contractor is to ensure technical and operational consistency among all participants involved in the Oak Ridge ER Program. The ER Division will conduct meetings; collect information; assemble total packages on ER Program activities; and prepare monthly status reports on budget, cost, schedule, and progress for use by DOE-ORO. Technical consistency in such areas as risk assessment, NEPA compliance, waste management, and others are monitored and ensured by the ER Division.

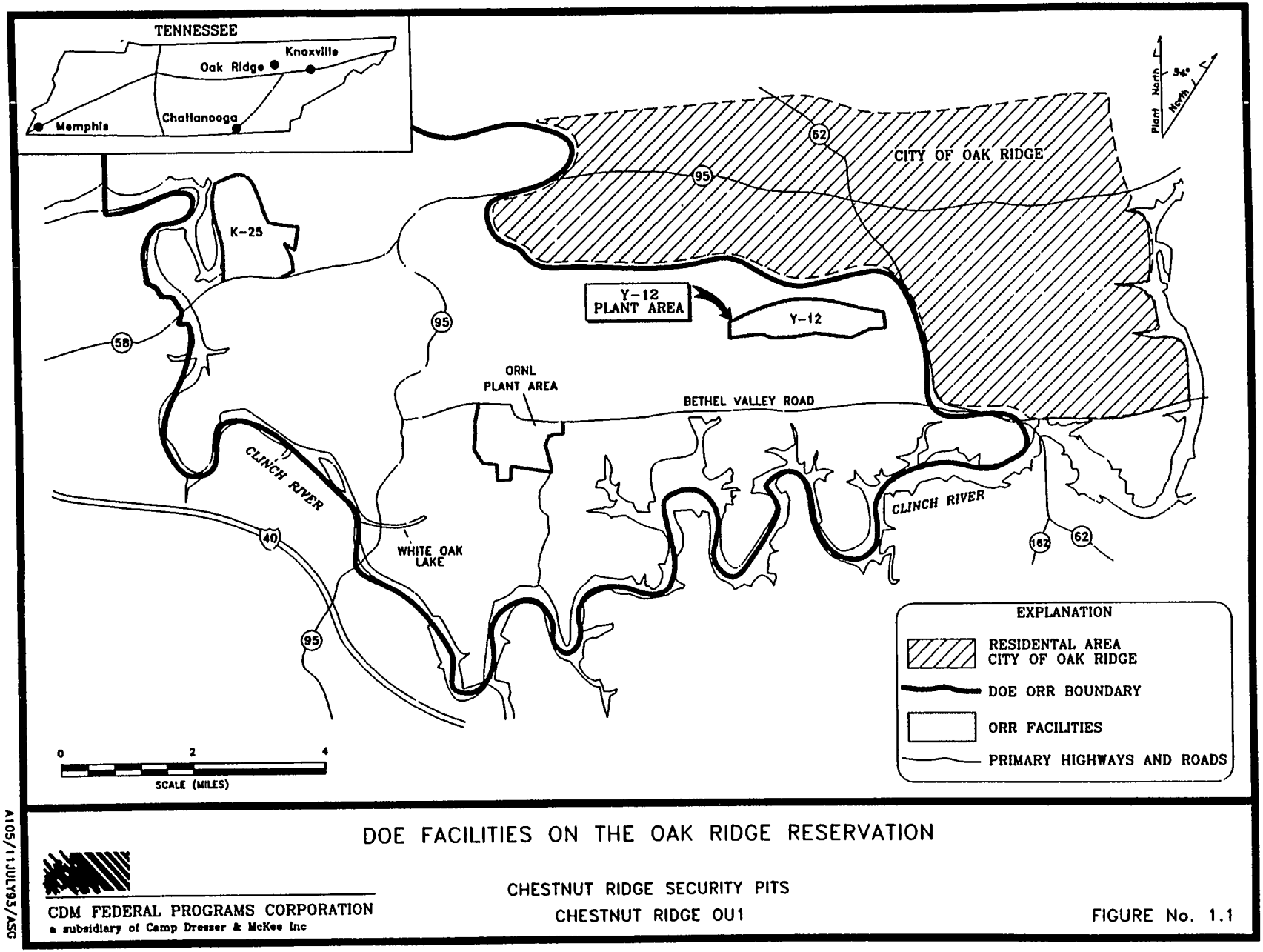
In addition to these primary responsibilities, the ER Division has a variety of other responsibilities in its role as integrating contractor, including:

- evaluation of other DOE prime contractor, subcontractor, and prospective contractor ER programs, policies, and procedures;
- coordination with plant operations for any fieldwork;
- evaluation of design, strategies, and sequencing of work;
- preparation of ER Program technical and administrative policy and procedures;
- coordination of technical reviews of all products and documents prepared by all ER Program participants;
- provision of treatment, storage, and disposal services for management of ER-originated wastes;
- conduct of a rigorous self-assessment program to evaluate regulatory compliance and procedure adherence during ER activities;
- development and operation of the Oak Ridge Environmental Information System (OREIS) to manage environmental data on the ORR; and
- coordination and evaluation of priorities for ongoing and proposed activities for the DOE-ORO ER Program.

DOE-ORO has delegated remediation activities at each WAG or OU to three primary contractors in addition to Energy Systems. Jacobs Engineering Group is responsible for the FS, Environmental Assessments, Proposed Plans, RODs for interim actions, and RODs. ENSERCH Services is responsible for Remedial Designs (RDs). MK-Ferguson is responsible for Remedial Actions. Additional information on the ER Program is available in the ORR Site Management Plan, DOE/OR-1001/R2 (Energy Systems 1992b).

1.3 FACILITY-SPECIFIC ER PROGRAM

The Oak Ridge Y-12 Plant, one of three major DOE facilities on the ORR, includes ~800 acres near the northeast corner of the reservation and adjacent to the city of Oak Ridge (Fig. 1.1). The U.S. Army Corps of Engineers built the Y-12 Plant in 1943 as part of the Manhattan Project. The plant is a manufacturing and developmental engineering facility that produced components for various nuclear weapons systems and provides engineering support to other Energy Systems facilities. More than 200 contaminated sites created by past waste management practices have been identified at the Y-12 Plant. Many of the sites have been grouped into OUs based on priority and on investigative and remedial requirements. Specific information on the OUs at the Y-12 Plant is provided in Sect. 1.4.



DOE FACILITIES ON THE OAK RIDGE RESERVATION

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CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 1.1

A105/11JULY93/ASG

Fig. 1.1. U.S. Department of Energy facilities on the Oak Ridge Reservation.

A major component of the investigative and remedial strategy to be applied to the Y-12 Plant, and the entire ORR, is a structured approach. This approach is based on separate studies of groundwater, surface water, and contaminant sources. The hydrogeologic regime at the Y-12 Plant is complex and includes surface water drainage, groundwater flow through a dominantly fractured system, and groundwater flow through a karst system. Numerous sources may have contributed to groundwater and surface water contamination; for example, sources contributing to groundwater that is part of one OU often contribute to groundwater contamination that is part of another OU.

Given these circumstances, the parties to the FFA concluded that the most timely and cost-efficient investigations would result if sources of contamination were studied separately from the groundwater and surface water. This conclusion led to the designation of source control and integrator OUs. Source control OUs focus on the nature and extent of contaminant contributions from a specific source or group of sources. Integrator OUs, on the other hand, focus on the nature and extent of contamination in a particular medium such as surface water or groundwater independent of the specific source or sources. Some OUs on the ORR combine both source control and integrator aspects.

Source control OUs will be addressed initially in interim action RODs. When all proposed source control OU interim actions are complete, there should be an adequate amount of monitoring data from integrator OUs to determine whether the interim actions have been effective, and if not, additional remediation will be undertaken in the integrator OU final ROD. OUs designated as both source control and integrator are anticipated to reach a final ROD.

1.4 FACILITY OPERABLE UNIT STRATEGY

The OUs established for the Y-12 Plant include source control units, groundwater integration units, surface water integration units, and combined units. The plant area includes two groundwater integrator units: Bear Creek and Upper East Fork Poplar Creek (EFPC). Chestnut Ridge is a distinct hydrologic regime and is handled as a combined source control and groundwater OU. The ultimate integrator unit of all surface water and groundwater contamination from the ORR is the Clinch River/Melton Hill Lake/Watts Bar Lake.

A total of 11 OUs have been established at the Y-12 Plant and include 31 of the contaminated sites within the plant boundaries and surrounding areas. Sites at the Y-12 Plant not included in an OU have been grouped collectively into the "Y-12 Study Area." These lower priority sites will be investigated as PAs/SIs. Sites will be grouped into new OUs or added to existing OUs if the PAs/SIs suggest that an RI/FS is necessary. The sites generally were grouped on the basis of proximity and by common physical and hydrogeological characteristics. Bear Creek and Upper EFPC hydrologic regimes each are associated with an integrated surface water and groundwater OU. The Lower EFPC watershed constitutes both a source control and groundwater OU. The remaining eight OUs are source control OUs within the Bear Creek, Upper EFPC, and Chestnut Ridge hydrologic regimes. Groundwater contamination in the Chestnut Ridge hydrologic regime is associated with each source control OU.

Four OUs have been established for the Chestnut Ridge hydrologic regime: Chestnut Ridge OU 1, the CRSP; Chestnut Ridge OU 2, the Filled Coal Ash Pond/Upper McCoy

Branch; Chestnut Ridge OU 3, the United Nuclear Corporation Disposal Site; and Chestnut Ridge OU 4, Rogers Quarry/Lower McCoy Branch. All OUs located in Chestnut Ridge are combined units that include source control and groundwater rather than addressing groundwater as a separate integrator unit. Media to be addressed in the investigations at these OUs include soil, groundwater, surface water, sediments, and air.

The ER Program prioritized the OUs established for the ORR and surrounding areas. Evaluation of the OUs was based on five weighted categories: human health risk, environmental impacts, regulatory obligations and other commitments, programmatic impacts, and negative socioeconomic impacts. Chestnut Ridge OU 1 currently is ranked third in priority of the 11 OUs established at the Y-12 Plant. Additional information on the prioritization process is available in the ORR Site Management Plan (Energy Systems 1992b).

1.5 INTENT AND SCOPE OF THE RI WORK PLAN

An RI is being conducted at the CRSP in response to CERCLA regulations. The observational approach will be used in compiling and analyzing currently available data and new data to be collected under this RI. The purpose of this work plan is to outline RI activities necessary to evaluate the nature and extent of known and suspected contaminants at Chestnut Ridge OU 1. Potential migration pathways will be investigated as well. Data collected during the RI will be used to evaluate the risk posed to human health and the environment by the CRSP.

Samples to be collected during the RI include surface and subsurface soil from borings around the perimeter of the pits; groundwater samples from five monitoring wells, four on site and one off site; and sediment and water samples from springs or seeps in the vicinity of the site. Soil samples will be submitted to a fixed base laboratory for Target Compound List/Target Analyte List (TCL/TAL) and radiological analyses. The samples will be analyzed for the full TCL/TAL because available waste inventories suggest that a variety of compounds were disposed of in the pits; in addition, no data on soils at the site have been obtained from previous investigations, so the nature and extent of contaminants must be verified. Groundwater, surface water, and sediment samples will also be analyzed for the TCL/TAL and radiological analytes. A variety of ecological sampling and testing procedures will be used at the site to evaluate ecological impacts if the results of surface soil and spring/seep sampling show contaminants are present at levels of concern.

No monitoring wells will be installed during this RI. Nineteen wells exist in and around the CRSP, as does a substantial amount of data from previous well sampling, with which to characterize the groundwater at the site and to evaluate the potential contaminant contribution from the CRSP. Additional wells probably would not add any significant new information because previous studies (Haase et al. 1987) have included well installation and a discussion of hydrogeologic conditions at the site. Data from the ORR Groundwater Monitoring Program also define hydrologic characteristics of the site.

In addition to sampling activities, a spring and seep survey will be conducted along Chestnut Ridge; the survey will provide data for an accurate and comprehensive data base that will help clarify the groundwater network in bedrock. A well-developed karst system underlies Chestnut Ridge, and a clear understanding of the distribution of springs and seeps is particularly significant because of their connection with this system. A dye tracer test will

be designed and conducted after the survey is completed. Two dye tracer tests have been conducted previously at Chestnut Ridge OU 1. One of the tests provided some data clarifying hydrologic relationships; the other test was inconclusive.

Source characterization will be accomplished by reviewing available inventory records, which are relatively comprehensive and complete. The multilayered, engineered RCRA cap on the CRSP will not be breached during the RI. The effectiveness of the engineered caps will be evaluated during the study.

1.6 SPECIAL PROBLEMS

Access to the CRSP is controlled, and the area is patrolled regularly by security personnel; therefore, all subcontract personnel performing the sampling must be badged and escorted by L- or Q-cleared escorts. In addition, the complete inventory of materials disposed of at the site is not available for inclusion in the RI report because many of the items are classified. Finally, some of the samples taken during the RI may be considered classified, given the controlled status of the site; this determination will be made by Energy Systems security personnel. If any samples are deemed classified, they will have to be analyzed at a laboratory at one of the facilities on the ORR, and access to the results of analyses will be controlled.

1.7 OVERALL PROJECT OBJECTIVES

The overall objectives of the RI are to collect data necessary to evaluate the nature and extent of contaminants of concern (COCs), support an ERA and an HHRA, support the evaluation of remedial alternatives, and ultimately develop a ROD for the site. The ROD for the CRSP will be consistent with the strategy outlined in the ORR Site Management Plan (Energy Systems 1992b).

The observational approach will be used to address the uncertainties inherent at hazardous waste sites such as this one. The observational approach involves several steps to identify the most probable model of the site and reasonable deviations from that model that must be accounted for during design and implementation. The observational approach recognizes that complete site characterization is not possible, and an attempt to fully define the nature and extent of contamination is generally not achievable.

Initially, existing information on general site conditions is gathered, and remedial objectives and general responses are set. Next, additional information is gathered to refine knowledge of general site conditions and the nature and extent of contamination, receptors, pathways, remedial objectives, and so forth. Then, the most probable site conditions and reasonable deviations are identified. From this information, a conceptual design incorporating both a base action and a contingent action can be developed and a ROD signed. Achieving an understanding of the processes involved in the fate and transport of hazardous and radioactive contaminants and their exposure and the effects on human health and the environment is a necessary addition to the observational approach to ensure that a reasonable model of the site can be developed.

The remedial action is designed from the most probable conditions and reasonable deviations expected. Key indicators (chemical, physical, and others) are selected for

observation during remediation to detect deviations during construction and operation. The purpose of this step is to identify where actual site conditions do not match estimated or expected site conditions and to determine the level of deviation that will trigger a response. The observational approach is not appropriate if a model of the most probable conditions and reasonable deviations cannot be established or if key indicators cannot be defined. Finally, the remedial alternative is implemented, and selected parameters are measured during remediation to identify necessary modifications.

Potential migration pathways for contaminants from the CRSP include surface runoff, groundwater transport, and air emission. Surface water is not present at the site, but surface runoff could carry contaminants to nearby surface water outlets or to groundwater via infiltration. In addition, contaminated groundwater could be discharged at the surface as leachate or springs and seeps. Groundwater pathways include fractures and karst conduits in bedrock. To date, 22 wells that monitor a range of depths in the bedrock have been installed in and around the perimeter of the CRSP; 3 of these wells have been plugged and abandoned, leaving 19 functional monitoring wells.

A review of historical records and existing data from sampling of groundwater around the CRSP indicates that the primary COCs are volatile organic compounds (VOCs); metals and radionuclides are also present in groundwater, but rarely at significant concentrations [i.e., exceeding maximum contaminant limits (MCLs)]. Samples to be collected during the investigation will include surface and subsurface soil samples from the site, surface soil samples from the wooded areas adjacent to the site, groundwater samples from monitoring wells in and around the site and from one background or control well, and surface water/ sediment samples from springs and seeps in the vicinity of the site. Chapter 6 provides detailed information on sampling locations and rationale.

1.8 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the required quality of sample collection and analysis based on the intended uses of the data. The purpose of DQOs is to ensure that the data collected in a given study are of appropriate quality to support activities such as site characterization, risk assessment, evaluation of remedial alternatives, or development of design criteria required by that study. DQOs are project-specific and applicable to all data collection activities. This section describes the DQO process as applied to Chestnut Ridge OU 1. A detailed presentation of the project DQOs is provided in Chap. 7, the Quality Assurance Project Plan (QAPjP).

A DQO workshop was held on February 25, 1994, for this project to develop the site-specific DQO criteria in greater detail and to optimize the design for data collection during the RI. Attendees at the workshop included representatives from DOE, TDEC, Energy Systems, Jacobs Engineering Group, and CDM Federal Programs Corporation (CDM Federal). As a result of this DQO workshop, the sampling strategy presented in the draft RI Work Plan (DOE/OR/01-1173&D1, Y/ER-112&D1) was modified as presented hereinafter. The modifications presented herein represent a consensus of all parties present.

1.8.1 Problem to Be Resolved

The CRSP site was used by the Y-12 Plant from 1973 to 1988 to dispose of classified hazardous and nonhazardous waste materials. Previous studies of the CRSP indicated the presence of contaminants in groundwater. The overall problem to be resolved during this RI is the determination of the nature and extent of contamination and the degree to which the CRSP poses a threat to human health and the environment.

The observational approach has been used in the development of RI activities described in this work plan. Historical data from previous studies at the site provided the information necessary to identify data gaps and to narrow the scope of the investigation. Media to be sampled include soil, groundwater, surface water, and sediments. Surface and subsurface soil will be sampled from borings located on transects across the site. Groundwater will be sampled from existing wells at the CRSP for TCL/TAL and radionuclide analytes. Air will be monitored at the site during the investigation for worker health and safety purposes only. Surface water and sediments will be collected from locations in the vicinity of the site identified in the spring and seep survey and will also be submitted for TCL/TAL and radionuclide analyses. Finally, various activities to collect data necessary to support an ERA will be included in the RI. Details of the sampling and analytical requirements are provided in Sect. 6.2.

1.8.2 Decision to Be Made

Decisions to be made in RIs on the ORR are defined by the FFA. Sites on the ORR identified as requiring an RI are designated on the basis of existing data indicating the presence of contamination. Decisions to be made after the RI include a determination of whether the site will require remediation and, if so, what type will be necessary. An FS follows the RI. The decision on whether to remediate will be based on NEPA criteria, National Resources Damage Assessment criteria, and the nine CERCLA criteria: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements (ARARs); long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; cost; state acceptance; and community acceptance. Chestnut Ridge OU 1 is a combined source control and integrator unit and is therefore projected to reach a final ROD at the conclusion of the FS.

To complete the RI/FS process and ensure that sufficient data are assembled to make subsequent decisions for this site, the following two questions were posed:

1. Does exposure to the disposed hazardous/radioactive material and/or contaminated media pose unacceptable risks to human health and the environment at the site under current or future land-use scenarios?

2. What parameters are required to assess the likely remedial technologies?

1.8.3 Identification of Inputs to the Decision

Input for decisions to be made based on data collected from the CRSP will consider both intended data users and uses. Primary data users include personnel who collect the data, who evaluate and manipulate the raw data, and who make recommendations or draw conclusions

from it. Examples of primary users include field personnel, the multidisciplinary project team that prepares the RI report, the FS subcontractor, and other subcontractors performing a specific task. Secondary data users include upper-level Energy Systems management, DOE, and the regulatory agencies (EPA and TDEC) that approve recommendations and support conclusions prepared by the primary users.

Specific inputs to the decisions developed for Chestnut Ridge OU 1 address the two questions posed in Sect. 1.8.2. These inputs are as follows:

Inputs to Question 1:

- concentrations of contaminants in soils (surface and subsurface);
- inventory and characteristics of the wastes;
- groundwater concentrations of contaminants;
- surface water concentrations of contaminants, if applicable;
- land use;
- human health and ecological conceptual site models;
- fate and transport of contaminants;
- background data for all media; and
- biological data for ecological risk assessment.

Inputs to Question 2:

- conclusions of the risk assessment,
- extent of the contamination,
- fate and transport of the contaminants,
- waste characterization,
- cap effectiveness,
- groundwater geochemistry, and
- geotechnical data about the site.

Collection of these data during the RI will provide the input needed to characterize risk, prepare the FS, and develop the ROD for this site.

1.8.4 Definition of the Boundaries of the Study

The boundaries of an RI are narrowed by applying a conceptual site model. The model is based on the history and current condition of the site and its environmental setting. Examples of factors that ultimately determine the boundaries of an RI include the existence of wetlands or floodplain, known or assumed groundwater flow direction, the relationship between the surface water drainage system and groundwater, potential migration and exposure pathways, and potential receptors.

The groundwater study boundary for Chestnut Ridge OU 1 is the Chestnut Ridge hydrologic regime. Because of uncertainties that the RI is designed to address via the spring and seep survey and the dye tracer study, the groundwater study boundaries could not be more narrowly defined at this time. The soil study boundaries are to the depth of the bedrock vertically and ~22 ft horizontally from the CRSP caps. The surface water boundaries of the study are the Chestnut Ridge hydrologic regime as may be modified by the results of the spring and seep. The boundaries for the ecological characterization are the same as the soil and surface water boundaries.

A conceptual model for Chestnut Ridge OU 1 that considers the environmental setting and illustrates potentially contaminated media and potential migration and exposure pathways is presented in Chap. 3. Chapter 3 also includes three specific models that consider the potential human health and ecological risks associated with the site.

1.8.5 Development of a Decision Rule

The purpose of developing a decision rule is to integrate the outputs from previous steps in the process into one statement that describes the logical basis of selecting among alternative actions. A decision rule was developed specifically for Chestnut Ridge OU 1 during the DQO workshop. The decision rule is presented in schematic format in Fig. 1.2.

1.8.6 Development of Uncertainty Constraints

The purpose of establishing limits on decision errors is to set acceptable limits that are used to establish appropriate performance goals for limiting uncertainty in the data used for decision making. Limits for error for field and analytical measurements are specified in detail in Chaps. 6 and 7 of this work plan. Limits for decision errors associated with study design are not specifically addressed herein. Because the observational approach method was used to design the study in lieu of a statistically based design, limits on error are difficult to assign. Special consideration will be given to decision error during design of the spring and seep survey and the dye tracer study. These studies are particularly subject to decision error, depending on the time of year of execution and antecedent climatological conditions.

1.8.7 Optimization of the Design for Obtaining Data

The purpose of optimizing study design is to identify the most resource-effective data collection design for producing data that will satisfy the DQOs for the project. Data design optimization for Chestnut Ridge OU 1 was based on a review of historical records, existing data, site visits, and discussion with Energy Systems personnel familiar with the site. The sampling locations identified in this work plan will provide representative samples of the potentially contaminated media at the site. A statistical analysis of the data may be necessary during the preparation of the RI report. The extent to which a statistical treatment is appropriate will be determined based on the results of the fieldwork. A statistical analysis combining existing data and newly collected data may be attempted; however, the variable quality of existing data may preclude this type of treatment.

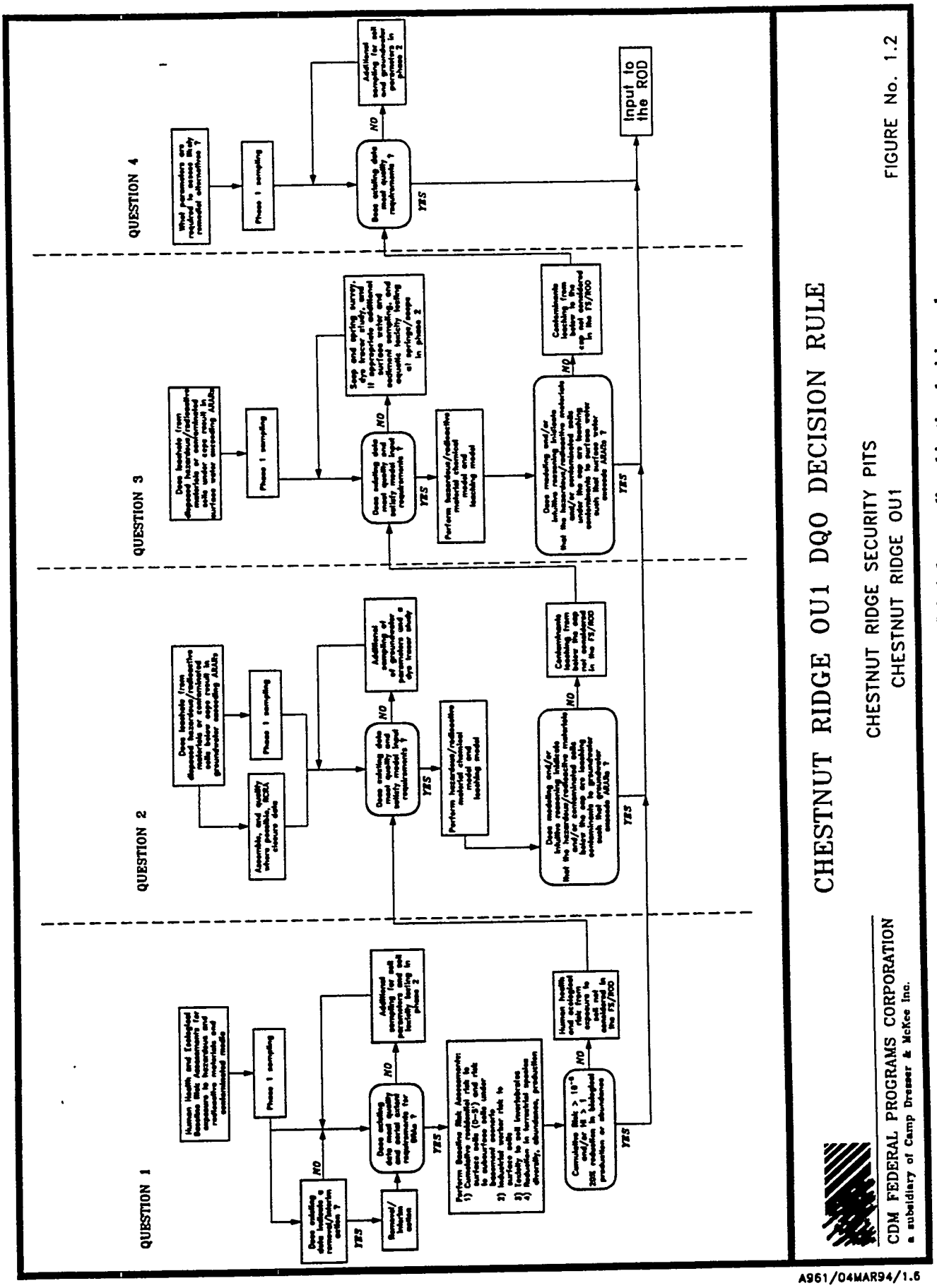


Fig. 1.2. Chestnut Ridge Operable Unit 1 data quality objective decision rule.

1.9 SCHEDULE

Table 1.1 is the schedule for completion of the RI Work Plan, the RI, and subsequent remedial actions for the CRSP. It is anticipated that field activities for this RI, including the spring and seep survey and the dye tracer studies, will take ~18 months. The 18-month time frame may be necessary to allow for wet- and dry-season dye tracer studies. The exact duration of the study will not be known until the scope of the study is defined. At this time, 18 months are being allowed to accommodate this eventuality. The ROD is scheduled for September 1999, and final remedial actions are to be completed by January 2010.

1.10 QUALITY ASSURANCE

All QA and quality control (QC) activities of this project will be governed by the *Environmental Restoration Quality Program Plan*, ES/ER/TM-4/R3 (Energy Systems 1993a), which addresses the guidance in EPA's *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*, QAMS-005/80 (EPA 1983); the specifications of the Energy Systems *Policies, Standards, and Procedures, Vol. 4, Quality Procedures Manual* (Energy Systems 1993); the American Society of Mechanical Engineers (ASME) document *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1 (ASME 1989); and applicable DOE orders. When appropriate, existing CDM Federal quality procedures will be used to implement ES/ER/TM-4/R3 requirements. The QAPjP for this project is provided in Chap. 7. The QAPjP addresses QAMS-005/80 and applicable ES/ER/TM-4/R3 requirements. The QAPjP locator page (p. xii) identifies the requirements and the location of the text that addresses each requirement.

Table 1.1. Remedial investigation/remedial action schedule for the CRSP (Chestnut Ridge OU 1)

Task name	Start date	End date
Notice to Proceed	26 Apr. 93	26 Apr. 93
Submit Draft Work Plan	14 July 93	14 July 93
Receive DOE/Energy Systems Comments	27 Aug. 93	27 Aug. 93
Submit Final Draft	17 Sept. 93	17 Sept. 93
Energy Systems Submit Final Draft to Regulators	30 Sept. 93	30 Sept. 93
Receive Regulatory Comments	05 Jan. 94	05 Jan. 94
Submit Final Remedial Investigation Work Plan	09 Mar. 94	09 Mar. 94
Remedial Investigation Work Plan Approved	06 Apr. 94	06 Apr. 94
Remedial Investigation Site Preparation	01 June 94	31 July 94
Field Activities	01 Aug. 94	27 Dec. 95
Remedial Investigation Report	06 Jan. 96	28 Aug. 96
Feasibility Study/Environmental Assessment Report	05 Jan. 97	04 Jan. 98
Feasibility Study/Proposed Plan	08 Mar. 98	01 Sept. 99
Feasibility Study/Record of Decision	05 Sept. 99	14 Dec. 00
Remedial Design	01 May 99	14 June 01
Remedial Action-Integration	01 May 99	23 Mar. 06
Remedial Action	17 June 01	14 Jan. 10

2. HISTORY AND CURRENT CONDITIONS

2.1 GEOGRAPHIC INFORMATION

The CRSP Hazardous Waste Disposal Unit (as it is referred to in the historical RCRA documentation) is located ~800 ft southeast of the central portion of the DOE Y-12 Plant (Fig. 2.1) atop Chestnut Ridge, which is bounded to the northwest by Bear Creek Valley and to the southeast by Bethel Valley. Operated from 1973 to 1988, the CRSP consisted of a series of trenches used for the disposal of classified hazardous and nonhazardous waste materials. Disposal of hazardous waste materials was discontinued in December 1984 (Energy Systems 1988); nonhazardous waste disposal ended November 8, 1988.

The CRSP occupy an area that extends from approximately plant grid coordinate E57,000 to E59,500 along the crest of the ridge and from N24,300 to N24,700 across the ridge. Local relief is ~70 ft, with elevations ranging from 1080 ft above mean sea level (MSL) at the eastern end of the site to 1150 ft above MSL at the western end of the site.

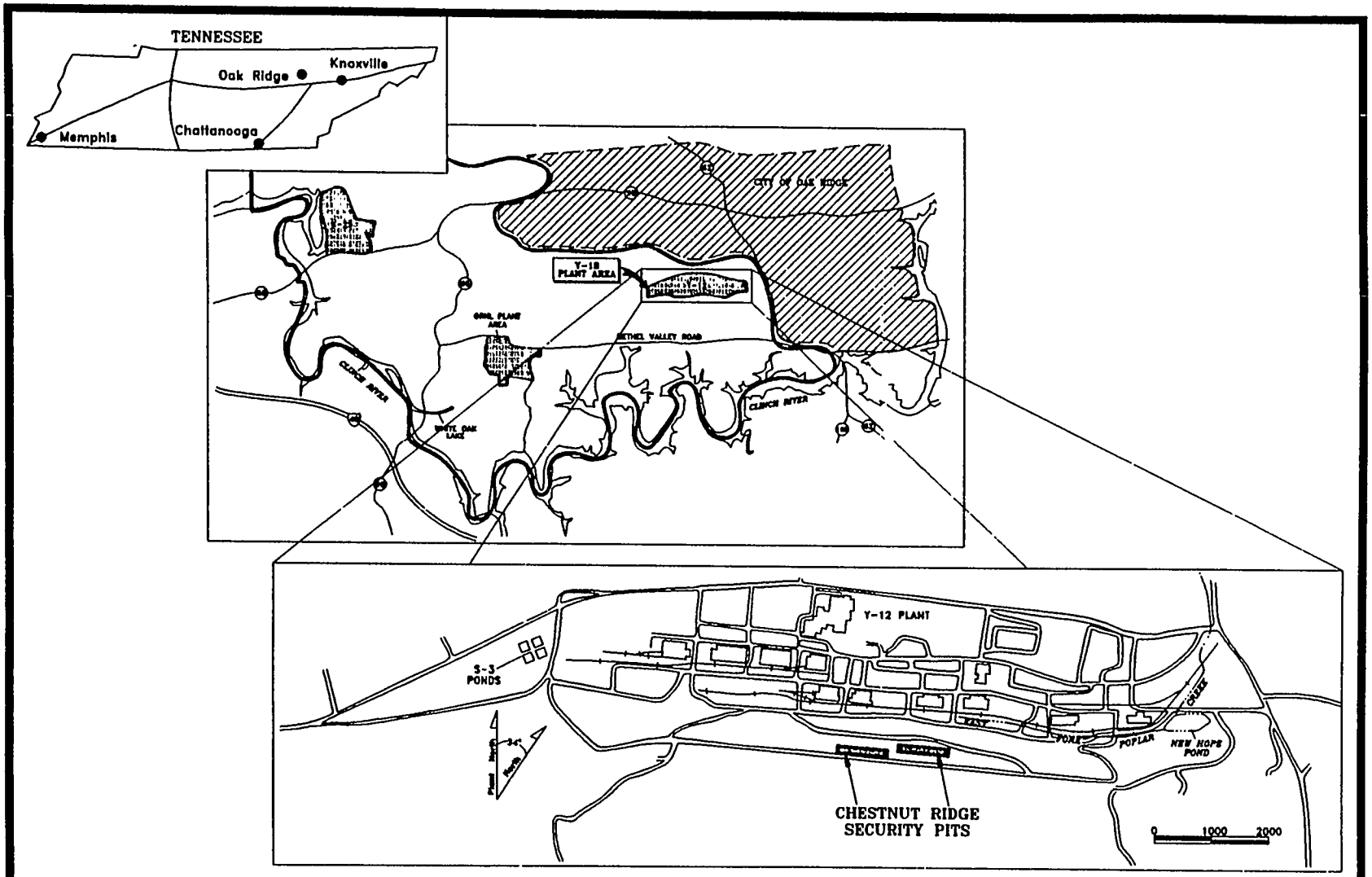
The 100-year floodplain of Upper EFPC occurs within the Y-12 Plant boundary but is confined by Chestnut Ridge to the southeast and does not extend above an elevation of 910 ft. The CRSP are situated ~200 ft above the highest elevation of the floodplain and, therefore, are not influenced by flooding from EFPC. Perennial streams on the southeast flank of Chestnut Ridge (e.g., McCoy Branch) have a relatively steep gradient and have not developed a discernible floodplain. During heavy storm events, any overbank flow from these streams would accumulate in Bethel Valley, where the base elevation is ~200 ft below the elevation of the CRSP.

A number of waste management sites are situated along Chestnut Ridge. The closest sites to the CRSP are the Filled Coal Ash Pond, ~1/4 mile to the southwest; the East Chestnut Ridge Waste Pile and Landfill III, ~1/2 mile to the northeast; and the United Nuclear Corporation Site, ~3/4 mile to the southeast along Chestnut Ridge. Existing data from the CRSP (discussed in sections that follow) do not suggest that these nearby sites are potential contaminant sources to the CRSP.

2.2 BACKGROUND INFORMATION

The CRSP disposal trenches are in two individual areas that have been designated the eastern trench area and the western trench area (Fig. 2.2), both of which are now capped and covered with grass. The individual trenches were about 8 to 10 ft wide and 10 to 18 ft deep and were excavated in sections and filled, as needed, for waste disposal activities. Sections of various trenches typically were open simultaneously to allow for the segregation of waste into separate cells. When a trench was nearly filled, it was covered with 3 to 6 ft of fill dirt (Energy Systems 1984).

The eastern trench area consists of three trenches (Nos. 1, 2, and 3). Trench No. 1 is ~700 ft long and was active from February 1973 through December 1977. Trench No. 2 is ~720 ft long and was active from December 1977 through January 1981. Trench No. 3 is about 690 ft long and was active from January 1981 through December 1982. Each trench is discontinuous in length by ~18 ft because of underground cables lying transverse to the



GENERAL LOCATION OF THE CHESTNUT RIDGE SECURITY PITS

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CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 2.1

A406/11JUL93/ASG

Fig. 2.1. General location of the Chestnut Ridge Security Pits.

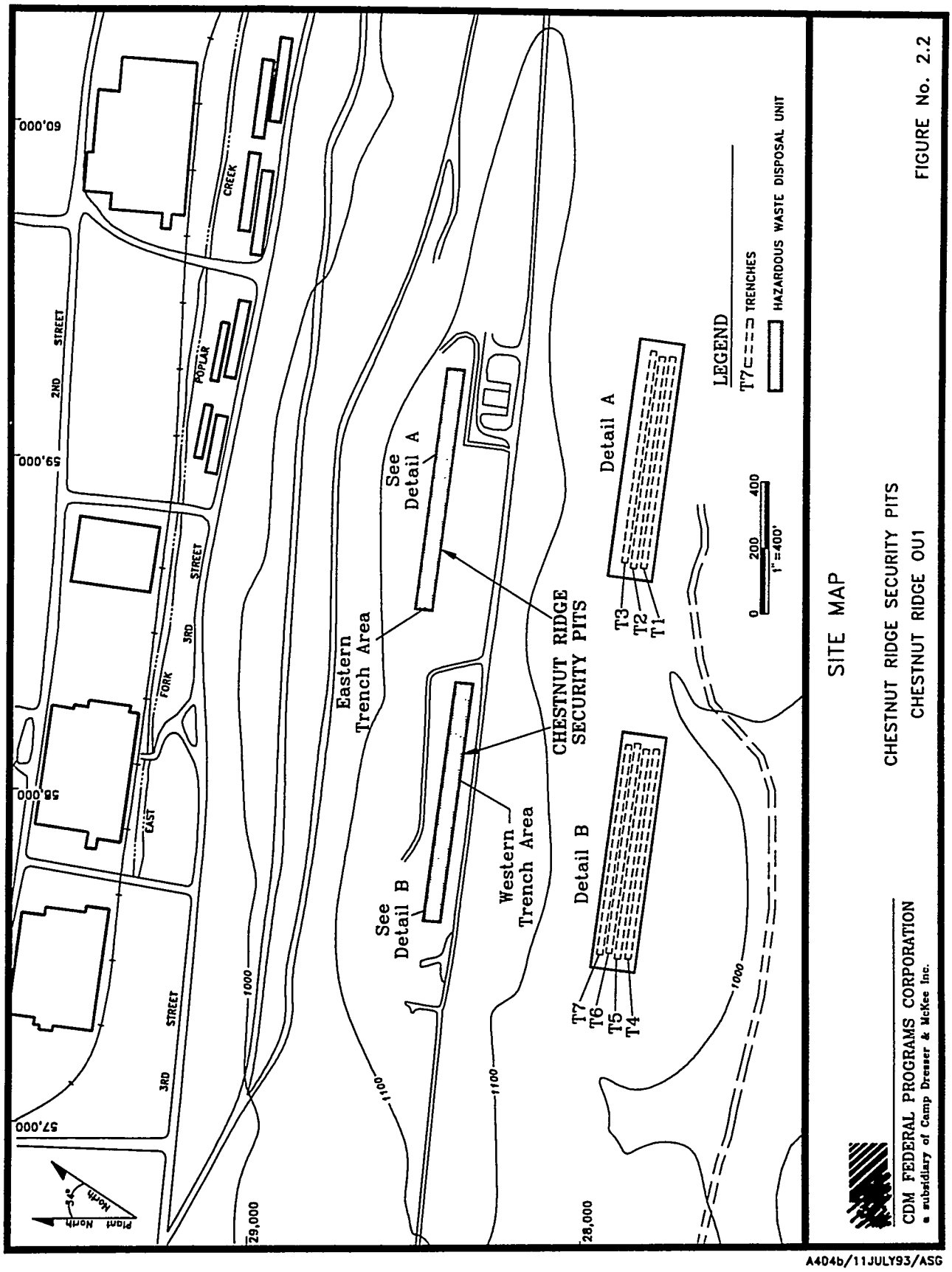


Fig. 2.2 Site map.

trenches. Reactive materials were disposed of in six auger holes located east of the eastern trench area. Each hole was ~2 ft in diameter and 10 ft deep. A temporary storage area was established adjacent to the eastern trench area on the south side of the trenches in the mid-1980s. The storage area receives dismantled roof debris from a building at the Y-12 Plant. The debris was characterized as containing asbestos, mercury, and uranium.

The western trench area included four trenches (Nos. 4 through 7) that ranged in length from ~720 to 780 ft. Two trenches in this area were operated from December 1982 until 1985 (Energy Systems 1984). The other two trenches received non-RCRA waste from 1985 through 1988.

2.3 OPERATIONAL INFORMATION

The CRSP began receiving classified hazardous and nonhazardous waste in 1973. Detailed inventories of the waste placed in the CRSP are classified because of the secure nature of the waste. An unclassified inventory of materials disposed of in the pits includes ten major categories of waste: acids, fiberglass, beryllium, biological materials, debris, heavy metals, inorganics, organics, thorium, and uranium (Radian 1992). Table 2.1 lists the hazardous and nonhazardous materials disposed of at the CRSP and their known quantities and relative percentages as of October 1985.

Table 2.1. Summary of waste disposal in the CRSP (through October 1985)

Waste	Quantity (lb)	Percentage of total
Uranium and uranium alloys	4,072,910	47.8
Steel, aluminum, stainless steel, copper, brass, and titanium	2,872,521	33.7
Wood, cardboard, foam, steel, paper, plastic, fiberglass, glass, and computer disks	863,185	10.1
Beryllium, beryllium oxide, magnesium, and carbon	316,794	3.7
Machine dust	193,341	2.3
Thorium	105,951	1.2
Water	65,034	0.8
Nonspecified metals	33,508	0.37
Acid	1863	0.02
Other	1174	0.01
Total	8,526,281	100.00

Source: Energy Systems 1988.

Most of the classified waste disposal in the CRSP consisted of solid metal components such as machined weapons parts, gages, and shipping containers; other debris included gloves, bottles, bags, badges, and computer tapes (Energy Systems 1984). Powders such as lithium oxide and beryllium oxide and liquids such as dilute hydrochloric acid, mineral oil, and alcohol have been disposed of but constitute a small quantity of the total inventory (Energy Systems 1984).

Records are adequate to determine that materials were not indiscriminately dumped and buried in the trenches. The trenches were segregated such that similar materials were generally buried in the same location over a long period. For example, in trenches 6E and 4, depleted uranium items were buried in 6E, and materials such as steel and aluminum, which may be contaminated with uranium, were buried in 4. At least 16 distinct areas, each for a specific material category, were used in trenches 1, 2, and 3.

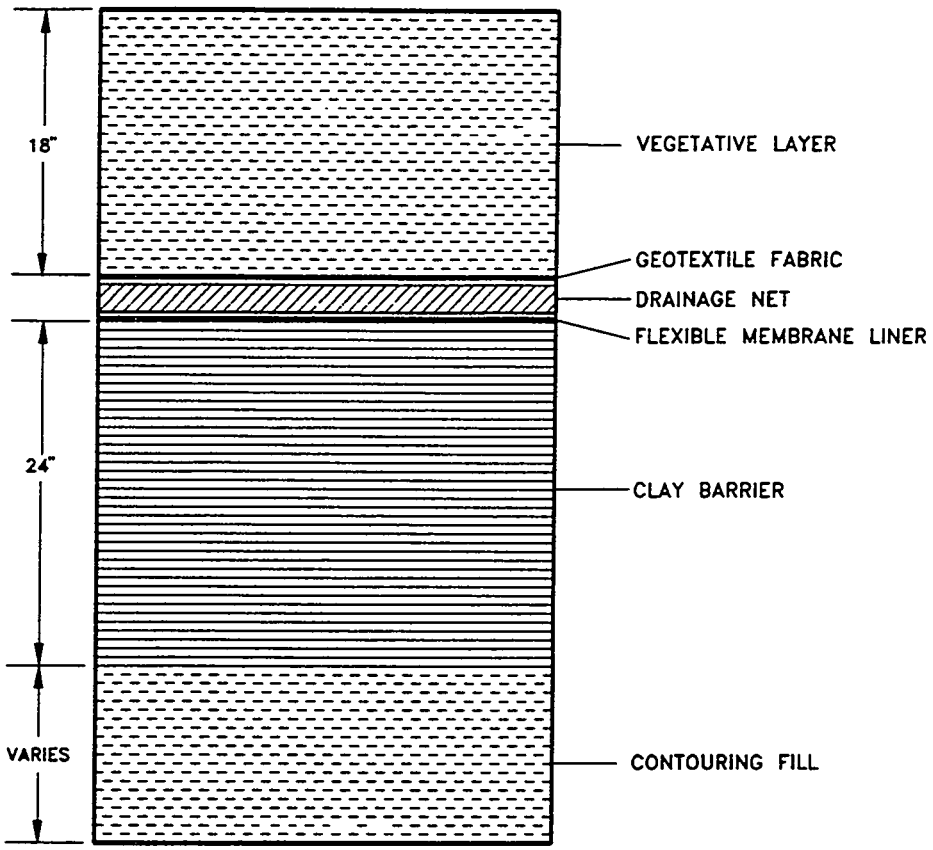
The CRSP were closed as interim status, hazardous waste landfills under RCRA because the classified nature of the hazardous wastes disposed of there precluded disposal, treatment, or removal by other means. The CRSP were granted interim status by EPA under RCRA in November 1985. A RCRA Closure/Post-Closure Plan for the CRSP was prepared and submitted to TDEC for review and approval in June 1987 (Energy Systems 1987). Subsequently, TDEC deleted the post-closure aspects of the plan and approved it on September 30, 1987. Later, a Revised RCRA Closure Plan (Energy Systems 1988) dated February 29, 1988, containing TDEC's recommended revisions, was prepared and submitted for approval. That document was approved by TDEC on May 24, 1988, and subsequently modified by approval changes.

Closure construction began in October 1988 and was completed on June 24, 1989. Closure consisted of construction of an engineered, multilayered cap as shown in Fig. 2.3. Field testing was performed as appropriate to ensure compliance with the Closure/Post-Closure Plan and closure performance standards. Closure certification was documented in a Closure Certification Report issued on June 29, 1989 (Dames & Moore 1989).

During closure construction, three exceptions were approved by TDEC and are found under *Summary of Closure Under Rules Governing Hazardous Waste Management in Tennessee* (Energy Systems 1988). A Post-Closure permit application was prepared in March 1989; however, it was never submitted to TDEC because of a controversy over regulator compliance status/compliance issues. This plan has been under revision and by agreement between DOE and TDEC will be submitted in November 1994. TDEC will involve EPA in the review process as appropriate.

Groundwater quality monitoring at the waste management sites along Chestnut Ridge has been in progress since the early 1980s. Between 1986 and 1988, groundwater monitoring under RCRA was initiated at three Chestnut Ridge sites, including the CRSP. Monitoring at these sites was conducted in accordance with RCRA regulations for interim status hazardous waste treatment, storage, and disposal facilities.

Since the initial groundwater monitoring, the assessment program at the CRSP has been modified in response to the analytical results. Each modification was proposed in the annual Groundwater Quality Assessment Report and implemented during the next year of the program. Examples of modifications include the installation of additional monitoring wells and refinement of the list of assessment parameters. Monitoring well installation subsequent to



TYPICAL CROSS-SECTION OF CAP

GEOTEXTILE FABRIC: MIRAFI 140N OR EQUAL
DRAINAGE NET: NATIONAL SEAL PN 3000 OR EQUAL
MEMBRANE LINER: 30 MIL PVC LINER

Modified From Energy Systems 1988a

COMPONENTS OF ENGINEERED CAP

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 2.3

4410/11JUL93/ASG

Fig. 2.3. Components of an engineered cap.

the installations for interim status compliance has been for assessment monitoring to determine the extent of groundwater contamination.

2.4 RELEASES

Available information about the CRSP does not indicate that catastrophic releases or spills have occurred at the site. Rather, gradual infiltration of contaminants through the soil and residuum to groundwater has occurred. In January 1986, interim status detection monitoring was initiated at the CRSP as required under Part 1200-1-11-.05(6)(c) of the Tennessee Department of Health and the Environment (TDHE, now TDEC) regulations. Background groundwater quality in each monitoring well at the site was established through quarterly monitoring during 1986 and semiannual monitoring for indicator parameters beginning in 1987. As required under Part 1200-1-11-.05(6)(d)2, analytical results from the first semiannual monitoring event were statistically compared to their corresponding background values.

The results of the statistical comparisons suggested that a contaminant release may have occurred at the site, as indicated by a significant increase in the level of some indicator parameters over their respective background values (Mercier and Kimbrough 1988). Follow up sampling to confirm the statistical increase was not performed, however, because data obtained during a concurrent DOE monitoring program (characterization monitoring) indicated that the site had released contaminants to the groundwater system. Continued monitoring since 1986 has shown that the characteristics of groundwater contamination at the CRSP have not changed significantly.

The primary contaminants in groundwater at the CRSP are VOCs. The most prevalent VOCs are 1,1,1-trichloroethane; tetrachloroethene; 1,1,-dichloroethane; and 1,1-dichloroethene. Metals and radionuclides have also been detected in groundwater samples. Concentration of these parameters have not typically exceeded their respective MCLs. Continued monitoring at the CRSP since 1986 has shown that the characteristics of groundwater quality have not changed significantly. Section 3.6 provides details on the hydrologic system at the CRSP and on groundwater chemistry and quality.

3. CHARACTERIZATION OF ENVIRONMENTAL SETTING AND CONCEPTUAL SITE MODEL

3.1 GEOGRAPHY

The ORR includes ~58,000 acres of federally owned land 20 miles west of Knoxville, Tennessee, bounded on the north and east by the city of Oak Ridge, Tennessee, and on the south and west by the Clinch River. The reservation is near the western margin of the Valley and Ridge physiographic province, a major subdivision of the Appalachians that stretches from Pennsylvania to Alabama. In the southern Appalachians, the Valley and Ridge province is bounded by the Blue Ridge province to the southeast and the Cumberland Plateau province to the northwest (Fig. 3.1). Characteristic features of the province include parallel valleys and ridges, typically trending northeast-southwest; topography controlled by alternating weak and strong rock units that have been folded and faulted and are now exposed by erosion; a trellis drainage pattern; abundant water gaps through resistant ridges; and many ridges with accordant summit levels that suggest former erosion surfaces.

The CRSP site is located atop Chestnut Ridge ~800 ft southeast of the Y-12 Plant area (Fig. 3.2) and is bounded to the north by Bear Creek Valley and the Y-12 Plant area and to the south by the South Patrol Road. Chestnut Ridge OU 2 (Filled Coal Ash Pond) and the new Steam Plant Ash Disposal landfill facility (currently under construction) are ~1/4 mile south and southeast, respectively, of the CRSP. The elevation of the CRSP ranges from ~1080 ft above msl at the eastern end of the site to ~1150 ft above msl at the western end of the site (Geraghty & Miller 1989b.)

3.2 CLIMATE

Climate in the Valley and Ridge province in the vicinity of the ORR is strongly influenced by the presence of the Great Smoky Mountains to the southeast and the Cumberland Mountains to the northwest. The mountains exert a moderating influence on the climate, which results in warm, humid summers and cool winters. Noticeable extremes in precipitation, temperature, and winds rarely occur. The Cumberland Mountains retard and weaken the force of cold winter air that commonly reaches south to these latitudes. The mountains also modify the hot summer winds that are common in the plains to the west. The Great Smoky Mountains act as an inclined plane, which lifts warm, moist air flowing northward from the Gulf of Mexico, thereby increasing the frequency of afternoon thunderstorms during summer months.

The mean annual temperature in the Oak Ridge area is 58°F (Webster and Bradley 1988). January is generally the coldest month; temperatures average ~38°F, but occasionally dip to 0°F or below. July is generally the warmest month, although average temperatures exhibit little variation between June and August. The average daily temperature in July is 77°F, with highs occasionally exceeding 100°F.

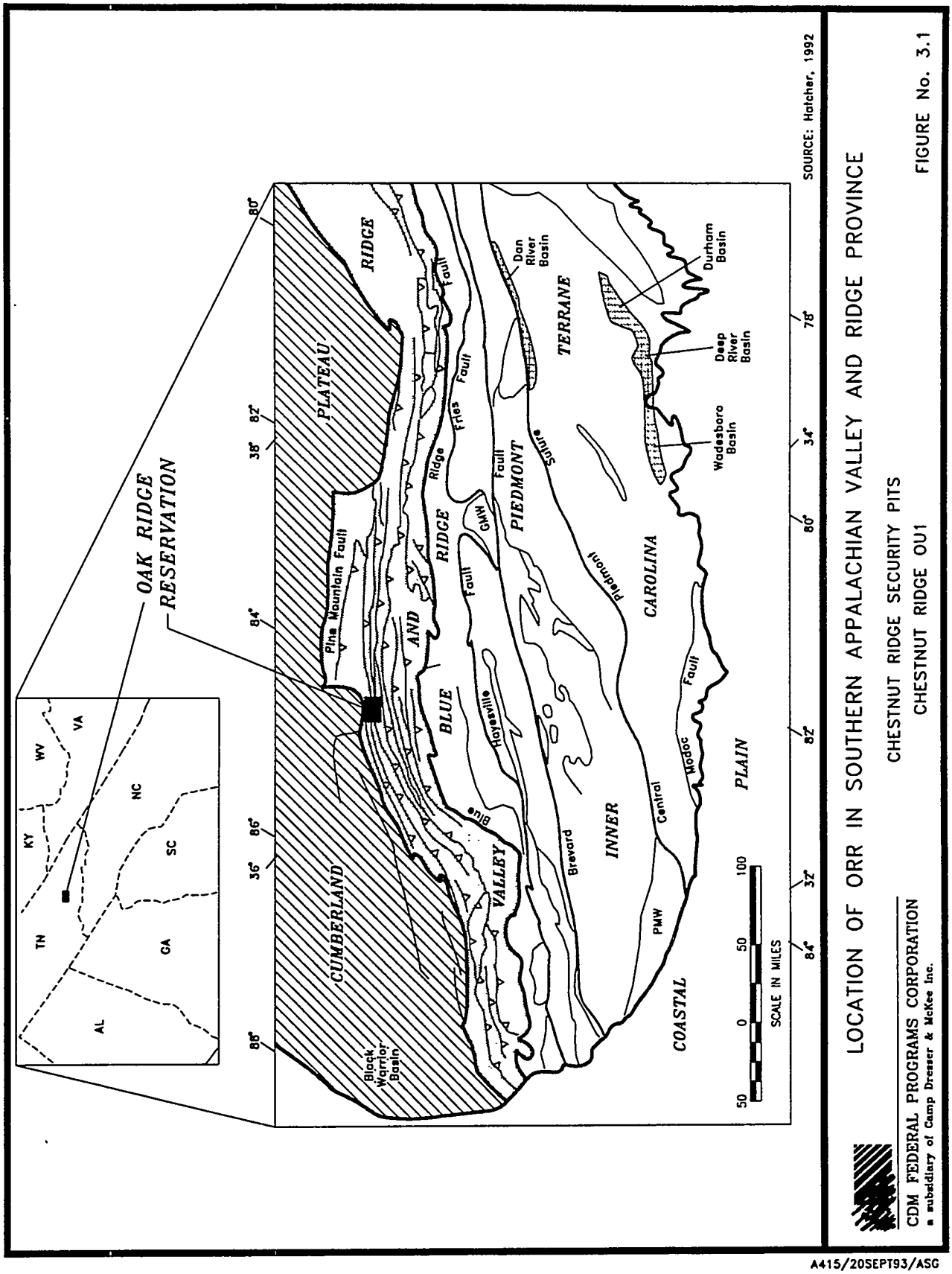


Fig. 3.1. Location of the Oak Ridge Reservation in Southern Appalachian Valley and Ridge Province.

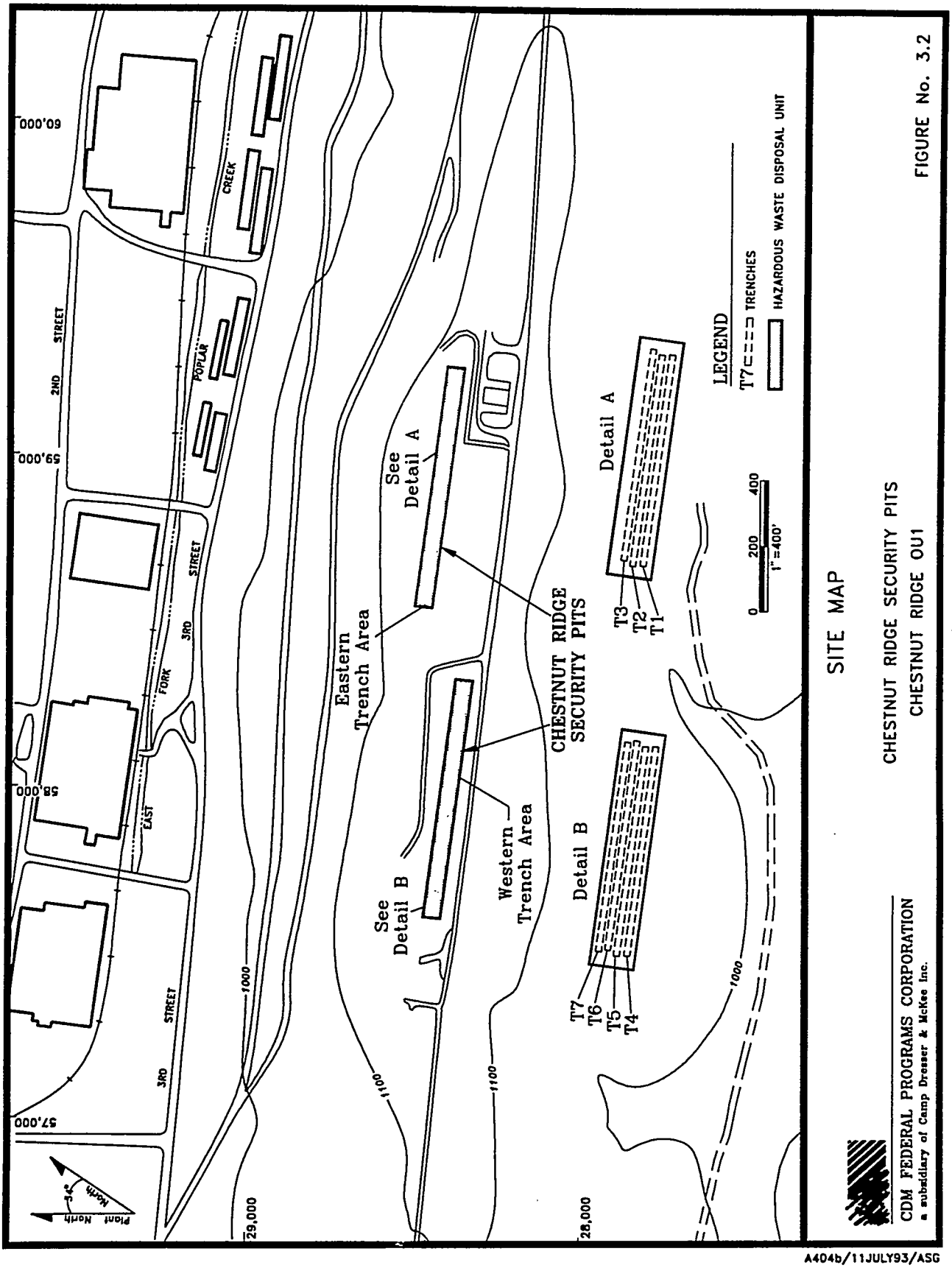


Fig. 3.2. Site map.

Data from the National Oceanic and Atmospheric Administration indicate that the mean annual precipitation in the Oak Ridge area is 55 in. The climate in the area is typically humid with frequent rain, and periods of 5 days or more without precipitation occur on average only four to five times per year (Boegly et al. 1984). Maximum monthly precipitation generally occurs between December and March and is associated with winter storms that are commonly of low intensity but long duration. Approximately 40% of the yearly precipitation falls during this interval. Snows occur between November and March, for the most part, and are usually light and accumulate only a trace. The mean annual snowfall between 1951 and 1988 was 9.8 in. (Energy Systems 1989). A second precipitation maximum occurs in July, when short, heavy rainfalls associated with thunderstorms are common (Davis et al. 1984). The driest period of the year normally occurs in September and October when slow-moving, high-pressure cells suppress rain and provide clear and dry weather.

Winds in the Oak Ridge area are controlled to some extent by the valley and ridge topography. The prevailing winds are either up-valley (northeasterly) or down-valley (southwesterly). Daytime winds generally blow up-valley; nighttime winds usually blow down-valley (Davis et al. 1984). Figure 3.3 is a wind rose that shows the relative frequency (by percentage) of occurrence of winds by compass orientation and wind speed. High-velocity winds and tornadoes are rare. Wind speeds are <7.4 mph 75% of the time, and wind speeds exceeding 18.5 mph are rare.

3.3 DEMOGRAPHY

The CRSP site is entirely within the ORR on federally owned land. The site is currently inactive; it was closed under RCRA as an interim status, hazardous waste landfill in 1988. Few Energy Systems employees use or visit the CRSP, and the site is in a controlled access area that is patrolled regularly by security personnel. Energy Systems personnel also visit the site several times each year to obtain samples for the ongoing groundwater protection program monitoring.

As of April 1993, the Y-12 Plant employs ~6200 regular employees. Within 1/2 mile of the OU 1 boundaries, there are no residents. The South Patrol Road, a paved two-lane road that runs along the crest of Chestnut Ridge adjacent to the main Y-12 Plant area, borders the site. Access to this road is controlled. Several businesses are located along Bethel Valley Road, ~1 1/4 miles southwest of the site and 1-1/2 miles southeast of the site at the Scarboro facility. Clark Recreational Park, which has a boat ramp with access to Melton Hill Lake, is ~1 1/2 miles south-southwest of OU 1. Melton Hill Lake is open to recreational uses, including fishing, boating, and hunting, as sanctioned by the state of Tennessee. Other recreational facilities in the vicinity include Scarboro Park and the city of Oak Ridge pool, which uses spring water.

There are no residents within 1 mile of OU 1 to the east, south, and west. The closest residents are ~3/4 mile north of OU 1 in a residential neighborhood north of the ORR boundary. The closest major population center is Oak Ridge, ~3/4 to 1 mile north-northeast of OU 1. The 1990 population of Oak Ridge was 27,310; the 1990 population of Anderson County was 68,250. Knoxville is the largest local population center, with a 1990 population of 165,121; the population of Knox County in 1990 was 355,749.

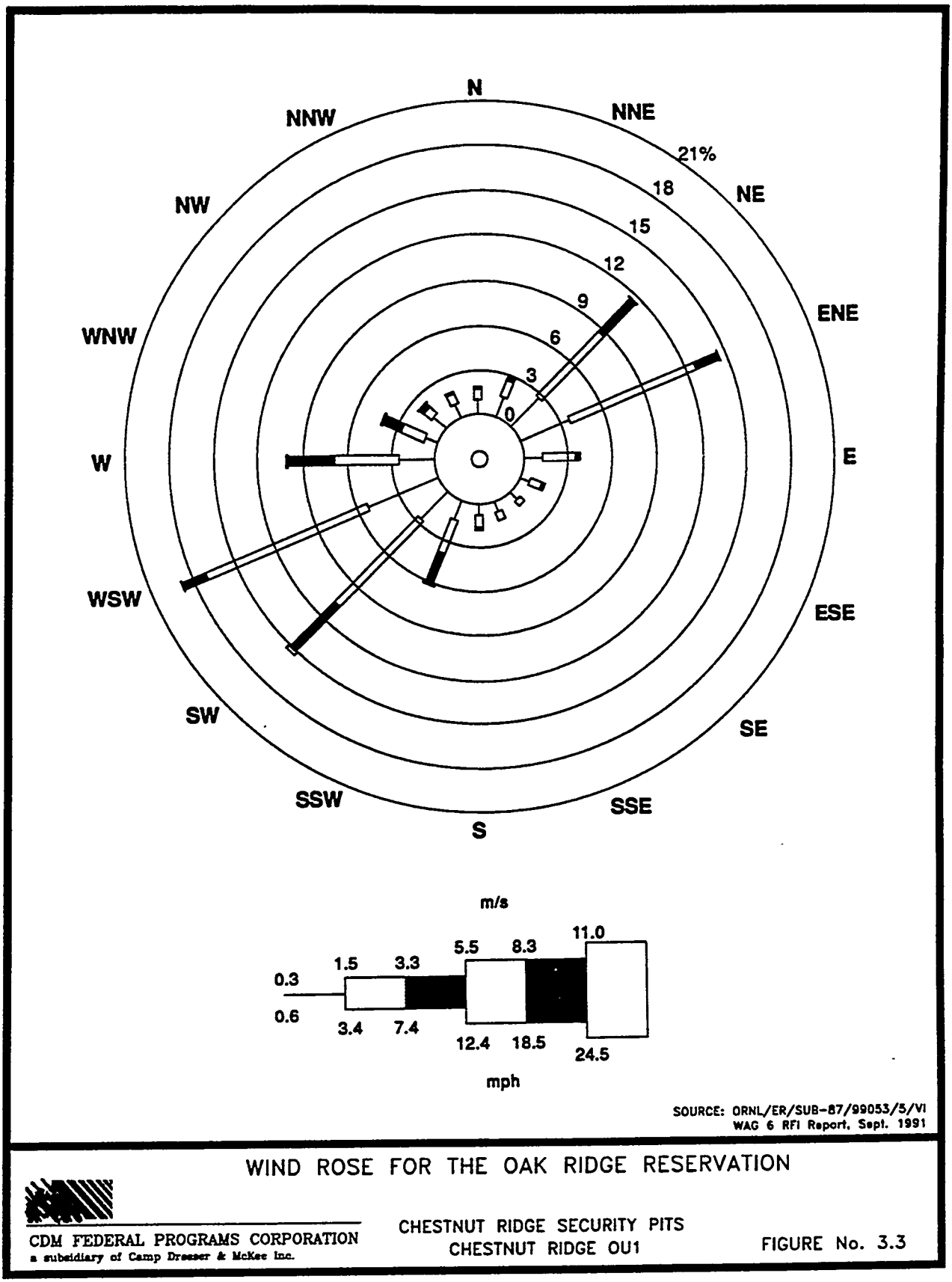


Fig. 3.3. Wind rose for the Oak Ridge Reservation.

3.4 GEOLOGY AND SOILS

The Valley and Ridge province of Tennessee, in which the ORR is located, is a belt of southeast-dipping thrust faults and accompanying folds. Two regionally extensive thrust faults, the Copper Creek and Whiteoak Mountain, are exposed across the ORR along with folds and small-scale subsidiary structures (Fig. 3.4). The stratigraphic section exposed on the ORR includes rocks that range in age from Early Cambrian to Early Mississippian. The stratigraphic section exposed in the vicinity of OU 1 has been abbreviated by faulting and includes beds ranging in age from Early Cambrian to Late Ordovician (Fig. 3.5). The units comprise a complex assemblage of lithologies, including shale, sandstone, siltstone, dolostone, and limestone; total thickness is ~2.0 to 2.5 km (Hatcher et al. 1992).

OU 1 is located atop Chestnut Ridge within the Whiteoak Mountain thrust sheet. The OU is underlain entirely by the Late Cambrian-Early Ordovician Knox Group, a sequence of dolostone with interbedded limestones that ranges from ~2000 to 3000 ft (700 to 1000 m) in thickness in east Tennessee. Safford (1869) named the Knox Group for exposures in Knoxville, and a succession of subsequent workers variously described and subdivided the group (e.g., Ulrich 1911; Oder 1934; Rodgers 1953; Bridge 1956; Harris 1969; Milici 1973). The Knox Group is found throughout the Valley and Ridge province of the Southern Appalachians; stratigraphic and petrographic studies suggest that the group was deposited in peritidal environments on a broad continental shelf setting (Churnet, Misra, and Walker 1982). The mechanism for widespread dolomitization is not clearly understood (Hatcher et al. 1992).

The Knox Group is a prominent stratigraphic sequence on the ORR and is one of the principal ridge-forming units; it underlies Copper Ridge, Chestnut Ridge, Blackoak Ridge, and McKinney Ridge. The thickness of the Knox Group on the ORR is believed to be ~2360 ft (720 m), based on a nearly complete exposure near the Bull Run Steam Plant, just northeast of the ORR (Hatcher et al. 1992). The Knox Group is divisible into five formations across the ORR (and throughout much of east Tennessee). The formations are, in ascending stratigraphic order, the Copper Ridge Dolomite, the Chepultepec Dolomite, the Longview Dolomite, the Kingsport Formation, and the Mascot Dolomite.

Chestnut Ridge OU 1 is underlain by the Copper Ridge Dolomite. The Copper Ridge is a massively bedded cherty dolomite, with beds ranging from 65 to 230 ft (20 to 70 m) in thickness. The lower two-thirds of the Copper Ridge is medium to coarsely crystalline, thick-bedded, dark brownish-gray saccharoidal dolomite (Hatcher et al. 1992). Toward the top of the formation, medium to light gray, fine-grained, medium- to thick-bedded dolomite, typical of the entire Knox Group, is more common. Nodular chert, often oolitic and bedded, is a common feature of the Copper Ridge Dolomite, especially in the upper portions of the formation. Quartz sandstone beds also occur in the formation, particularly in the upper part.

Haase et al. (1987) briefly summarize the geology of Chestnut Ridge OU 1, based upon corehole description; no bedrock is exposed at the site, and exposures of the Copper Ridge Dolomite are rare along Chestnut Ridge. Beds in the subsurface strike northeast-southwest and dip 40–50° southeast. Data from outcrops of the Copper Ridge east of the site are consistent with these corehole observations (Hatcher et al. 1992).

Fractures are well developed in all stratigraphic units on the ORR and are the most pervasive mesoscopic structure (Hatcher et al. 1992). Both systematic and nonsystematic

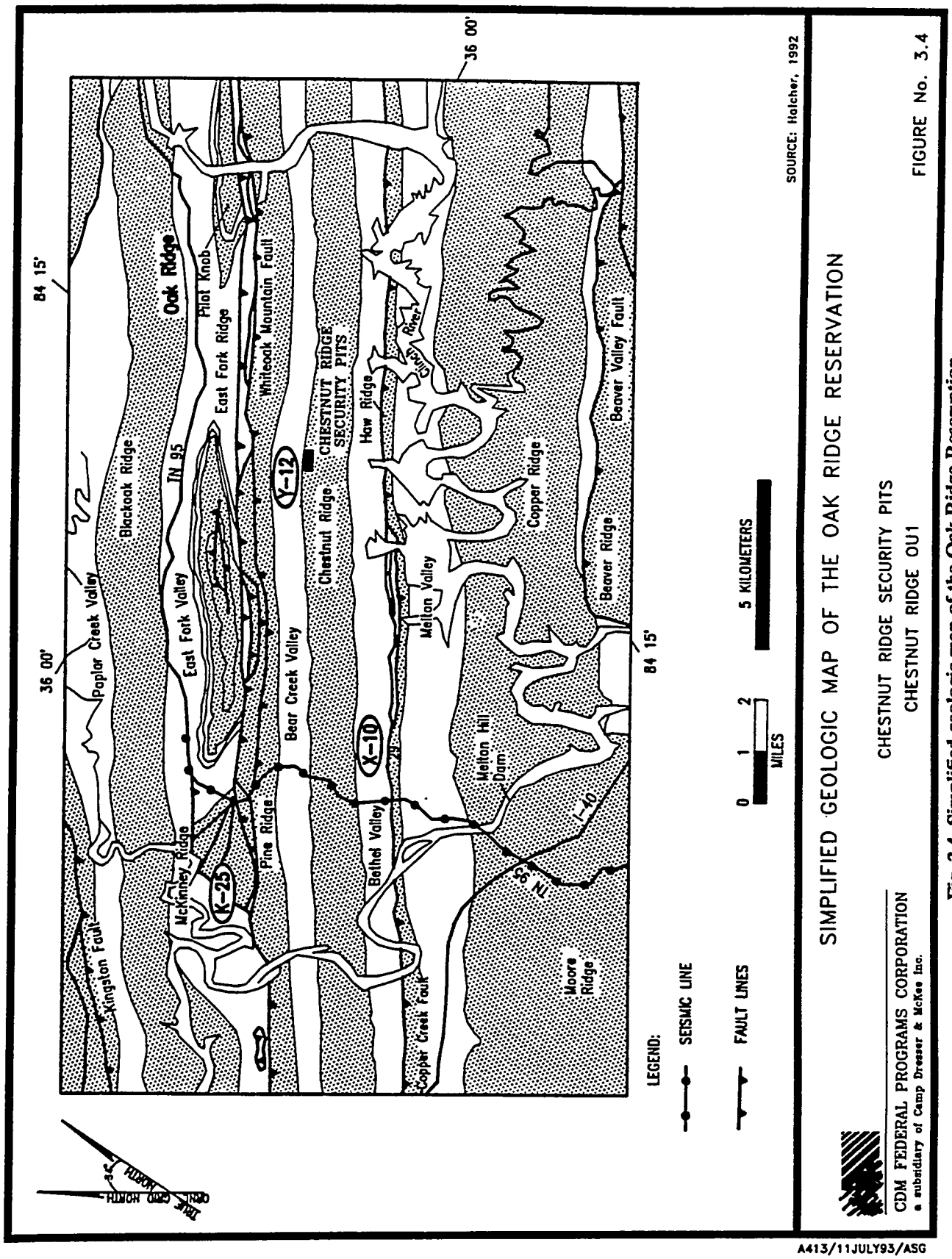
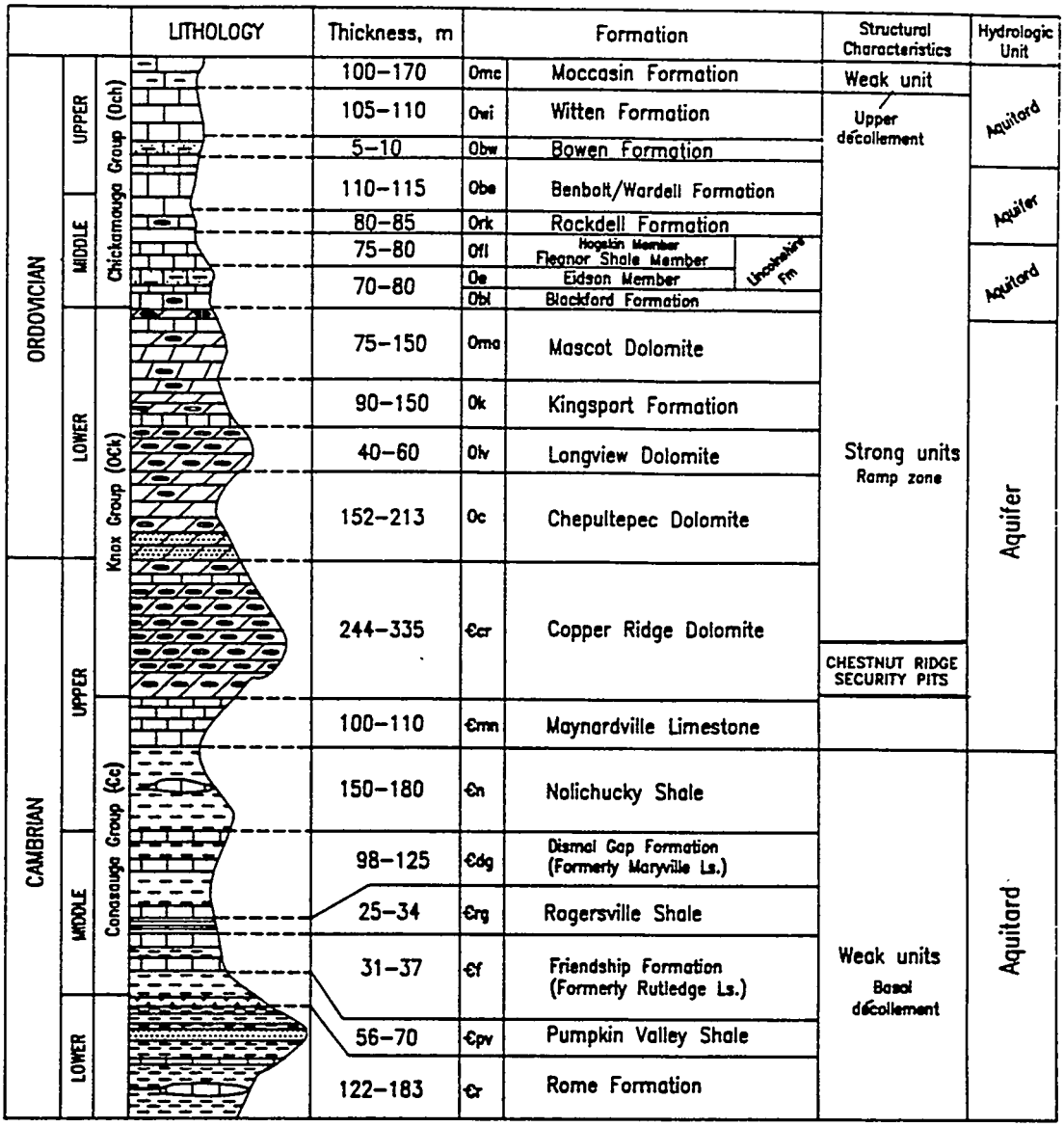


Fig. 3.4. Simplified geologic map of the Oak Ridge Reservation.



STRATIGRAPHIC SECTION IN VICINITY OF CHESTNUT RIDGE OU1, ORR

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CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 3.5

A412/11JUL93/ASG

Fig. 3.5. Stratigraphic section in the vicinity of Chestnut Ridge OU 1, Oak Ridge Reservation.

fractures that formed at various times during the tectonic history of the Southern Appalachians are present. The fractures form a network of discontinuities and intersections that provide pathways for groundwater flow. Although there is some scatter in the orientation of the fractures, most of them tend to develop systematic orientations over a particular area, allowing patterns to be interpreted (Solomon et al. 1992).

Hatcher et al. (1992) studied the fracture system developed in bedrock across the ORR. Measurements of fractures in the Knox Group in the Whiteoak Mountain thrust sheet indicated the presence of two dominant fracture sets, one striking N68°E and dipping 56° NW and the other striking N39°W and dipping 87° SW. A third set is also present, and previous workers have described four fracture sets (Geraghty & Miller 1989b). Nonsystematic fractures of varying orientation are also developed.

Fracture density is highly variable and is noted to decrease with depth; reported values on the ORR range from 5 to 200 per meter (Solomon et al. 1992). Fracture lengths generally range from several centimeters up to 1 m. Hatcher et al. (1992) discuss fracture spacing in strata on the ORR and note that dolomite has the greatest variation in fracture spacing versus bed thickness of the lithologies present; no clear trend was observed. Fracture spacing data from the Knox Group show considerable variation, with values ranging from a few inches to a nearly a foot.

Haase et al. (1987) described localized solutional widening of fractures and other karstic features from the core of the Knox Group underlying OU 1. Indeed, karst development is widespread in the Knox Group across the ORR (Ketelle and Huff 1984) and is responsible for features such as sinkholes, dolines, and an extensive network of subsurface cavities. Individual subsurface cavities develop independently but enlarge through solutional processes driven by groundwater and eventually coalesce into dominant flow channels somewhat analogous to a surface drainage system (Solomon et al. 1992).

The soil and residuum mantling the Knox Group in Chestnut Ridge OU 1 is of variable thickness because of the irregular bedrock surface along Chestnut Ridge; reported depth to bedrock values range from 38 to 100 ft below land surface (bls) (Geraghty & Miller 1989b; Hatcher et al. 1992). In general, the soil or residuum is a reddish-brown to yellow-orange, plastic to very plastic clay with locally abundant chert. A rubble-rich zone with large blocks of bedrock in a matrix of the clay is commonly encountered just above the top of the bedrock (Geraghty & Miller 1989b). Hatcher et al. (1992) point out that the Knox Group soils are typically either Paleudults or Hapludults, both of which are within the Ultisol order. Ultisols have a clay-enriched subsoil but are mostly highly weathered and have <35% base saturation at a depth of 1.8 to 2.0 m.

A number of investigators have studied the permeability of the soil and residuum underlying the Knox Group along Chestnut Ridge (Mishu 1982; Ketelle and Huff 1984; Woodward-Clyde 1984). The permeability has been evaluated both in the field and in the laboratory, and results indicate widely variable values. For example, falling head permeability tests in the field resulted in values ranging from 7.05×10^{-10} to 6.35×10^{-8} ft/day at varying depths (Mishu 1982; Woodward-Clyde 1984). Laboratory values range from 2.11×10^{-11} to 1.41×10^{-9} ft/day at one site, with permeability decreasing with depth (Woodward-Clyde 1984).

Energy Systems personnel conducted a soil gas survey at OU 1 in October 1991 (Wilson 1991). The survey included measurements of soil gas for VOCs at 45 locations in and around the trenches. The VOC concentrations were determined by photoionization and flame ionization measurements in each hole and by gas chromatographic head space analysis on samples collected from the bottom of each hole. Maximum photoionization and flame ionization measurements were 4.8 and 5.3 ppm, respectively; maximum depth was 33 in. below the surface.

Gas chromatographic analysis on soil samples used retention time for identification and tentatively identified the presence of acetone; trichloroethylene; 1,1,1-trichloroethane; and tetrachloroethylene. The analysis also identified benzene at two locations, but the identification was deemed "suspect." Concentrations were not provided from the gas chromatographic analyses, but samples were ranked "low," "medium," or "high." Criteria used to rank the samples were not provided (Wilson 1991). VOCs were not detected in ~44% of the samples, and another 35% of the samples had a "low" ranking.

3.5 SURFACE WATER AND SEDIMENTS

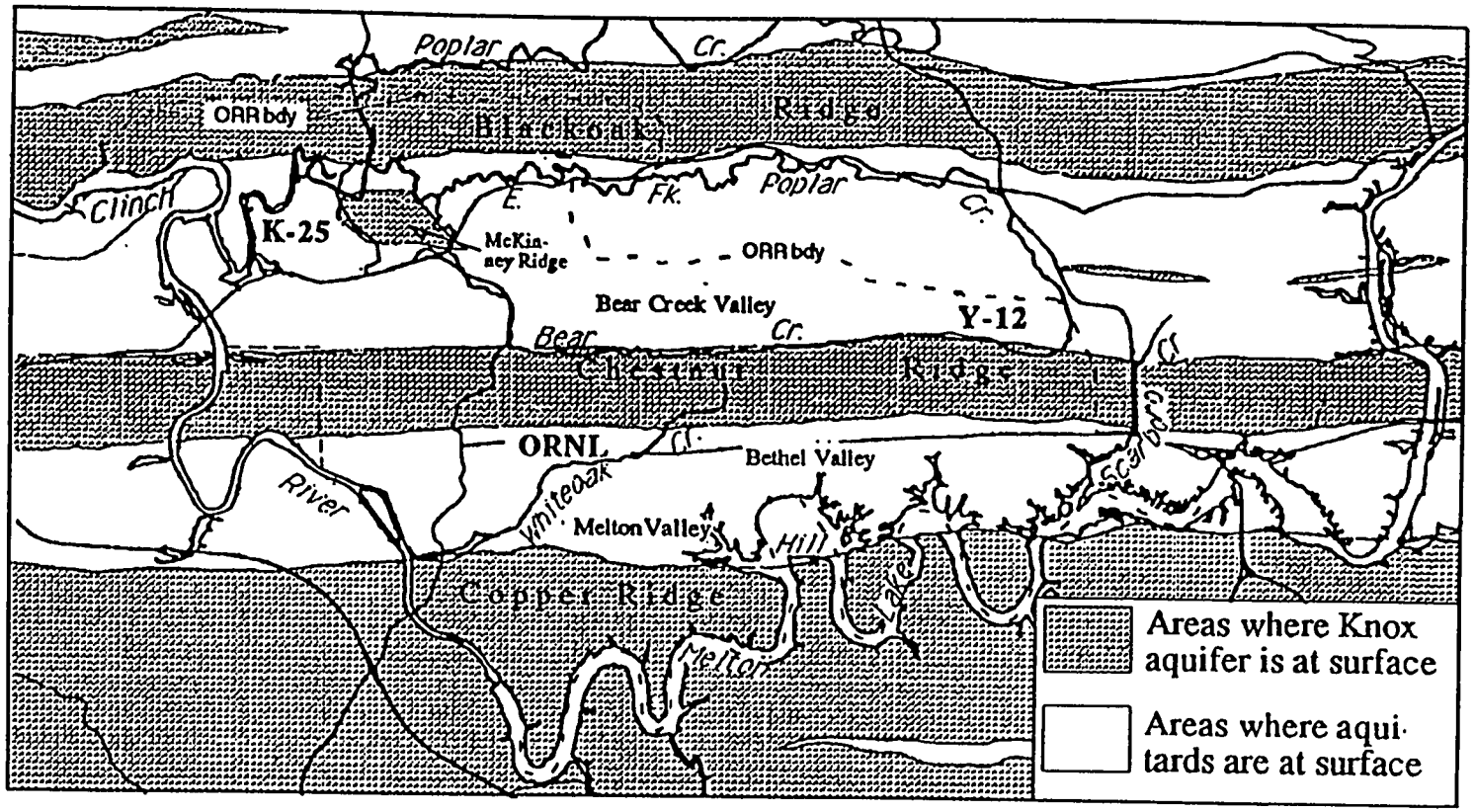
Chestnut Ridge OU 1 is located atop Chestnut Ridge, which forms a topographic divide between the EFPC watershed to the northwest and the watersheds of McCoy Branch and several numbered tributaries to the southeast (Geraghty & Miller 1989b). OU 1 is covered with grass, and there is no surface water; however, surface runoff from the site may potentially intercept either EFPC or the watersheds to the southeast. Detailed information on the characteristics of these watersheds and the surface water system on the ORR can be found in numerous documents (Geraghty & Miller 1989b; Solomon et al. 1992).

Numerous springs and seeps along Chestnut Ridge feed the various watersheds described above. The karst hydrologic system underlying OU 1 is connected with at least some of the springs and seeps. Previous dye tracer tests at OU 1 have shown some hydrologic connection between groundwater and the springs and seeps, but the results have not been entirely conclusive (Geraghty & Miller 1990b; SAIC 1992).

3.6 GROUNDWATER

The characteristics and movement of groundwater on the ORR are a function of the varying hydrologic properties of the underlying geologic units. Two broad groupings can be distinguished: the Knox aquifer, consisting of the Knox Group and the Maynardville Limestone of the Conasauga Group, and the ORR aquitards, consisting of the remaining geologic units on the ORR (Solomon et al. 1992). (Refer to Fig. 3.5 for the stratigraphic succession on the ORR.) Groundwater flow in the Knox aquifer is dominated by conduit flow through solution features that resulted from karst processes. Flow in the ORR aquitards, on the other hand, is dominated by flow through fractures. Figure 3.6 shows the distribution of the Knox aquifer and the aquitards across the ORR.

The flow system in both the Knox aquifer and ORR aquitards has been divided into four zones: storm flow, vadose, groundwater, and aquiclude (Solomon et al. 1992). The storm flow zone is a relatively thin interval at the surface. The zone includes precipitation-generated flow that constitutes nearly all the water moving through the subsurface. It is a pathway for the



SOURCE: Solomon et. al., 1992

DISTRIBUTION OF KNOX AQUIFER & AQUITARDS ACROSS THE OAK RIDGE RESERVATION

CDM FEDERAL PROGRAMS CORPORATION
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CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 3.6

A411/11JUL93/ASG

Fig. 3.6. Distribution of Knox aquifer and aquitards across the Oak Ridge Reservation.

transportation of contaminants to the subsurface. The vadose zone is an unsaturated zone above the water table. The groundwater zone is continuously saturated and is the region in which the remainder of subsurface water (exclusive of the storm flow zone) occurs. The aquiclude is a zone in which any water movement occurs on a geologic time scale.

The Copper Ridge Dolomite (described in Sect. 3.4), which is part of the Knox aquifer, underlies Chestnut Ridge OU 1. The Knox aquifer is the only true aquifer on the ORR; it is the source of sustained natural flow in many perennial streams (Solomon et al. 1992). The aquifer can supply large quantities of water to wells, and flow volumes are significantly larger than in the ORR aquitards. Flow paths are also deeper than in the aquitards.

Solomon et al. (1992) point out that flow in the Knox aquifer is dominated by a few cavity systems. Two wells in the Knox aquifer have produced large quantities of water (>60 L/s), but most wells yield relatively small quantities of water (<1 L/min). King and Haase (1988) investigated hydraulic conductivity in the Knox aquifer along Chestnut Ridge. Their study employed straddle packer tests in 21 intervals selected from three core holes. All intervals were in the Copper Ridge Dolomite, and depths ranged from 120 to 615 ft below surface. Hydraulic conductivity values from the King and Haase study ranged from 2.59×10^{-11} to 3.98×10^{-7} ft/day.

Transmissivity values for the Knox aquifer suggest that the bulk permeability of the Knox is ten times greater than the ORR aquitards; however, the Knox is very permeable locally because of the presence of cavities and conduits and is, therefore, capable of transmitting large quantities of water. The potential groundwater flow path length in the Knox aquifer is much greater than in the ORR aquitards, with path lengths on the order of kilometers versus tens of, or a few hundred, meters in the aquitards (Solomon et al. 1992).

Groundwater investigations conducted by Energy Systems in the 1980s and 1990s included the installation of 22 monitoring wells in and around the perimeter of OU 1; three of these wells have been plugged and abandoned (1080, GW-607, and GW-608A). The existing 19 monitoring wells at the site all monitor bedrock and include both screened and open-hole construction. Groundwater has not been found in the overburden above bedrock at OU 1. Numerous fracture zones and cavities were encountered during the installation of many of the monitoring wells (Jones, Harrington, and Field 1992). Total depths of the wells range from 117 to 420 ft bls, providing extensive vertical coverage of the aquifer. Table 3.1 summarizes some pertinent information about the monitoring wells, including elevations, total depths, screened or open-hole intervals, construction materials, and completion date. Figure 3.7 shows the location of OU 1 monitoring wells, and Figs. 3.8 and 3.9 provide cross-sectional interpretations of the site hydrogeology.

Haase et al. (1987) conducted one of the first studies of OU 1. Included in the study was the installation of five monitoring wells (GW-173, -174, -176, -177, and -179), weekly water-level measurements, and quarterly collection of groundwater samples. Analysis of groundwater samples included parameters to evaluate both water chemistry and quality.

The Haase et al. (1987) study was the first systematic one of the hydrology of OU 1. Their data indicated that hydrostatic head decreased in elevation to the northeast (parallel to Chestnut Ridge) with the highest elevation in GW-177 at the west end of the site and the lowest elevation in GW-173 at the east end of the site. Subsequent water-level monitoring at the site generally has been consistent with the Haase et al. data (HSW Environmental

Table 3.1. Chestnut Ridge OU 1 monitoring wells

Well	Top of casing[a]	Total depth[b]	Screened interval[c]	Construction material	Completion date
GW-173	1115.00	165.0	155.0–165.0	SS[d]	8/15/85
GW-174	1116.52	145.0	135.0–145.0	SS	8/15/85
GW-175	1084.00	166.7	150.6–166.4	SS	6/22/88
GW-176	1125.27	145.0	135.0-145.0	SS	8/27/85
GW-177	1157.95	145.0	133.0-143.0	SS	10/25/85
GW-178	1143.49	133.0	122.0-132.0	SS	8/20/87
GW-179	1128.00	117.0	107.0-117.0	SS	12/3/85
GW-180	1103.97	144.0	132.2-143.0	SS	8/11/87
GW-181	1093.03	168.0	Casing to 155.0; open to 168.0	Steel	7/13/88
GW-182	1147.35	402.1	Casing to 126.6; open to 402.1	Steel	5/27/88
GW-322	1134.25	193.0	Casing to 128.0; open to 193.0	Steel	9/2/87
GW-511	1093.21	153.7	143.3–153.3	SS	4/19/88
GW-608	1073.95	220.0	Casing to 148.0; open to 220.0	Steel	10/5/89
GW-609	1112.11	269.0	258.7–269.0	SS	10/18/90
GW-610	1059.44	117.4	107.1–117.4	SS	1/2/90
GW-611	1048.38	121.6	107.0–117.0	SS	1/19/90
GW-612	1131.03	254.0	Casing to 230.6; open to 254.0	Steel	11/1/89
GW-742	1100.97	420.0	Casing to 350.0; open to 420.0	Steel	12/5/91
GW-743	1100.36	161.1	150.1–161.1	SS	12/13/91

Notes:
[a]Elevations of top of casing are in feet above sea level.
[b]Total depth is in feet below top of casing.
[c]Screened interval is in feet below top of casing.
[d]SS = Stainless steel

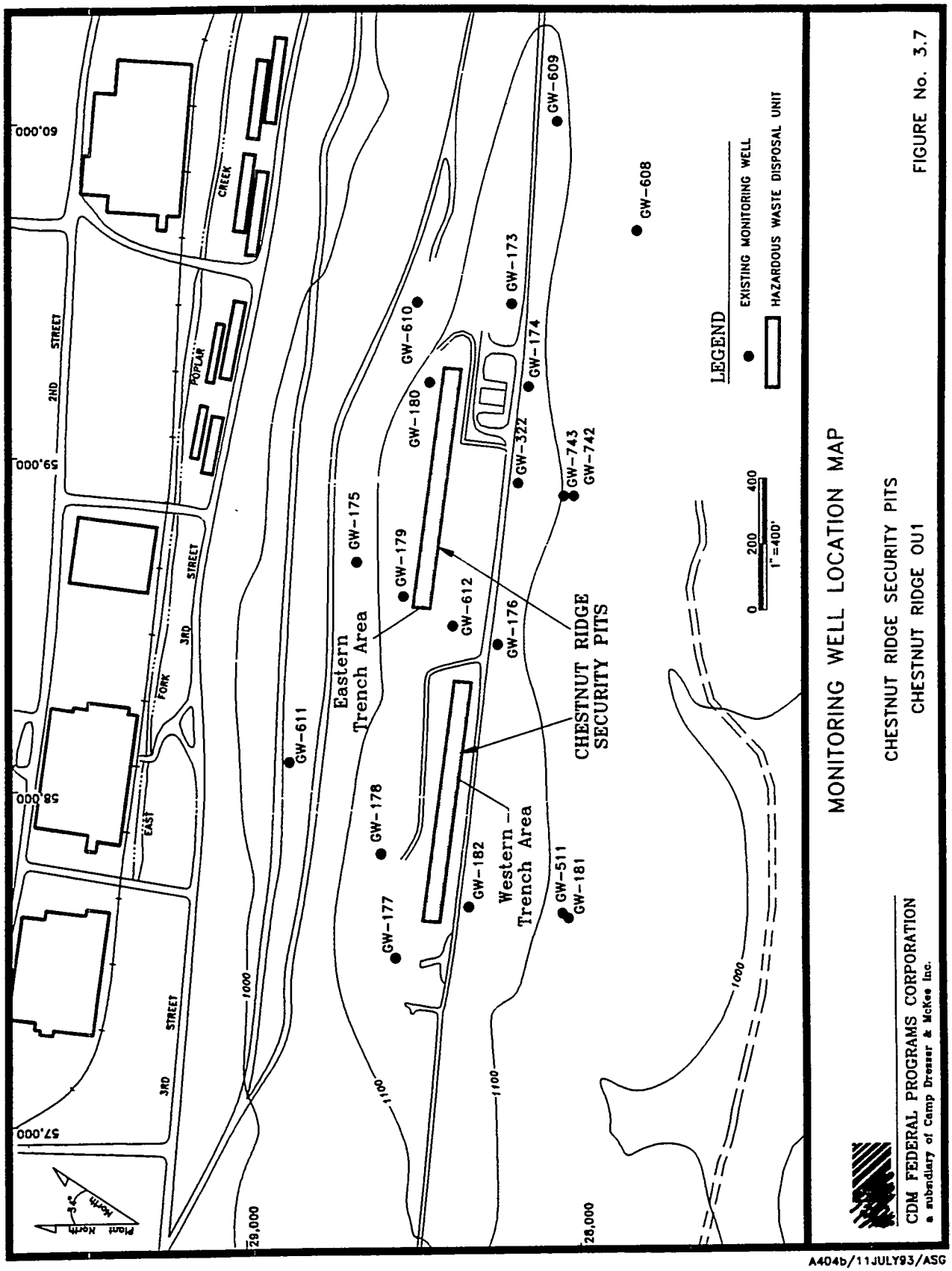


Fig. 3.7. Monitoring well location maps.

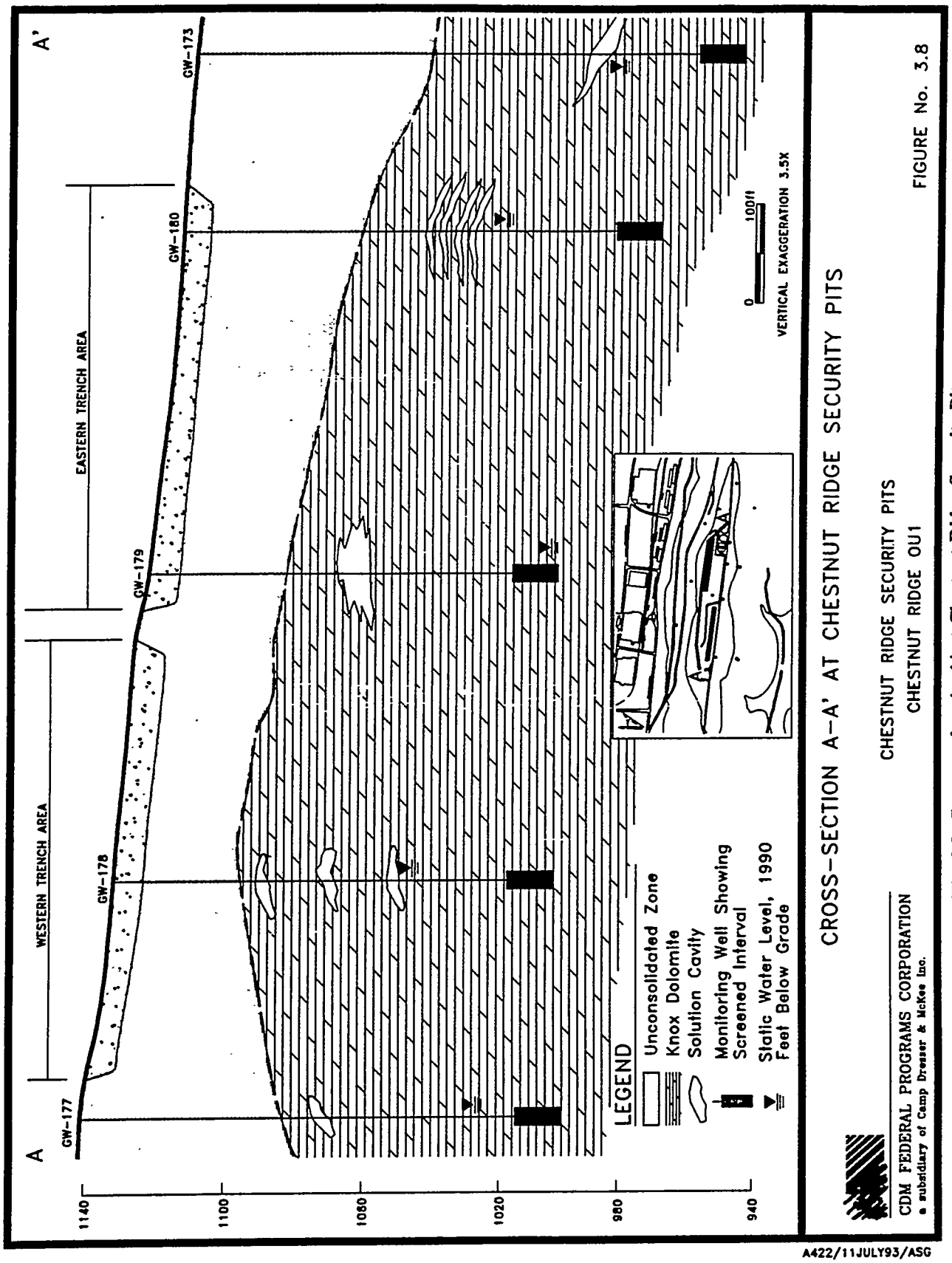


Fig. 3.8. Cross-section A -A' at Chestnut Ridge Security Pits.

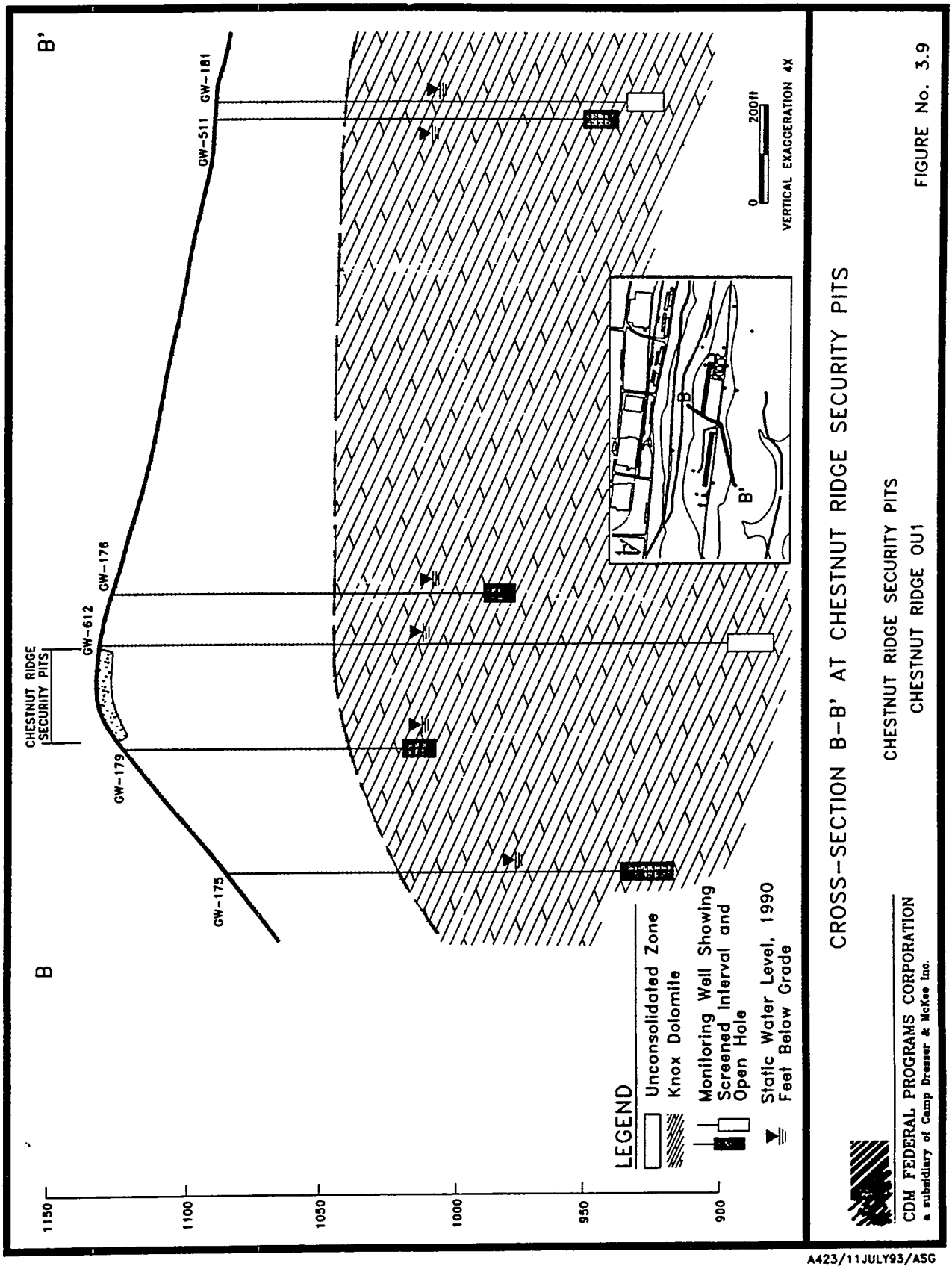


Fig. 3.9. Cross-section B -B' at Chestnut Ridge Security Pits.

Consultants 1991 and 1992) (Fig. 3.8). The potentiometric surface generally reflects surface topography, and a groundwater divide underlies the vicinity of the CRSP. The potentiometric surface appears to have a steep gradient north of the CRSP, reflecting the slope of Chestnut Ridge (Fig. 3.9). The direction of the groundwater gradient across the site is probably related to the development of channels or conduits in the bedrock by karst processes, which typically follow the orientation of fractures and/or bedding planes. Figure 3.10 presents a groundwater contour map of the site based on groundwater elevation data collected in January 1992 (SAIC 1992).

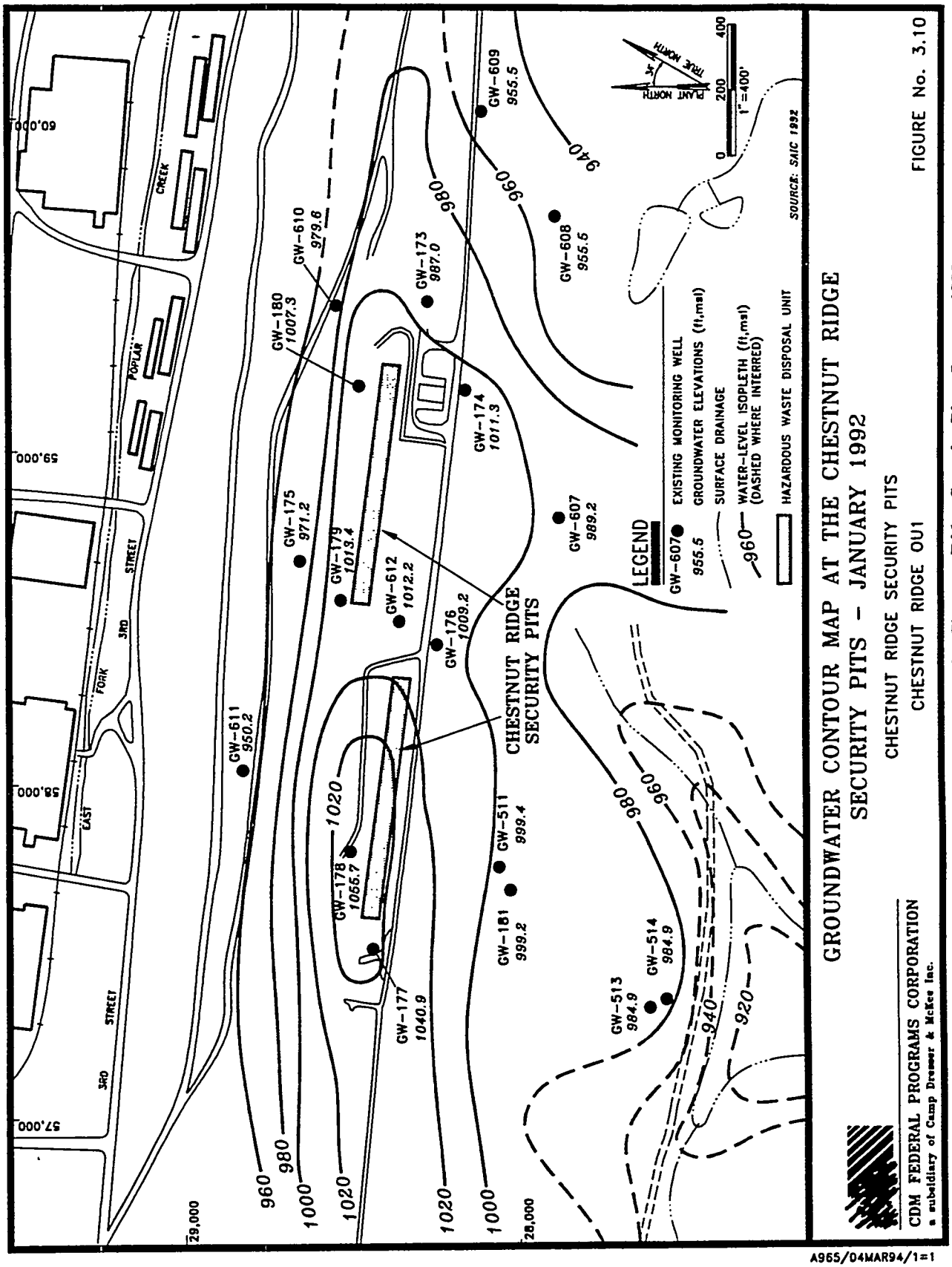
Two dye tracer studies have been performed at Chestnut Ridge OU 1 to clarify the hydrologic system and groundwater gradient. The first test was conducted during the driest part of 1990. Before the test was started, a survey of potential discharge points was conducted. Forty monitoring points were established in both Bethel Valley and Bear Creek Valley, including streams, springs, and monitoring wells. Charcoal dye detectors were placed at each monitoring point. For 3 weeks before dye introduction, the points were monitored to collect background fluorescence data.

Fluorescein dye mixed with potable water (10 kg) was introduced into well GW-178 on July 11, 1990. Detectors at the monitoring points were sampled over a 6-month period. Dye was positively recovered from five springs, one monitoring well, and six surface water sites. Several other monitoring points were identified as having a "possible" connection. The study concluded that flow is dominantly along strike (i.e., northeast–southwest) coincident with Chestnut Ridge itself, with a potential component of flow toward the east and southeast (Geraghty & Miller 1990b).

On the basis of results from the first study, Energy Systems recommended that a second test be conducted. The purpose of the second test was twofold. First, the study was undertaken to verify the hydraulic continuity between the source well and groundwater discharge points identified in the first test as containing dye (SAIC 1992). Second, it was undertaken to conduct a test during the wet season to identify any potential differences in flow characteristics between wet and dry portions of the year.

The second test started in February 1992 with a 4-week baseline monitoring period of background fluorescence. GW-178 again was selected for dye injection; 34 potential discharge points, including springs, streams, and wells, were monitored with charcoal detectors. Dyes included 255 lb of Rhodamine WT and 246 lb of Burco Fluor AR solution, and an optical brightener equivalent to Fluorescent Brightener 28. Dye injection commenced on March 13, 1992, and monitoring was to continue for 12 weeks. The monitoring period was subsequently extended to 18 weeks because no definitive results were obtained. The test results were inconclusive. No results could be characterized on a qualitative basis as positively indicating the detection of dyes at monitoring locations (SAIC 1992). The investigators concluded that GW-178 may not be well integrated with the karst system and that the dye might not be available for transport even after several months (SAIC 1992).

Water chemistry data from OU 1 (Haase et al. 1987) show that the major cations are calcium and magnesium; the calcium-magnesium ratio was typically 0.45 to 0.55. Major anions are carbonate-bicarbonate. Trace amounts of sulfate are present, along with a small but relatively constant silicon concentration. Specific conductance values range from 300 to 500 μmho/cm, and pH values range from 6.9 to 8.3, typical of Knox Group groundwater on the ORR.



A965/04MAR94/1=1

Fig. 3.10. Groundwater contour map at the Chestnut Ridge Security Pits—January 1992

Solomon et al. (1992) discuss chemical characteristics of the Knox aquifer and note that a calcium-magnesium-bicarbonate type of water exists to depths of nearly 984 ft (300 m) and that a transition to sodium-bicarbonate or sodium-chlorine water, observed with depth in the ORR aquitards, is not present. The difference in major ion chemistry of the Knox aquifer as compared to the aquitards may result from differences in residence times and dominant geochemical processes (Solomon et al. 1992).

Water quality data from the OU 1 study of Haase et al. (1987) included analysis for metals, phenols, pesticides/herbicides, VOCs, semivolatile organic compounds (SVOCs), and radionuclides. The data showed that the primary COCs were VOCs, specifically 1,1-dichloroethene, 1,1-dichloroethane; and 1,1,1-trichloroethane. Summed concentrations of VOCs ranged from 20 to 945 ppb, with the highest concentrations in wells 1080 (now plugged and abandoned), GW-176, and GW-179. Metal concentrations showed considerable scatter and few instances of exceeding any water quality standards; Haase et al. attributed several of the exceedences to high turbidity generated by poor sampling techniques. Concentrations of pesticides/herbicides and SVOCs were all minimal or below detection limits. Radionuclide concentrations were widely variable and typically below any water quality standards.

Groundwater quality at OU 1 has received considerable attention since the study of Haase et al. (1987) and has resulted in the installation of numerous wells and subsequent monitoring. Appendix A includes groundwater quality data from OU 1 monitoring wells from 1986 (the Haase et al. data) and 1988 through 1992. Energy Systems conducted an Appendix IX sampling program in 1987, but these data were not available for inclusion in this document. The results of that sampling are summarized below.

The Appendix IX sampling program included over 100 monitoring wells at the Y-12 Plant, including seven wells at OU 1 (GW-173, -174, -176, -177, -178, -180, and -322). The results of analysis from this program showed that VOCs were again the primary COCs in groundwater. VOCs most commonly detected and present at relatively high concentrations were carbon tetrachloride; 1,1-dichloroethane; 1,1-dichloroethene; trans-1,2-dichloroethene; tetrachlorethene; and 1,1,1-trichloroethane. The data showed that the dominant VOC contaminant in the western portion of the site was 1,1,1-trichloroethane; the dominant VOC contaminant in the eastern portion of the site was tetrachloroethene (Geraghty & Miller 1989b).

Metals (As, Ba, Be, Cr, Cu, Pb, Hg, U, and Zn) were also detected, but the data did not indicate substantial groundwater contamination. Several metals exceeded EPA primary drinking water standards in a few samples, but the exceedences were not corroborated by historical monitoring results and were considered anomalous. Analyses for radionuclides did not show significant contamination; concentrations of uranium, gross alpha, and gross beta were typically below EPA primary drinking water standards, although a few slight exceedences were observed.

Subsequent monitoring of wells at OU 1 has shown that VOCs continue to be the primary COCs at the site and that concentrations of VOCs and other parameters (i.e., metals and radionuclides) remain consistent with no significant changes (Geraghty & Miller 1990a; Geraghty & Miller 1990a; HSW Environmental Consultants 1991, 1992). The Y-12 Plant Groundwater Protection Program continues to monitor groundwater at OU 1. Ten wells (GW-175, -177, -181, -511, -608, -609, -610, -611, -742, and -743) are currently included in the program's sampling sequence. Monitoring wells not currently included in the program have

been dropped because their historical data show that they are clean or have been replaced by other wells that are deeper and/or farther away from the source of contaminants.

3.7 ECOLOGY

Chestnut Ridge OU 1 consists of an upland artificial grassland (mowed fescue) surrounded by second-growth oak-hickory woodland. The ecological composition of the site is discussed in more detail in Sect. 4.2.

3.8 RADIOLOGICAL SURVEY

Available information indicates that uranium and uranium alloys constitute ~48% of the total waste inventory at OU 1 and that thorium constitutes 1% (Radian 1992). As discussed above, analytical data from groundwater sampling show that radionuclides, principally uranium, gross alpha, and gross beta, are present but generally below applicable standards. A number of exceedences of EPA primary drinking water standards for radionuclides have been observed, but the exceedences generally are small and do not occur consistently. A reservation-wide geophysical survey was conducted during January 1993 from an elevation of 150 ft. The survey included radiological parameters, magnetics, and electromagnetics. Results from the survey were expected in late spring 1993 but were not available for inclusion in this document.

3.9 CONCEPTUAL SITE MODEL

A generalized conceptual site model for Chestnut Ridge OU 1 is presented in Fig. 3.11. This model depicts potential exposure pathways and sources of contaminants. The primary sources of contaminations at the CRSP site are materials/wastes buried in the pits. These wastes are leaking into the groundwater as evidenced by the presence of VOCs in groundwater samples. Contaminated groundwater may be discharging at remote locations within the Chestnut Ridge hydrologic regime, thereby creating surface water/sediment contamination and presenting a mechanism for further off-site transport of contaminants. Because the pits are covered by a multilayered engineered cap, there is currently no surface contamination at the site. The extent of surface soil contamination in adjacent areas, potentially contaminated by surface runoff during operation of the pits, and subsurface soil contamination beneath and surrounding the pits is unknown. Subsurface soil contamination can act as a source of groundwater contamination in the event that source control is achieved. The presence of contaminated surface soils adjacent to the site could potentially be impacting terrestrial flora and fauna in the wooded areas adjacent to the site. Because the site itself is mowed regularly, it has extremely low habitat value.

There are no surface water features directly associated with the CRSP, nor are there defined, intermittent surface drainage features or wetland areas. Some of the springs and seeps along Chestnut Ridge and in the adjacent valleys are likely connected with the karst hydrologic system underlying the CRSP.

In subsequent sections the conceptual site model will be expanded to describe specific, potential exposure media and pathways for both human and ecological receptors. Identifica-

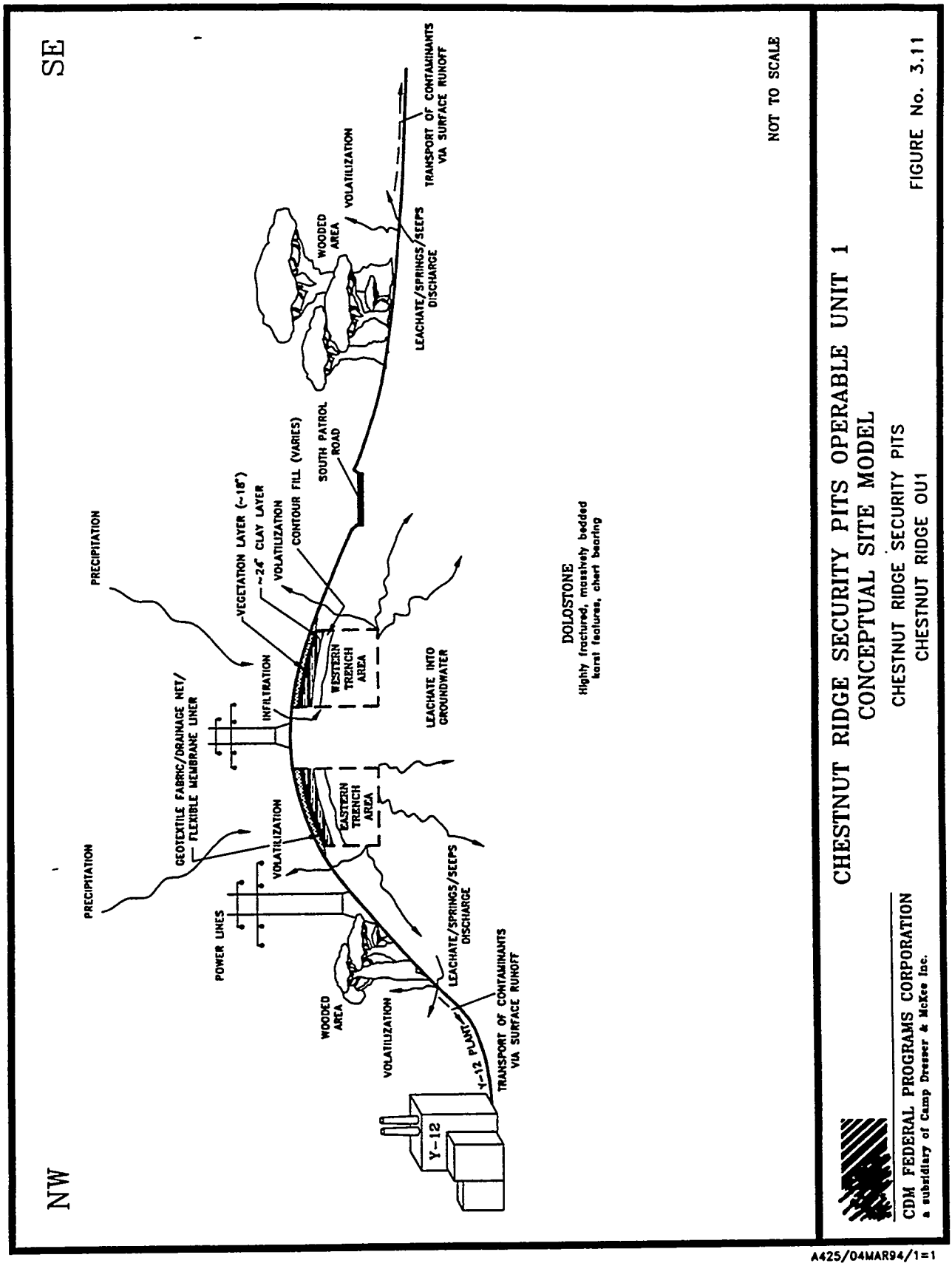


Fig. 3.11. Chestnut Ridge Security Pits OU 1 conceptual site model

tion of these media and pathways forms the basis for the development of the RI sampling approach described in detail in Chap. 6.

3.9.1 Conceptual Site Model for Exposure of Human Receptors

The conceptual site model flow diagram for human receptors is illustrated in Fig. 3.12 and considers five potentially contaminated media: (1) soil, (2) surface water, (3) groundwater, (4) air, and (5) biota. The primary source of contamination to these media is hazardous and nonhazardous wastes disposed of in the CRSP. Primary and secondary release mechanisms include (1) chemical releases to soil, (2) infiltration/percolation to groundwater, (3) groundwater discharge to surface water, (4) wind-generated dust, (5) volatilization from soil and water, and (6) plant and animal uptake.

3.9.1.1 Soil

The soil is a potential pathway of migration for the contaminants at Chestnut Ridge OU 1 via percolation/infiltration into groundwater, volatilization of contaminants into the air, resuspension of particles (wind-generated dust) into the air, and plant and animal uptake. This exposure medium will be evaluated in terms of human health risk using the hypothetical future on source-OU residential scenario in a baseline risk assessment (BRA) [i.e., a reasonable maximum exposure (RME) risk assessment using residential exposure parameters as discussed in Sect. 6.4]. Exposure pathways/routes that will be evaluated include ingestion of soil, inhalation of resuspended soil (dust), dermal contact with soil, inhalation of volatiles from the soil, ingestion of homegrown vegetables/fruits, and external exposure to radionuclides in the soil.

3.9.1.2 Surface water

Although Chestnut Ridge OU 1 contains no surface water, contamination (to off source-OU surface water) may result from contaminated groundwater discharge to surface water. If such discharge points (seeps and/or springs) can be identified, the off-source surface water exposure medium will be evaluated in terms of human health risk. A risk assessment of the identified off source-OU surface water contaminants (using the current industrial scenario) will be performed to identify and prioritize springs/seeps that are the primary contributors to off source-OU migration of contaminants. A hypothetical residential scenario risk assessment will also be performed to support final action RODs for any off source-OU surface water attributed to CRSP groundwater discharge. Exposure pathways/routes to be evaluated include ingestion of and dermal contact with the surface water and inhalation of volatiles in surface water.

3.9.1.3 Groundwater

The groundwater system is an on source-OU exposure medium and is also identified as a mechanism for contaminant transport (off source-OU) via groundwater movement and groundwater discharge to surface water. The on source-OU groundwater will be evaluated to support a final action ROD (for groundwater remediation) using a BRA with residential exposure parameters. Exposure pathways/routes that will be evaluated include ingestion of and dermal contact with groundwater and inhalation of volatiles in groundwater.

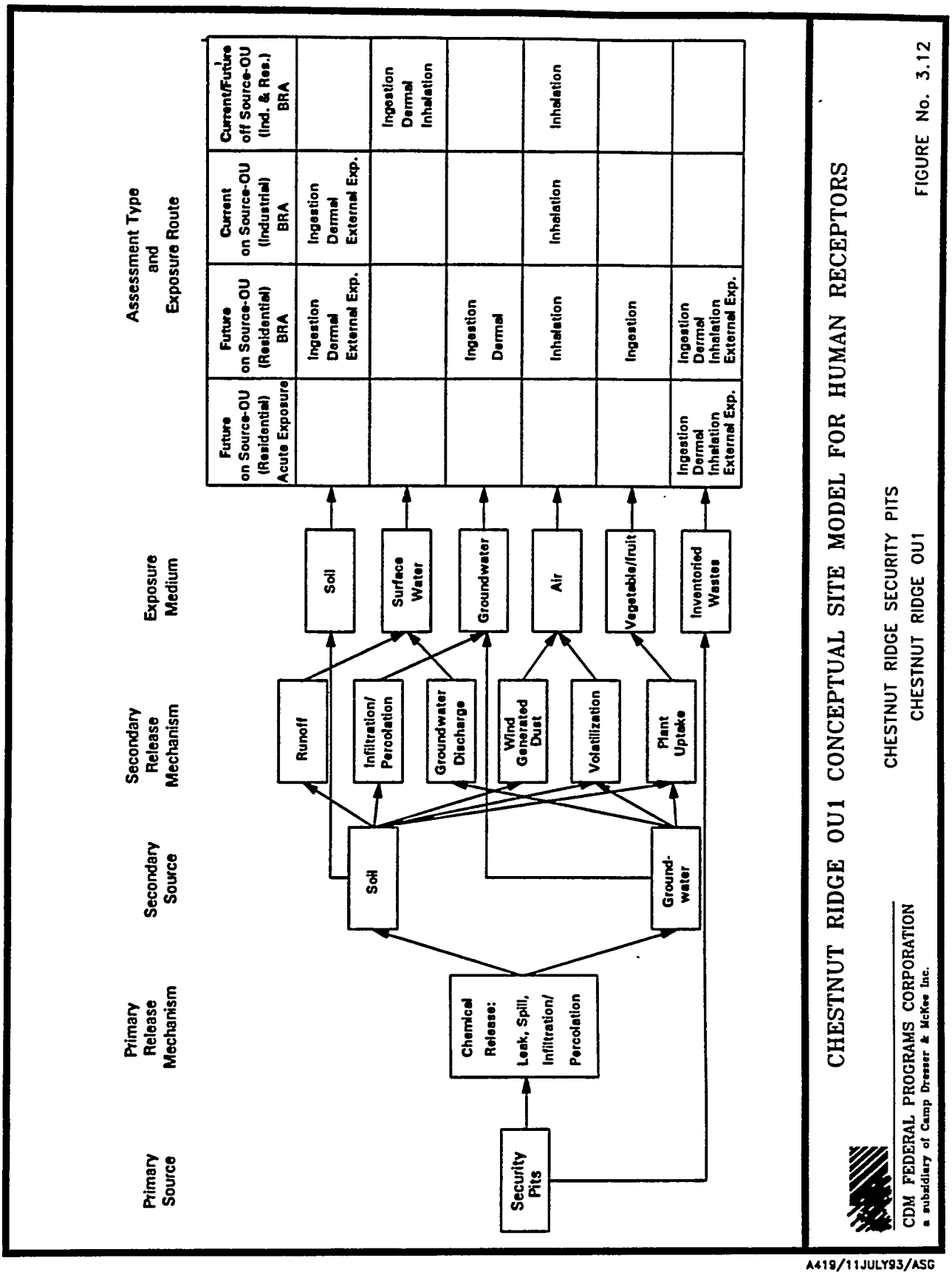


FIGURE No. 3.12

Fig. 3.12. Chestnut Ridge source OU 1 conceptual site model for human receptors.

3.9.1.4 Air

Contaminant release into the air may occur as a result of resuspension of dust (from soil) and volatilization of contaminants from surface water and directly from the soil; some residential uses of groundwater (e.g., showering) can also result in volatilization of contaminants. Inhalation is the primary exposure route for contaminants in air.

3.9.1.5 Biota

Plants may accumulate contaminants in the soil and irrigation water. On source-OU groundwater (and associated off source-OU groundwater and surface water, if identified) would be the irrigation source for homegrown vegetables/fruits. This exposure medium will be evaluated using the hypothetical residential scenarios in the BRA for the vegetable/fruit ingestion pathway.

3.9.1.6 Direct exposure

Human receptors could be at risk from direct exposure to the contaminants (inorganics, organics, and radionuclides) placed in the CRSP; classified and unclassified inventory lists are available for the CRSP. A cap was placed on the CRSP in 1989, and no soil samples were taken at that time; therefore, a conservative estimate of the risk to a human receptor will be determined using the inventory list of the wastes deposited in the pits. (Best estimates for the total volume of each contaminant deposited in the pits will be used.) Exposure pathways to be considered include ingestion, dermal contact, inhalation, and external exposure. A bounded estimate will be determined in which the lower bound will be determined using a residential risk assessment, and an upper bound will be determined by evaluating risk from acute exposure to contaminants of potential concern listed in the CRSP inventory.

3.9.2 Conceptual Model for Exposure of Ecological Receptors

Figure 3.13 shows a conceptual exposure model for ecological (nonhuman) receptors in the current baseline state. Figure 3.14 shows a conceptual model for ecological receptors in a hypothetical future state where the site is unmaintained.

Ecological assessment of a source OU (such as CRSP) is limited to those biota that can be definitively associated with the site. This approach does not address contaminant exposure that may be experienced by wide-ranging species (white-tailed deer, wild turkey, red fox, hawks, etc.) that may periodically use the site. To thoroughly evaluate risks to these species, a reservation-wide context is necessary in which the cumulative effects of exposure to multiple site are considered. Data from individual waste sites are still necessary, however, to provide estimates of the contaminant exposure wide-ranging species may experience at each site. Because CRSP is a source OU, the current baseline and hypothetical future case conceptual exposure models developed for the site focus on biota resident at the site. However, as shown in Figs. 3.13 and 3.14, contaminants from CRSP may contribute to exposures within the site-wide terrestrial ecosystem. Risks to biota in the site-wide terrestrial ecosystem will be addressed as part of the ORR-wide ecological assessment.

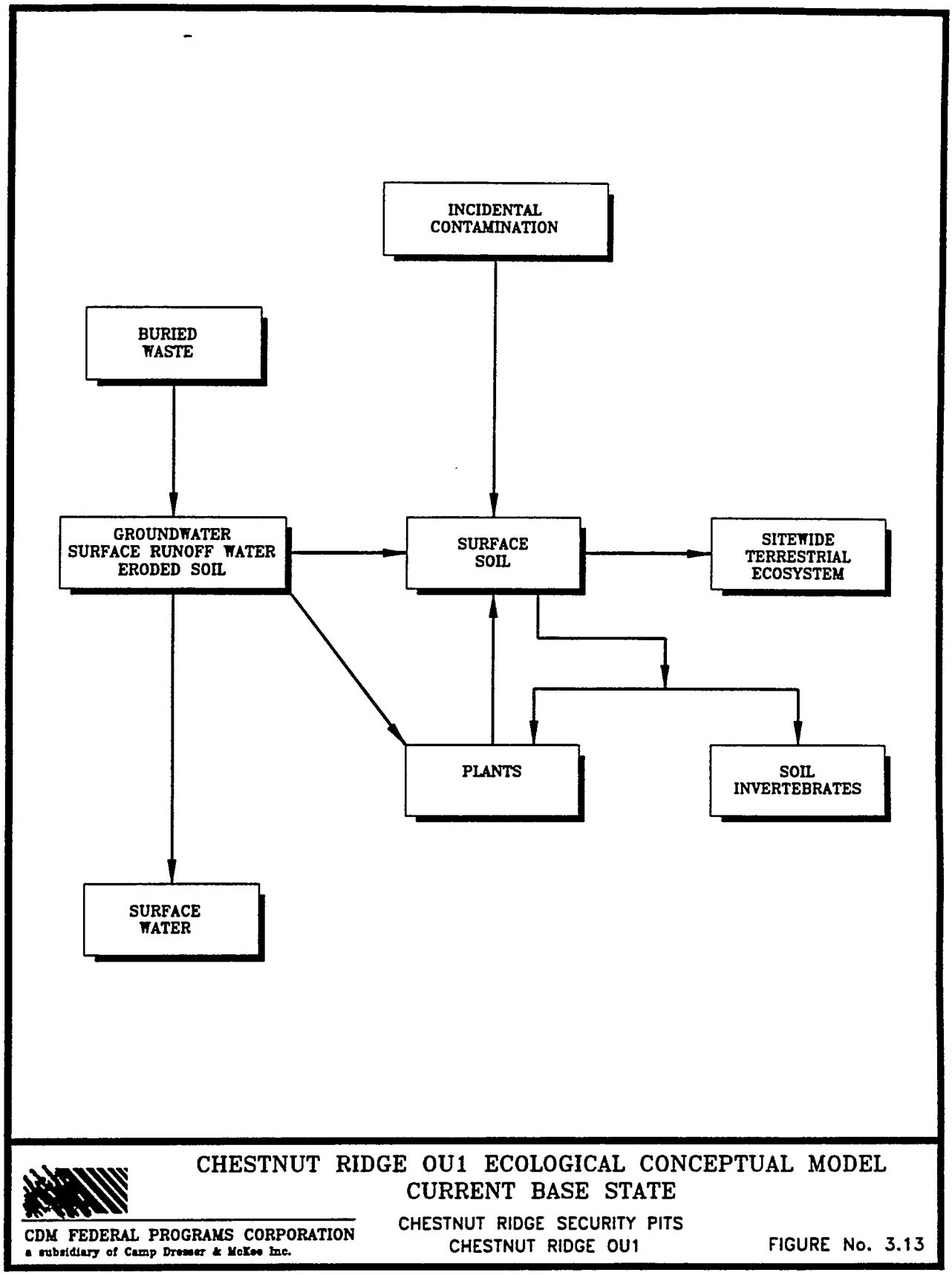


Fig. 3.13. Chestnut Ridge OU 1 ecological conceptual model current base state.

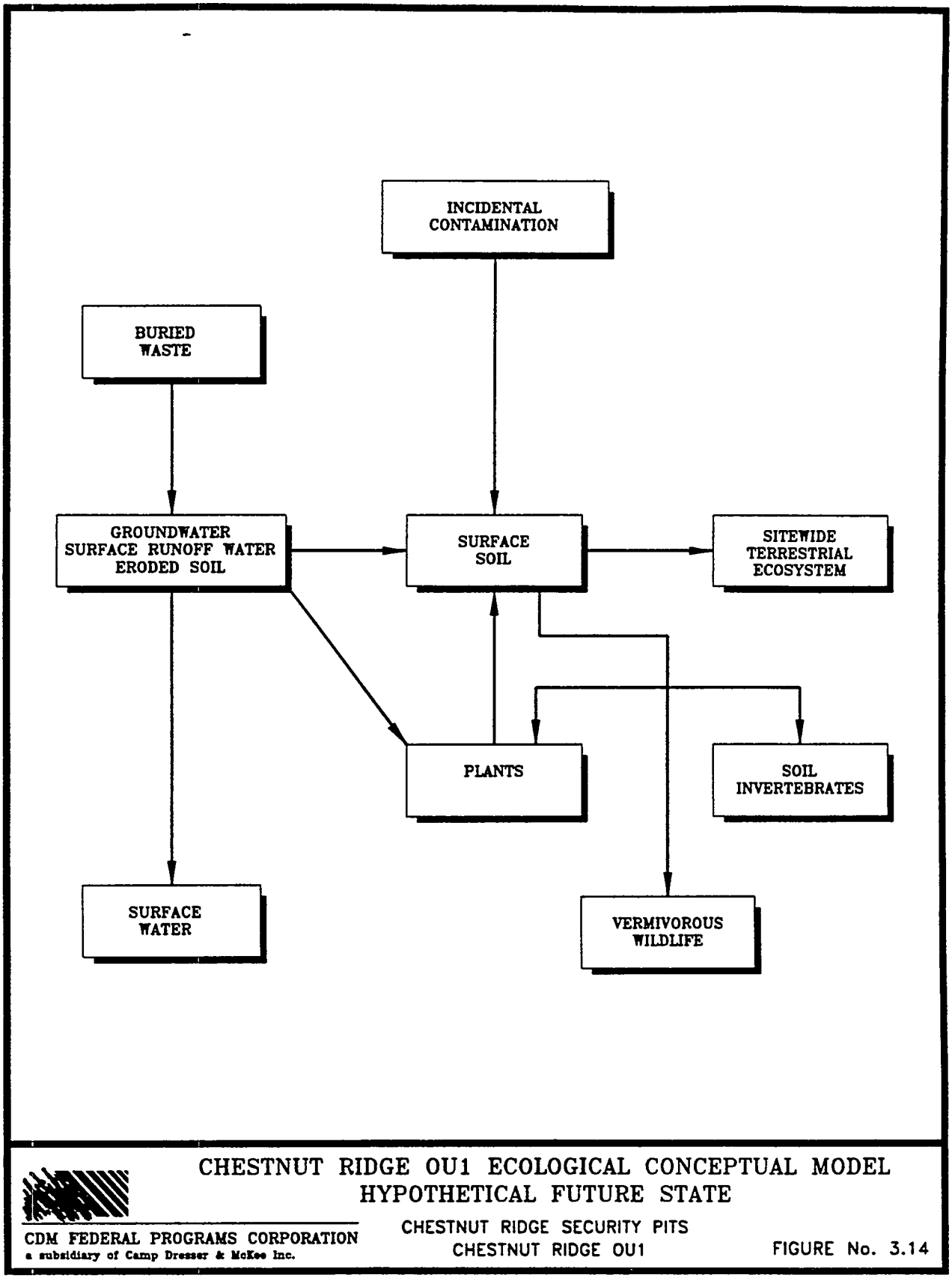


Fig. 3.14. Chestnut Ridge OU 1 ecological conceptual model hypothetical future state.

3.9.2.1 Problem definition

The standard paradigm for an ERA will be followed in the baseline assessment (Suter 1992, EPA 1992). The contaminant source of concern was identified as the mixed wastes buried in the CRSP. Concern is for the ecological risk associated with the waste site itself through (1) incidental soil contamination that occurred at the time of dumping (contaminated soil not covered by the three-layer RCRA cap) and (2) surface runoff water. The purpose of this ERA is to characterize the nature and extent of contaminant contributions from the source OU (Chestnut Ridge OU 1) to adjacent aquatic (Chestnut Ridge OU 2 or OU 4, or Upper EFPC) or terrestrial (ORR site-wide ecosystem) integrator OUs. The spatial extent of Chestnut Ridge OU 1 is limited to the mown grassland area. However, if contaminants originating from the CRSP are detected in downslope spring/seeps, these areas will be included in Chestnut Ridge OU 1. A 20% reduction in the abundance or production of any population of wildlife or vascular plant was chosen as the assessment endpoint. These endpoints were selected based on an analysis of EPA guidance and regulatory practice and on the feasibility of detecting effects (Suter et al. 1992).

The conceptual exposure model for the current baseline state (refer to Fig. 3.13) shows how contaminants move from the source through the physical components of the site to the various biotic components. While surface runoff water is believed to be the primary source of contamination (because the site is capped), spring seeps downslope from Chestnut Ridge OU 1 will be monitored for contaminants.

Chestnut Ridge OU 1 is believed to drain primarily to the northeast. Contaminants may therefore move in surface runoff water into Upper EFPC. In addition, surface runoff water may flow south-southwest into the McCoy Branch watershed or southeast into the sludge disposal ponds. These sites will be monitored to determine whether Chestnut Ridge OU 1 is significantly contributing to their current contaminant load. As a result of observed drainage patterns and the absence of aquatic habitat at Chestnut Ridge OU 1, Chestnut Ridge OU 2 and OU 4 and Upper EFPC have been identified as the integrator OUs for aquatic effects from Chestnut Ridge OU 1. Risks to aquatic biota for Chestnut Ridge OU 2 and OU 4 and Upper EFPC should be assessed in the RIs.

Surface soils may be exposed to contaminants through incidental contamination (at time of dumping) and surface runoff water and by cycling of plants previously exposed to contaminants via surface runoff water. Soil invertebrates may be exposed to contaminants through surface soil contact. While there may be some use of the site by large mobile wildlife species such as whitetail deer and wild turkeys, these organisms cannot be clearly associated with the site, so they are not included. (Most of their diet comes from Chestnut Ridge OU 1.) Because they are exposed to multiple WAGs, risks to such species should be assessed in a reservation-wide assessment.

Small mammal abundance in the contaminated grasslands is expected to be low because mowed fescue lawns provide poor habitat. Talmage and Walton (1991) were able to trap significant numbers of small mammals in the wooded and brushy areas surrounding WAG 4 (a site similar to and near Chestnut Ridge OU 1) but not on the lawns of the burial ground. Because small mammals could not be sampled in sufficient numbers to characterize the distribution of exposure on the site, they are not included. Small birds (robins in particular) may be exposed to contaminants by consuming earthworms from CRSP. However, while some individual birds may forage almost exclusively from within the area, there is no population of

birds that will use the CRSP exclusively or predominantly. Exposures and effects experienced by individual birds that may use CRSP are unlikely to produce population effects due to the large regional populations of these species. Ecological risk assessments usually only consider effects on individuals of a species significant if that species is endangered. Because the birds that may use the CRSP are not endangered, effects on individuals that may use the site will not be considered at this site (but they may be considered in the reservation-wide assessment). Therefore, the terrestrial portion of the ecological conceptual model focuses on the proximate receptors that can be associated with the site—plants and soil invertebrates. To assess risks to these receptors, earthworms will be sampled and analyzed from any significantly contaminated surface soils; plant and earthworm toxicity tests will be performed on soil from the same areas. In addition, contaminant concentrations in soils will be compared to concentrations reported to be toxic to plants or soil invertebrates.

If the U.S. government ceased to exist or abrogated responsibility for the ORR; if no other governmental entity assumed responsibility; and if no agricultural, residential, or industrial development occurred on the site, Chestnut Ridge OU 1 would revert to mixed deciduous forest. This is the hypothetical future baseline case (refer to Fig. 3.13) for the ecological risk assessment.

The conceptual model for this case is complex because the habitat quality of the site would be greatly improved relative to the current case. All the routes in the current case would continue to operate, and the route to the aquatic communities (OU 4, EFPC, McCoy Branch, and sludge disposal ponds) would be substantially unchanged. (Greater transpiration would decrease aqueous flow.) However, in addition to uptake of contaminants from surface soil, deep-rooted trees could take up contaminants from shallow groundwater. Contaminants taken up in this manner and translocated to the aboveground parts would enter the litter layer and surface soil, thereby creating a route from groundwater to surface soil. In addition, the site would be occupied by shrews and ground-feeding birds that would consume soil and litter invertebrates. Although these species are not demonstrably ecologically important, they are highly exposed to contaminants in soil that bioaccumulate through food. They are likely to be the most susceptible wildlife species and are included for that reason. In forests, herbivores (predominantly insects) are not ecologically important in terms of either energy or nutrient dynamics. (Most energy and nutrients in these forests pass from the primary producers to the decomposers.) In addition, herbivores would have lower contaminant exposures than soil/litter invertebrates.

In east Tennessee forests, most vertebrate consumers of herbivorous insects are birds. These birds would have lower exposures than litter foragers because their food would be less contaminated and they would experience less incidental consumption of soil, so they should not be particularly susceptible. Similarly, omnivores such as *Peromyscus* are not exceptionally susceptible or ecologically important. Vertebrate forest predators such as bobcats and broadwinged hawks could not be particularly associated with the site because they have large home ranges, would not be particularly susceptible, and are not demonstrably ecologically important (i.e., are not keystone species and are not important to energy or nutrient dynamics). Exposure and effects on plants, soil invertebrates, and vermivorous wildlife will be estimated based on current concentrations and on estimates of additional exposure due to deep-rooted vegetation.

3.9.2.2 Data needs for ecological risk assessment

Surveys will be conducted for endangered, threatened, or in-need-of-management species and their habitats. Because Chestnut Ridge OU 1 is an upland site, surveys for wetlands and floodplains at the waste disposal site are unnecessary. However, if hydrologic studies indicate that contaminated water from this site is reaching the surface, the exposed areas will be surveyed for wetlands and floodplains as well as threatened and endangered species.

Data are needed on the presence and nature of contaminants in the soil. If contaminants are found at potentially hazardous concentrations, soil invertebrates will be collected to evaluate contaminant bioaccumulation and soil toxicity tests will be performed using earthworms and cabbage seedlings in accordance with demonstrated procedures (Green et al. 1988; Roberts and Dorough 1985; Wentsel and Guelta 1987 and 1988).

Additionally, if monitoring of springs/seeps indicates contamination originating from the CRSP, then ambient toxicity tests should be performed. These tests will be the EPA's 7-d fathead minnow larval and *Ceriodaphnia dubia* tests.

4. POTENTIAL RECEPTORS AND EXPOSURE PATHWAYS

This chapter considers characterization of the human and ecological populations on or near the CRSP site. The receptor assessment aims to identify those individuals or populations with a current or future potential for exposure to CRSP site contaminants. The exposure pathway assessment identifies the routes by which a receptor might be exposed.

4.1 HUMAN POPULATIONS AND EXPOSURE PATHWAYS

The CRSP are within the Y-12 Plant (~800 acres) and are part of the ORR, which covers ~58,000 acres. The CRSP site is located along the crest of Chestnut Ridge south of the main Y-12 Plant facility. The Y-12 Plant is located along the northeastern boundary of the entire ORR [which includes the Y-12 Plant, the Oak Ridge National Laboratory (ORNL) and the K-25 Site], adjacent to the city of Oak Ridge. The presence of unauthorized persons at the Y-12 Plant is controlled. Security precautions currently limit admittance to this controlled area; consequently, the potential for human exposure to contaminants is currently limited.

A conceptual site model for human health risk assessment is discussed in Sect. 3.9.1 and illustrated in Fig. 3.11. Inhalation, ingestion, dermal contact, and external exposure pathways (for both groundwater and soil) were selected as potential pathways of concern at Chestnut Ridge OU 1 through the use of available knowledge of site conditions. In addition, direct exposure to the inventoried wastes via ingestion, inhalation, dermal contact, and external exposure are potential pathways of concern.

An exposure pathway is the means by which contamination from any contaminated medium is transported from a source to a receptor. The components necessary to complete the pathway are (1) a contaminated source and a mechanism for release, (2) a transport medium, (3) an exposure point, (4) potential receptors, and (5) an exposure route. Exposure can occur if contaminants migrate from the CRSP to a receptor or if a receptor comes into direct contact with the contaminated media. Identification of exposure pathways for this OU include descriptions of both primary and secondary sources.

For the CRSP site, both primary and secondary media are identified (refer to Fig. 3.12 in Sect. 3.9.1). The primary source of contamination for this OU is from contaminants disposed of in the security pits. Contaminants from this primary source are released, through primary mechanisms (e.g., leaks, spills, and infiltration/ percolation), to secondary sources. Two potential secondary sources (those that contribute contaminants through their exposure media) have been identified; they are soil and groundwater. Contaminants in these secondary sources are released to exposure media through secondary release mechanisms that include infiltration/percolation, groundwater discharge, wind-generated dust, volatilization, and plant uptake. The exposure media identified for the CRSP are on source-OU soil, groundwater, air, and biota; an off source-OU exposure medium is surface water.

A potential exists for the ingestion of contaminants via surface water and groundwater consumption as well as soil and biota intake. Exposure via ingestion of surface water or groundwater could occur if one or the other is used as a drinking water source by future residential receptors. On source-OU surface water has not been identified at the present time. There is, however, groundwater attributed to this OU, and the potential exists for

contamination of this water through infiltration. The groundwater associated with the CRSP site is currently not a source for domestic or industrial use. Potential exposure to the contaminants in groundwater moving off of the source-OU to an off source-OU receptor must also be considered here. In addition, exposure to the off source-OU receptor via contaminated surface water (i.e., groundwater discharged to surface water) must also be considered. The potential also exists for exposure to contaminants through ingestion of soil by the hypothetical on source-OU resident living on or near the CRSP. If soil sampling does not identify contamination, exposure from soil pathways is not expected and will not be evaluated in terms of risk to human health. Potential exposure via ingestion of homegrown vegetables/fruits on source-OU must also be considered.

Exposure of receptors to contaminants through dermal contact with soil and water is also a potential route. For the future hypothetical resident, dermal exposure to groundwater might occur through showering. Dermal contact with soil is another means of exposure. The potential for a receptor to be externally exposed to radionuclides (gamma radiation) in the CRSP soils also exists. There is a potential for exposure to volatile contaminants through inhalation of wind-generated dust, volatilization from soils, and/or through contact with water (e.g., through showering). Furthermore, direct exposure to the contaminants disposed of in the CRSP (identified on the CRSP inventory lists) may also be a potential pathway of concern (e.g., for the remediation worker).

4.1.1 On-site Potential Human Receptors and Exposure Pathways

Employment at the Y-12 Plant (as of April 1993) consisted of ~6200 full-time on-site personnel, most of whom work in the main Y-12 Plant complex in the northeastern part of the ORR. The CRSP site is south of the main Y-12 Plant on the crest of Chestnut Ridge. Employees do not frequent this area, although on-site workers do have the greatest risk of exposure to contaminants from the CRSP. Because this source OU has been closed and capped, activities are limited at this OU, and potential exposure of the on-site worker is limited to a small group of maintenance workers and future sampling and remediation workers. Exposure to a trespasser must also be considered here. A baseline risk assessment (residential RME assessment) will, however, be performed to support a final action ROD for Chestnut Ridge OU 1.

Sensitive subpopulations identified as being of specific concern in this report (both off source-OU and on source-OU) are children who are potential receptors. Children 0 to 6 years of age will be evaluated to ensure protection of this population.

4.1.2 Off-site Potential Human Receptors and Exposure Pathways

The greatest potential for off source-OU human exposure is from groundwater migration of contaminants. Contributions to off source-OU surface water via groundwater discharge (seeps and springs) are also potential exposure pathways to an off source-OU receptor. If off source-OU surface water or groundwater is identified as being contaminated from the CRSP, exposure to receptors at those points will be evaluated in the BRA to support a final action ROD for Chestnut Ridge OU 1.

4.2 ECOLOGICAL POPULATIONS

This ecological assessment is concerned only with those upland terrestrial communities (grasslands and woodlands) and biota that may be definitively associated with Chestnut Ridge OU 1. Ecological risks to wide-ranging species that may periodically use CRSP will not be assessed here. However, the contribution of CRSP to the overall exposure experienced by these wide-ranging species will be evaluated. Risks to wide-ranging species will be assessed as part of the ORR-wide assessments.

The sources for this information include the ORR Resource Management Plan (Parr 1984; Kroodsma 1987; Cunningham and Pounds 1991; Parr and Evans 1992) and the RCRA Facility Investigation Plan for the Y-12 Plant (Welch 1989).

4.2.1 Aquatic Biota

As an upland site, no aquatic biota are present at the CRSP site. Risks to aquatic biota will be addressed in Bear Creek OU 4 and EFPC OU 1, depending on surface and groundwater discharge points.

4.2.2 Terrestrial Biota

Because the CRSP site consists of a lawn of mown fescue, only incidental and peripheral use by wildlife is expected. Species that may make occasional use of the actual disposal site include small mammals (shrews and mice), rabbits, skunks, and foxes. Greater wildlife diversity and abundance are expected in the woodland habitat surrounding the CRSP.

4.2.3 Threatened and Endangered Species

No federally or state-listed threatened or endangered species or other specially designated species are known to exist on the CRSP site. However, no survey specific to this OU has been conducted. Specially designated species that may occur are listed in Table 4.1.

4.2.4 Wetlands and Floodplains

Chestnut Ridge OU 1 is a ridgetop, upland site. Therefore, no wetlands or floodplains are present.

Table 4.1. Federally and state-listed threatened and/or endangered species and species designated In Need of Management by the state of Tennessee known or expected to occur on the ORR

Common name	Scientific name	Administrative status[a]
Fish		
Tennessee dace	*Phonixus oreas*	INM
Birds		
Black-crowned night heron	*Nycticorax nycticorax*	INM
Black vulture	*Coragyps atratus*	INM
Common barn owl	*Tyto alba*	INM
Cooper's hawk	*Accipiter cooperii*	ST
Grasshopper sparrow	*Ammodramus savannarum*	ST
Osprey	*Pandion haliaetus*	SE
Red-shouldered hawk	*Buteo lineatus*	ST
Sharp-shinned hawk	*Accipter striatus*	ST
Mammals		
Indiana bat	*Myotis sodalis*	FE, SE
Plants		
Spreading false foxglove	*Aureolaria patula*	ST
Appalachian bugbane	*Cimicifuga rubifolia*	ST
Pink lady's slipper	*Cypripedium acaule*	SE
Tall larkspur	*Delphinium exaltatum*	SE
Northern bush honeysuckle	*Diervilla lonicera*	ST
Nutall waterweed	*Elodea nuttallii*	SS
Mountain witch-alder	*Fothergilla major*	ST
Golden seal	*Hydrastis canadensis*	ST
Butternut	*Juglans cinerea*	ST
Canada lily	*Lilium canadense*	ST
Michigan lily	*Lilium michiganense*	ST
Fen orchid	*Liparis loeselii*	SE
Ginseng	*Panax quinquefolium*	ST
Tubercled rein orchid	*Platanthera flava var herbiola*	ST
Purple fringeless orchid	*Platanthera peranoena*	ST
Carey saxifrage	*Saxifraga careyana*	SS
Lesser ladies' tresses	*Spiranthes ovalis*	SS

FE = Federally endangered
FT = Federally threatened
INM = In need of management according to the state of Tennessee
SE = State endangered
SS = State special concern
ST = State threatened

5. IDENTIFICATION OF INVESTIGATION REQUIREMENTS

5.1 IDENTIFICATION OF ARARS

CERCLA guidelines specify that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are ARARs for a site. The following is a preliminary list of federal and state chemical- and location-specific ARARs for Chestnut Ridge OU 1:

- National Contingency Plan (NCP);
- NEPA;
- CERCLA;
- RCRA;
- Safe Drinking Water Act;
- Clean Water Act;
- Clean Air Act;
- TDEC, Chap. 1200-4-6-.05(2);
- TDEC, Chap. 1200-5-1.12;
- TDEC, Chap. 1200-1-13-.08(4) (proposed);
- TDEC, Chaps. 1200-4-3 and 1200-4-4;
- TDEC, Chap. 1200-1-13 (proposed);
- TDEC, Chap. 4-7 et seq.; and
- Toxic Substance Control Act.

The relevance of each of these federal or state laws or regulations is presented and discussed in Appendix B.

5.2 IDENTIFICATION OF PRELIMINARY REMEDIAL ACTION GOALS

The first step in the FS scoping process is the development of preliminary remedial action objectives (RAOs) for protecting human health and the environment. These objectives should specify contaminants and media of concern, potential exposure pathways, and preliminary remediation goals (PRGs). PRGs are chemical-specific concentrations in media based on readily available environmental or health-based ARARs or risk-based values calculated with default assumptions. As new information and data are collected and additional ARARs are identified during the RI, the PRGs may be modified, and RAOs will be established. These goals are used throughout the RI/FS process for screening purposes after the first phase of sampling. They identify general response actions and help to identify, screen, and develop remedial action alternatives.

Chestnut Ridge OU 1 will be addressed in a ROD consistent with the strategy outlined in the ORR Site Management Plan (Energy Systems 1992b). The general goal for the Chestnut Ridge OU 1 remedial action is to protect human health and the environment from the contaminant sources within the OU. For each contaminant source, the PRGs will be set for each COC and for each medium of concern at whichever of the following values is lowest and most technically feasible: (1) health-based criteria for carcinogenic effects or for systemic toxic effects, (2) the lowest chemical-specific ARARs, (3) ecologically based criteria, or (4) background concentrations.

5.3 IDENTIFICATION OF POTENTIAL CLASSES OF REMEDIAL TECHNOLOGIES

EPA-established requirements pertaining to the remediation of CERCLA sites are listed in Sect. 300.430(a)(1)(iii) of the NCP. These requirements have been considered in developing the PRGs, which serve to focus the consideration of remedial action alternatives. The classes of remedial technologies are summarized below.

- **Institutional controls** such as fences and deed restrictions may be used alone or as a supplement to engineering controls, as appropriate, to prevent exposure to hazardous substances.
- **Containment technologies** such as capping, vertical barriers, horizontal barriers, and dust suppression may be used, as appropriate, to control contaminated areas that pose a relatively low long-term threat and for sites where treatment is impractical (e.g., in a pyrophoric setting).
- **Removal technologies** such as excavation may be used, as appropriate, alone or in combination with treatment to remove contamination or to abate the further migration of contaminants.
- **Treatment technologies** such as physicochemical, biological, or thermal ex situ or in situ may be used, as appropriate, alone or in combination with any of the other listed technologies to (1) abate principal threats such as highly mobile or toxic substances, (2) prevent further migration of contaminants, or (3) remove contamination. Where possible, treated material that no longer poses a threat to human health or the environment will be returned to the excavation site, or treatment will occur in situ.
- **Innovative technologies** may be considered when they offer the potential for superior treatment performance or lower costs for performance similar to that of demonstrated technologies.

As the RAOs are revised throughout the RI/FS process, the development and evaluation of the remedial action alternatives will reflect the scope and complexity of the site problems being addressed. During the FS, alternatives will be developed to protect human health and the environment by eliminating, reducing, and/or controlling risks posed through each exposure pathway.

The media of concern at Chestnut Ridge OU 1 are soil, sediment, surface water, and groundwater. RAOs for this OU are described in Table 5.1. Soil and sediment are grouped together only because they have similar treatments.

Table 5.1. Identification of preliminary remedial action goals, preliminary general response actions, and preliminary remedial technology types in specified media

Media	Remedial action objectives	General response actions	Remedial technology type
Soil/sediment	**For protection of human health:** Prevent ingestion/direct contact with soil or sediment having non-carcinogenic contaminants of potential concern in excess of PRGs[a] Prevent ingestion/direct contact with soil or sediment having 10^{-4} to 10^{-7} excess cancer risk from carcinogenic contaminants of potential concern Prevent inhalation of carcinogenic contaminants of potential concern posing excess cancer risk levels of 10^{-4} to 10^{-7} **For protection of environment:** Prevent migration of contaminants of potential concern that would result in groundwater contamination in excess of PRGs	**No action:** 1. No action **Institutional actions:** 1. Access restrictions 2. Legal restrictions 3. Monitoring **Containment actions:** 1. Containment **Removal/treatment actions:** 1. Excavation/disposal 2. Excavation/treatment/disposal 3. Excavation/treatment/replacement 4. In situ treatment	**No action:** 1. Not applicable **Institutional options:** 1. Access barriers 2. Deed restrictions 3. Sampling and analysis **Containment technologies:** 1. Capping 2. Vertical barriers 3. Horizontal barriers **Removal technologies:** 1. Solids excavation **Treatment technologies:** 1. Physicochemical treatment 2. Biological treatment 3. Thermal treatment 4. In situ treatment **Disposal technologies:** 1. Construct on-site landfill

Table 5.1 (continued)

Media	Remedial action objectives	General response actions	Remedial technology type
Surface water	**For protection of human health:** Prevent ingestion of water having noncarcinogenic contaminants of potential concern in excess of PRGs Prevent ingestion of water having 10^{-4} to 10^{-7} excess cancer risk from carcinogenic contaminants of potential concern **For protection of environment:** Restore surface water to PRGs for contaminants of potential concern	**No action:** 1. No action **Institutional actions:** 1. Access restrictions 2. Legal restrictions 3. Monitoring **Containment actions:** 1. Containment **Collection/treatment actions:** 1. Collection/treatment/discharge 2. In situ surface water treatment	**No action:** 1. Not applicable **Institutional options:** 1. Access barriers 2. Deed restrictions 3. Sampling and analysis **Containment technologies:** 1. Vertical barriers 2. Horizontal barriers **Collection technologies:** 1. Collection **Treatment technologies:** 1. Physicochemical treatment 2. Biological treatment 3. Thermal treatment 4. In situ treatment 5. Existing Y-12 Plant treatment facility

Table 5.1 (continued)

Media	Remedial action objectives	General response actions	Remedial technology type
Groundwater	**For protection of human health:**	**No action:**	**No action:**
		1. No action	1. Not applicable
	Prevent ingestion of water having noncarcinogenic contaminants of potential concern in excess of PRGs	**Institutional actions:**	**Institutional options:**
		1. Access restrictions	1. Fence/access barriers
		2. Legal restrictions	2. Deed restrictions
	Prevent ingestion of water having 10^{-4} to 10^{-7} excess cancer risk from carcinogenic contaminants of potential concern	3. Monitoring	3. Sampling and analysis
		Containment actions:	**Containment technologies:**
		1. Containment	1. Vertical barriers
			2. Horizontal barriers
	For protection of environment:		3. Capping
			4. Subsurface collection drains
	Restore groundwater aquifer to PRGs for all contaminants of potential concern		5. Groundwater diversion pumping
		Extraction/treatment actions:	**Extraction technologies:**
		1. Extraction/treatment discharge	1. Groundwater collection and pumping
		2. In situ groundwater treatment	2. Dewater entire site
			3. Selective alternate recovery
			Treatment technologies:
			1. Physicochemical treatment
			2. Biological treatment
			3. Thermal treatment
			4. In situ treatment
			5. Existing Y-12 Plant treatment facilities

[a]Preliminary remediation goals.

Table 5.1 also presents a preliminary range of remedial action alternatives and associated technologies for Chestnut Ridge OU 1. This table is not meant to present a detailed compilation of alternatives but to make an initial determination as to which general response actions might be applied to the sites alone or in combination with one another. This will be used later during the FS process to screen technologies and assemble alternatives. Identifying potential technologies at this stage will help ensure that data needed to evaluate them can be collected as early as possible. Early identification of technologies will also determine whether treatability studies are needed.

The general response actions are (1) no action, (2) institutional actions, (3) source containment, and (4) removal/treatment technologies. The "no-action" response required by CERCLA serves as a baseline comparison against which the other actions can be measured. The potential principal contaminants of interest affecting the specified media are primarily VOCs (see Chap. 3). As additional information becomes available, the list of contaminants may be revised.

6. SITE DATA NEEDS

As described in previous sections, there have been numerous earlier investigations and monitoring activities conducted in and around the CRSP. Despite the resulting body of knowledge, additional site characterization data are needed to perform the HHRA, the ERA, and the FS and to prepare the ROD describing the most appropriate remedial action, if any.

The overall sampling strategy is based on the following five premises.

1. Source characterization will be achieved using existing waste inventories, as-built drawings, and professional judgment regarding contaminant concentrations and exposure levels.

2. Existing groundwater quality data are generally adequate to define the extent of groundwater contamination at the site for VOCs, metals, and radionuclides. Additional samples will be collected for analysis of all TCL organics (plus TAL metals and radionuclides) to confirm the presence or absence of these analytes. In addition, a study (dye tracer study, spring/seep survey, and/or spring/seep sampling) will be performed to identify and investigate/characterize the potential for exposure to contaminated groundwater discharged off-site.

3. There are no existing data on surface and subsurface soil contaminant levels other than the soil-gas survey results. These data will be collected using a Geoprobe. If the full extent of soil contamination is not characterized by direct measurements, the data base should be adequate to apply predictive models to simulate the possible extent of contamination and potential exposure levels.

4. The site is located in an upland area. Therefore, migration of contaminants is likely from gravity drainage of leachate, and discharge of contaminants into adjacent areas is possible. There is minimal habitat value associated with the site in its current condition. There are wooded areas on either side of the CRSP that provide habitat for indigenous flora and fauna; however, at this time there are no indications that the wooded areas have been impacted by CRSP operation. Various biological tests and/or chemical analyses are proposed if the results of surface soil sampling suggest that shallow soils in the wooded areas are contaminated. Similarly, if the dye tracer study and spring/seep sampling show that contaminants are present at these locations, then aquatic toxicity testing will be performed to assess potential ecological impacts.

5. The presence of VOCs at the site as indicated by previous groundwater analyses suggests a potential for the presence of air contamination as well. The presence of the multilayered engineered cap should mitigate surface release of VOCs. Contaminant concentrations for the air pathway will be determined based on modeling results; quantitative sampling will not be conducted. If spring/seep samples are found to be contaminated, exposures from volatilization of contaminants will also be estimated or modeled.

Subsequent sections will describe the detailed approach for data collection for each of the media/pathways/receptors of concern at the CRSP.

6.1 PHYSICAL/CHEMICAL CHARACTERIZATION

Some of the physical characteristics of the CRSP have been well defined; surface and geological characteristics were presented and discussed in Sect. 3.4. Previous investigations associated with RCRA compliance activities conducted by Y-12 Plant personnel have generated chemical data that will be used in this RI. To fill data gaps and supplement and confirm existing data, additional site characterization data are needed in the following areas: site hydrogeology, groundwater quality, surface and subsurface soil contamination, and ecological characterization. The site investigation will specifically include:

- collecting groundwater samples for chemical analyses (from four existing monitoring wells surrounding the CRSP and one existing monitoring well from a background location in the same geologic group) twice during the investigation as representative of wet and dry weather periods,
- screening for subsurface soil VOC contamination using an HNu or organic vapor analyzer (OVA),
- collecting soil samples using the Geoprobe for chemical analyses from 0 to 5 ft and 20 to 25 ft; if contaminants are present at 20 to 25 ft, then the sample will be collected from 30 to 35 ft,
- collecting surface soil samples (0 to 12 in.) from the wooded area adjacent to the site,
- conducting wetlands and endangered species habitat surveys,
- collecting surface soil samples for chemical and grain size analyses,
- conducting a spring and seep survey to identify potential monitoring locations for design of the dye tracer study,
- designing and conducting a dye tracer study to elucidate the hydrology of Chestnut Ridge,
- collecting spring/seep and sediment samples from locations identified by the dye tracer study as hydrologically associated with the CRSP,
- collecting earthworm samples for chemical analyses if areas of surface soil contamination are found adjacent to the pits,
- conducting plant and earthworm toxicity testing if areas of surface soil contamination are found adjacent to the pits, and
- conducting aquatic toxicity testing with daphnids and fathead minnow larvae at spring and/or seep locations if contaminants are found there.

The groundwater characterization data will be used to establish COCs for the groundwater pathway. The soil characterization data will be used to identify COCs in on-site (near-site) soils and to provide information on the nature and extent of soil contamination. The spring and seep survey/sampling and the dye tracer study will be used to estimate groundwater flow characteristics and to determine whether contaminated groundwater is discharging to surface waters or at ground surface within the watershed. The biological/ecological data will specifically be used to evaluate aquatic and terrestrial risk pathways for biota and man. Existing data on the volume and types of waste in the pits

available in the waste inventory will be used for source characterization; the cap on the pits will not be sampled or breached in any way during this investigation. All these data are needed to determine exposure points and pathways for the ERA and HHRA and to establish locations and extent of contamination for the development of remedial alternatives in the FS; the data will also be used to evaluate potential treatment/process alternatives.

Background soil samples will not be collected. Results from the ORR-wide background soil study will be used in lieu of sampling. The scope of collection of background spring/seep data cannot be fully evaluated at this time. If warranted, these data will be collected. All locations where samples are collected will be surveyed for horizontal and vertical control and referenced to the Y-12 Plant grid system and state planar coordinates.

6.2 SAMPLING AND ANALYTICAL REQUIREMENTS

Proposed groundwater sampling locations for the CRSP RI are shown in Fig. 6.1. Proposed surface and subsurface soil sampling locations are shown in Fig. 6.2. The primary COCs for all matrices are VOCs; secondary COCs include metals and radionuclides.

Although SVOCs and the other TCL organics are not considered COCs at this site, they will be included in the list of analytes for all media to provide definitive data concerning the presence or absence of these parameters. Radionuclides will be evaluated by analysis of gross alpha, gross beta, isotopic thorium and uranium, and gamma spectroscopy. These parameters were selected based on review of the disposal inventory and previous data collected at the site. Gross alpha and gross beta analyses will be performed on all aqueous samples; isotopic thorium and uranium analyses and gamma spectroscopy will be performed on all aqueous and soil/sediment samples.

All groundwater and surface water samples will be analyzed for total and dissolved TAL metals; total TAL metals analyses will only be performed on soil/sediment samples. Additional parameters have been included in the list of analytes for groundwater samples (on a limited basis) to provide data for analysis of treatment technologies and alternatives. These parameters include total organic carbon (TOC), total dissolved solids (TDS), total suspended solids (TSS), and alkalinity. This list will be referred to as the water quality parameters (WQPs) list. A limited number of subsurface soil samples will be analyzed for TOC, moisture content, and grain size and also to provide data needed for analysis of treatment technologies/alternatives. If earthworm samples are collected for chemical analysis, the list of parameters will be selected based on the results of analyses of soil samples and information in the literature concerning parameters known to bioaccumulate in this species.

Table 6.1 summarizes the maximum number of samples to be collected and the analytical requirements, excluding the QC samples. The QAPjP discusses in detail the number and type of QC samples.

6.2.1 Groundwater Sampling

Two rounds of groundwater sampling will be conducted, one following the dry season and one following the wet season. The purposes of conducting two sampling rounds are to determine whether there is seasonal variation in groundwater quality and to clarify the hydrology in the vicinity of the CRSP. Section 3.6 provides additional information on the

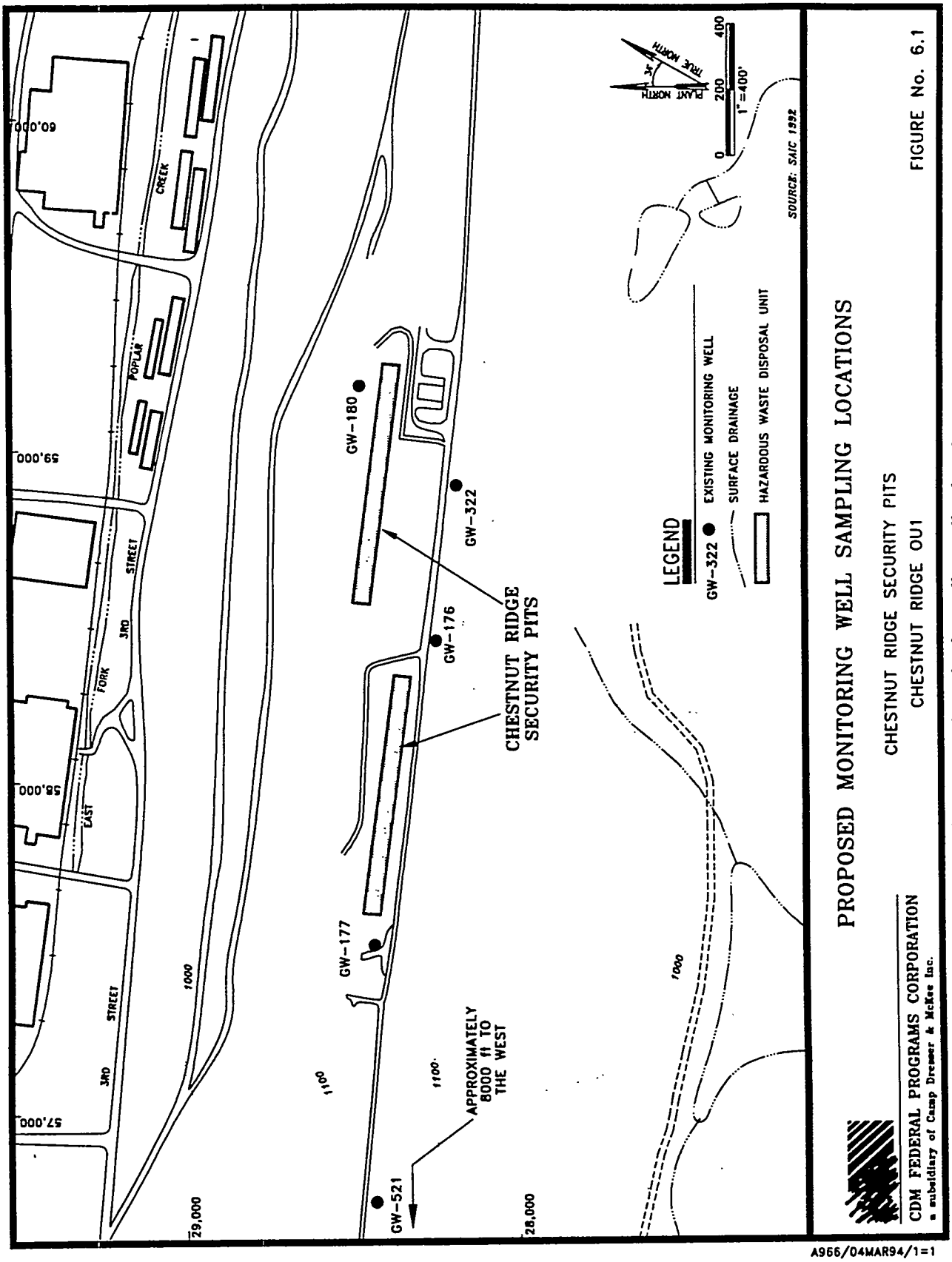


Fig. 6.1. Proposed monitoring well sampling locations.

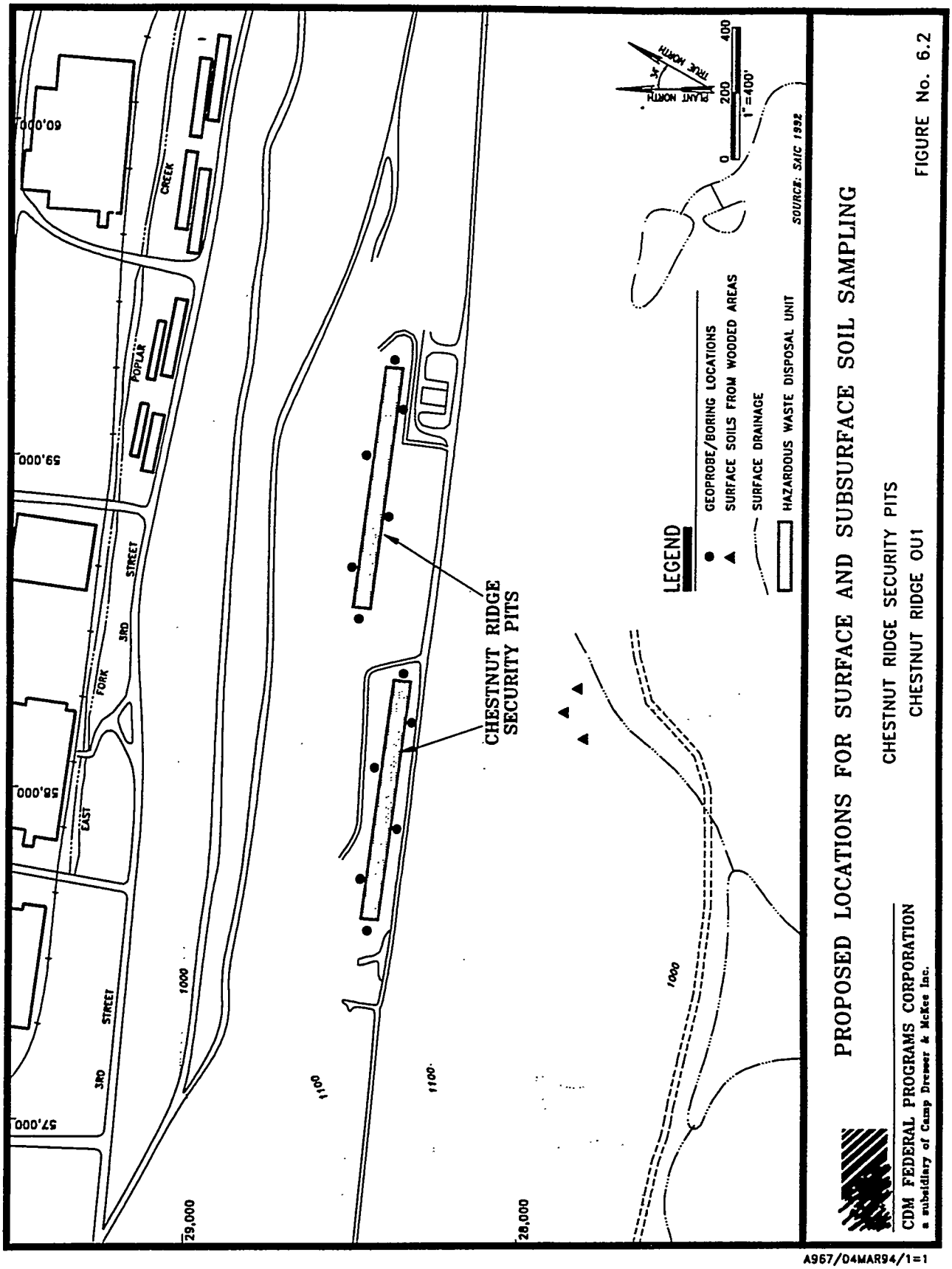


Fig. 6.2. Proposed locations for surface and subsurface soil sampling.

Table 6.1. Summary of sample numbers, media, and parameters for chemical analysis

Media	TAL metals		Gross alpha-beta	Isotopic uranium	Isotopic thorium	Gamma spectroscopy	TCL (organics)	Dissolved oxygen, pH, temperature, conductivity	Water quality parameters[a]
	Total	Dissolved							
Groundwater[b]	10	10	10	10	10	10	10	10	3
Surface soils[c]	15	NA	NA	15	15	15	15	NA	NA
Surface water/sediment	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	NA
Tissue (worms)	TBD	NA	NA	TBD	TBD	TBD	TBD	NA	NA
Subsurface soils[c,d]	12	NA	NA	12	12	12	12	NA	NA

NA = Not applicable
TAL = Target Analyte List
TBD = To be determined; the number of tests or analyses to be performed is unknown at this time.
TCL = Target Compound List (Includes VOCs, semivolatile organic compounds, pesticides, and polychlorinated biphenyls)
VOC = Volatile organic compound
[a]Total organic carbon, total suspended solids, total dissolved solids, and alkalinity.
[b]Two rounds of sampling.
[c]Maximum sample numbers to be sent to the laboratory.
[d]Three samples will be analyzed for TOC, grain size, and moisture content.

existing monitoring wells; Appendix A summarizes results of analyses from previous sampling rounds.

Five monitoring wells will be sampled; four wells are immediately adjacent to the CRSP (GW-176, -177, -180, and -322), and one well (GW-521) will be used for background data. Monitoring well GW-521 was chosen for background control because there is an extensive data base of analytical results from this well that has been statistically analyzed to establish parameter concentrations at unimpacted levels. GW-521 is located ~7000 to 8000 ft west of the CRSP.

Monitoring wells GW-176, -177, -180, and -322 were selected for their proximity to the CRSP and spatial coverage of the study area. They were also included to provide conclusive information on the presence or absence of the other TCL organics not routinely measured at the site. Two of the wells (GW-180 and -322) are no longer being sampled under the groundwater assessment/monitoring program because they are within the contaminant plume and, therefore, are unsuitable for point-of-compliance monitoring.

All groundwater samples will be analyzed for total and dissolved TAL metals, gross alpha and gross beta, isotopic uranium and thorium, gamma spectroscopy, and TCL organics. Samples for dissolved metals will be filtered at the time of collection using a 0.45-μm in-line filter or equivalent. Samples will be collected from three wells (GW-176, -177, and -180) for analysis of the WQPs list. These wells were selected based on spatial coverage of the site. All wells will be purged and sampled using a bladder pump operated at a low flow rate to minimize groundwater turbidity and maximize analytical accuracy. Puls and Powell (1992) discuss the advantages of this approach to monitoring well sampling. Groundwater samples will be subject to field measurements of dissolved oxygen, specific conductance, pH, and temperature. An inflatable packer may be used in conjunction with the bladder pump to facilitate sampling. The packer will be placed just above the top of the screened interval, thereby minimizing the volume required to purge the monitoring wells and the waste water generated by purging. The packer will be constructed of chemically inert material (e.g., Viton).

6.2.2 Dye Tracer Study

Due to the karstic hydrologic system underlying the CRSP, it is difficult to determine the direction(s) of groundwater flow and, therefore, to determine exposure points for risk analysis. Dye tracer studies provide a mechanism for determining flow paths in karstic systems. Two dye tracer studies have been conducted within the Chestnut Ridge hydrologic regime and are described in Sect. 3.6. The results of these two studies were inconclusive; therefore, a third study will be designed and performed in conjunction with this investigation. Development of the design of the dye tracer study is included in the tasks to be performed. The two previous studies will be reviewed and scrutinized, and the spring and seep survey will be conducted before the study design becomes definite. Study parameters to be determined include the dye to be used, monitoring locations, frequency and duration of monitoring, and dye injection points. During design of the dye tracer study, a meeting will be convened with the regulators to review the approach. An addendum to the work plan and QAPjP will be prepared once the final details of the dye tracer study and sampling program have been defined. The study will be conducted under wet season conditions.

6.2.3 Spring/Seep Surface Water/Sediment Sampling

The CRSP site is an upland area and not directly connected to surface waters. However, based on the hydrogeological characteristics of the site, there may be nearby locations where groundwater discharges as a spring or seep and becomes surface water. A spring and seep survey will be conducted within the Chestnut Ridge hydrologic regime to identify locations for monitoring during the proposed dye tracer study. Following the dye tracer study, springs and seeps believed to be hydrologically associated with the CRSP will be subject to sampling. A surface water and sediment sample will be collected from each location. Surface water samples will be analyzed for the same list of parameters as the groundwater samples (listed above). The sediment samples will be analyzed for the same list, except that dissolved metals, gross alpha, and gross beta will not be measured. Surface water samples will be subject to field measurement of dissolved oxygen, specific conductance, pH, and temperature, if possible.

At this time there is no way to accurately project the number of spring and seep surface water and sediment samples to be collected; therefore, Table 6.1 shows these numbers as to be determined (TBD). Results of the dye tracer study and selection of spring/seep sampling locations will be discussed with the regulators before initiation of the spring/seep sampling campaign. This information will also be described in the work plan addendum.

6.2.4 Surface and Subsurface Soil Sampling

Surface and subsurface soil sampling adjacent to the CRSP will be conducted at 12 locations that surround the site (Fig. 6.2). There are no existing surface or subsurface soil data for the CRSP. The borings for soil sample collection will be located as close to the cap as possible. Boring locations have been distributed around the pits on all sides. There are numerous obstructions and other constraining site features that must be accommodated in the field. The precise locations of the borings will be determined in the field. Also, due to overhead destruction, it is probable that a Geoprobe will be used for sample collection.

6.2.4.1 Surface soil sampling

A total of 15 surface soil samples will be collected, 12 of which will be collected from boring locations around the CRSP using a Geoprobe soil sampling device. These 12 samples will be composited from the 0- to 5-ft horizon, except for samples for VOC analysis, which will be grab samples collected at 5 ft below grade. These surface soil samples will be analyzed for TAL metals, TCL organics, isotopic uranium and thorium, gamma spectroscopy, and particle size and used to characterize the risk from direct contact (ingestion and inhalation of dust) with surface soils under the no-action scenario.

The remaining three surface soil samples will be collected from one of the wooded areas adjacent to the CRSP. These samples are needed to determine whether contaminants are present in these areas and whether biological testing should be performed. The locations of these samples will be determined based on a field reconnaissance to specifically look for leachate or signs of vegetative stress. These samples will be collected from the 0 to 12 in. horizon and analyzed for the same parameters as the samples collected adjacent to the CRSP.

6.2.4.2 Subsurface soil sampling

The 12 boring locations adjacent to the CRSP will also be used to collect subsurface soil samples using the Geoprobe device. At each of the 12 locations, a sample will be composited from the 20- to 25-ft horizon and screened on-site using an HNu or OVA. If this screening activity indicates the presence of VOCs, the boring will be extended to the 30 to 35 ft horizon and the terminal sample will be composited from this horizon. If VOCs are not indicated, then the sample will be collected from the 20- to 25-ft horizon. In either case, the sample for VOC analysis will be collected as a grab sample from the 25- or 35-ft depth, as appropriate. The 25-ft bls depth addresses a zone adjacent to the pits where a future homesteader might excavate to construct a basement or other potential construction activities could occur.

The sample (25 or 35 ft) from each borehole will be sent to the laboratory for Contract Laboratory Program (CLP) analysis. For practical purposes, the 35-ft depth is considered the maximum depth for collection of samples via Geoprobe at this site. The data collected from the 0- to 5- and 20- to 25- or 30- to 35-ft horizon should be adequate to provide data that can be used for exposure modeling to greater depths.

All subsurface soils sent to the laboratory will be analyzed for TAL metals, TCL organics, isotopic uranium and thorium, and gamma spectroscopy. In addition, samples will be collected from the 25-ft depth from three locations for analysis of TOC, grain size, and moisture content to support exposure modeling and treatment technology screening in the FS.

6.2.5 Air Sampling

Quantitative air sampling is not required to evaluate the no-action alternative. Modeling will be used to estimate VOC exposure levels based on surface soil concentrations. The dust inhalation pathway will be evaluated using surface soil contaminant levels and soil particle size data.

6.2.6 Ecological Surveys

Because the CRSP constitute an upland site, there are no wetlands on-site; therefore, a wetland survey is not required. If, however, specific springs and seeps are found to be hydrologically associated with the site, wetland surveys of these areas will be performed as appropriate. An endangered species habitat survey will be conducted in the wooded areas adjacent to the CRSP. These areas could be impacted during site remediation. Similarly, endangered species habitat surveys will be performed at spring/seep locations hydrologically associated with the CRSP.

6.2.7 Biological Sampling

As discussed in Sect. 3.9.2, plant (lettuce seedlings) and earthworm testing/contaminant analyses are included as contingencies for use if contaminants are found at significant concentrations in surface soil samples collected in the wooded areas adjacent to the CRSP. The need for and the numbers and locations of these test and analyses to be performed will be determined following receipt of the analytical results from the laboratory and data validation of surface soil samples.

Similarly, aquatic toxicity tests using fathead minnow larvae and *Ceriodaphnia dubia* will be performed at selected spring/seep locations where contaminants are present. Testing locations will be selected based on review of validated data from the spring/seep sampling campaign.

The biological sampling program described herein is essentially a Phase II investigation that will be fully determined following receipt of validated data on surface soils and spring/seep samples. The regulators will be involved in the data review process and contribute to the decision of the numbers and locations of tests/analyses to be performed. The details of the investigation will be included in the work plan addendum.

6.3 DATA EVALUATION AND INTERPRETATION

Data collected during this RI will be used to evaluate the nature and extent of contamination at the CRSP, support an HHRA and ERA, and evaluate the remedial alternatives for the FS. An RI report will be prepared that discusses the OU (i.e., site history, geology, hydrology, etc.); the work conducted during the investigation; an interpretation of the data; conclusions; and, as appropriate, recommendations. The report will follow the format specified by Energy Systems and will be subject to review by Energy Systems, DOE, and regulatory agencies (i.e., EPA and TDEC).

To accomplish the objectives of the RI, the data will be assessed and interpreted in a variety of ways. Before any interpretation or assessment is made, all analytical data from the contract laboratory will be verified and validated. Data will meet appropriate precision, accuracy, representativeness, comparability, and completeness (PARCC) parameters. The QAPjP (Chap. 7) discusses data assessment and validation parameters applicable to this RI.

All sampling locations will be surveyed and clearly shown on a base map of OU 1. Water level data will be presented in tabular form and also plotted on a map to evaluate any patterns in hydrostatic head for the groundwater. Cross sections may be prepared to depict the water table and/or potentiometric surface. Similarly, validated laboratory data from the monitoring wells will be tabulated. Contaminant concentrations and contours also may be prepared on maps, as appropriate, to depict relevant trends. If the data suggest vertical variation in contaminant levels, cross sections may also be prepared. Validated surface water and sediment data will be presented in tabular format and, if appropriate, plotted on a map. Validated surface and subsurface soil data will be presented in a similar manner. As previously discussed, the results of surface soil and spring/seep sampling will be reviewed and evaluated to define the numbers and locations of biological tests/analyses to be performed.

Analytical data obtained from the RI will also be compared to existing data from OU 1. Every attempt will be made to determine the statistical significance and associated confidence represented by the entire body of data. Because the observational method/approach was used in design of the sampling program, nonrandom, nonparametric statistical tests, such as the Mann-Whitney U-Test, will be used to compare site data to background data.

The HHRA and ERA will use the data described above as well as data from the ecological/biological studies. The baseline ERA will follow the standard paradigm for an ERA, as described in Chap. 3. The baseline HHRA will be conducted following established EPA

guidelines. In addition, recommendations from the ER Risk Assessment Council and other supporting documentation will be followed.

6.4 RISK ASSESSMENT METHODOLOGY

6.4.1 Baseline Human Health Risk Assessment

The scope of this RI Work Plan entails using the data collected in the RI to evaluate the potential risk to human health from exposure to the potentially contaminated media related to the CRSP; refer to the conceptual site model for human health risk assessment in Fig. 3.12 of Sect. 3.9.1. The objective will be accomplished by evaluating on source-OU and off source-OU human exposure to media using a residential scenario BRA.

Source OUs are defined as on-site (property owned/managed by DOE-ORO) waste areas that are currently releasing or have the potential to release contaminants into the environment. For final action RODs, the future land use scenario will be used; this land use (i.e., industrial or residential) will be agreed upon by the regulators. The BRA, under the current default parameters, describes a future residential land use.

The methodology employed to conduct the BRA will follow guidelines established in the *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)* (EPA 1989). In addition, recommendations from the Risk Assessment Council and other supporting documentation, including the results from the Background Soil Characterization Project (BSCP) for the ORR, will be followed. A method will be used that includes upper (acute exposure) and lower (RME assessment) bounds to evaluate the risk posed to human health via direct exposure to all COPC in the CRSP (i.e., those reported in the inventory list).

6.4.2 Ecological Risk Assessment Methodology

A baseline ERA will be performed for the CRSP because of possible soil contamination and because the site is a potential source of contaminants for EFPC, McCoy Branch, and the sludge disposal ponds. Risk assessments for the CRSP will serve to characterize the pits' contribution to these other sites.

An ERA for waste sites differs from an HHRA in that the consequences of the risks can be measured. Biological surveys provide a direct measure of the state of the biotic communities that constitute the ecological assessment endpoints. Hence, ecological epidemiology will be employed (Suter 1990, Suter 1992, Suter and Loar 1992). In ecological epidemiology, the primary data are the field survey data that indicate the actual state of the system relative to the expected uncontaminated state. Other data are used to support inferences concerning the causes of any deviations from this expected state. This approach is consistent with the *Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual* (EPA 1989b).

The goals of the baseline risk assessment will be to determine (1) whether significant ecological effects are occurring in the OU, (2) the cause of any such effects, (3) the source of the causal agent, and (4) the consequences of leaving the system unremediated. These goals call for an epidemiological approach based on the weight of evidence. New and historical biological survey data will be compared to data from reference sites to determine

the nature and magnitude of effects. Alternative causal factors such as habitat quality will be considered.

A phased approach will be applied to the ERA for the CRSP. In the initial phase, potential routes of exposure of the biotic community by contaminants will be identified. These routes are outlined in the baseline conceptual model (Sect. 3.9.2). Contaminant levels and contaminant transport routes in abiotic substrates will be quantified and identified in the second phase (Sects. 3.4, 3.5, and 3.6). In the final phase, actual exposure of the biota to contaminants will be determined and toxicity testing performed if appropriate (Sect. 3.9.2.2).

6.5 FEASIBILITY STUDY

The following sections describe the tasks necessary to conduct and produce the FS report. The report will follow the format outlined in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988) and the annotated outline developed by the DOE-ORO Document Content and Response Committee. The FS report will be prepared to integrate Natural Resource Damage Assessment (NRDA) and NEPA requirements. When EPA and TDEC approve the FS, a proposed plan will be submitted that presents the preferred alternative for a remedial action, followed by a ROD.

6.5.1 FS Contractor Responsibilities

The FS contractor will prepare the FS within project quality, cost, and scheduling goals. The FS contractor will also provide engineering and technical resources to support QC efforts, provide project management, and coordinate project activities to ensure that established goals are achieved. Monthly progress reports on the FS process will be issued to DOE. FS contractor activities for Chestnut Ridge OU 1 include scoping activities and technical support of the RI and will be completed upon final approval of the ROD prepared for this OU.

6.5.2 Scope and Assumptions

As stated in Sect. 5.2, the general goal for Chestnut Ridge OU 1 remedial action is to protect human health and the environment from the contaminant sources within the OU. To meet this goal, the CERCLA process will be followed. The process will include characterization of this source control OU to the extent necessary to (1) identify, screen, and develop remedial action alternatives; (2) select a preferred remedial alterative or a set of alternatives; and (3) prepare the required decision documents.

The FS contractor will be responsible for completing the FS process for Chestnut Ridge OU 1. This process will require preparing the following milestone documents: (1) the FS report, which documents the process used to examine the remedial technologies and select the preferred remedial alternative(s) and which incorporates the requirements under NRDA and NEPA; (2) the Proposed Plan, which is a summary plan for presenting the selected remedial alternative; and (3) the ROD, which is the legal document that confirms that selected remediation methods met statutory and regulatory requirements. The FS/Proposed Plan/ROD process may include the principal Work Breakdown Structure elements listed below.

- FS scoping activities,
- NRDA activities,
- treatability studies,
- FS OU coordination/oversight,
- FS development,
- proposed plan development,
- NEPA activities, and
- ROD development.

6.5.2.1 FS scoping activities

Preliminary remedial alternatives have been selected to address the response actions for Chestnut Ridge OU 1. The response actions are listed in Sect. 5.3 and in Table 5.1. These or similar alternatives will be screened as part of the FS process to eliminate those judged too difficult to implement based on unproven technologies, those judged insufficient to remediate the site within a reasonable time period, or those judged to have limited application for the specific contaminant or site conditions. Those technologies judged to have a reasonable chance of success for remediation will be carried forward for more detailed development and analysis.

The following issues must be addressed before the technologies can undergo detailed development and analysis. This list may change as additional information becomes available.

- results of the HHRA,
- quality of any affected surface water or sediment,
- results of ERA,
- presence of classified material,
- groundwater characteristics,
- possible treatability studies,
- groundwater quality,
- surface and subsurface soil quality,
- air quality, and
- level of NEPA documentation required.

6.5.2.2 Treatability studies

If necessary, treatability studies will be conducted to provide data to allow treatment alternatives to be fully developed and evaluated during the detailed analysis and to support the remedial design of a selected alternative.

6.5.2.3 FS development

The FS contractor will use the format presented in the CERCLA RI/FS guidance document and the DOE-ORO Document Content and Response Committee FS annotated outline to develop the FS. As required, exceptions and modifications to the format will be made for site-specific conditions at Chestnut Ridge OU 1. Based on the data obtained during the RI, selected alternatives will be analyzed and compared using the following 11 criteria:

- overall protection of human health and the environment;
- compliance with ARARs;
- short-term effectiveness;
- long-term effectiveness;
- reduction of contaminant toxicity, mobility, and volume;
- implementability;
- cost;
- state acceptance;
- community acceptance;
- compliance with NEPA requirements; and
- compliance with NRDA requirements.

NEPA and NRDA requirements are discussed in more detail in the following subsections.

The FS will be developed in sufficient detail to allow the preferred alternative(s) to be selected in the Proposed Plan. Criteria will be developed to assess the ability of the alternatives to meet the cleanup goals and to comply with administrative and regulatory requirements. The draft FS report will be issued to EPA and TDEC for review. Submittal of the draft FS report to EPA is an FFA milestone.

6.5.2.4 NEPA activities

To comply with the federal facility requirements under NEPA, the remedial alternatives will be evaluated for their impact on the environment. NEPA establishes public policies and goals for protecting environmental quality and mandates procedural requirements to be considered when implementing decisions that may impact the environment. DOE Order 5400.4 requires that NEPA and CERCLA be integrated to the maximum extent possible to avoid duplication of efforts that might slow the process. NEPA issues to be addressed include rare and endangered species, archeological studies, wetlands, and floodplains. The environmental impacts of the alternatives will be integral to the evaluation and selection process.

6.5.2.5 NRDA activities

To comply with NRDA, the Natural Resource Trustees may assess damages or injuries to natural resources resulting from the release of hazardous substances. The first step in the NRDA process is to perform a preassessment screen. If the screening indicates that NRDA is inappropriate, no further assessment actions will be taken. However, if the preassessment screen indicates that NRDA is appropriate, a type B assessment will begin, requiring an Injury Determination phase, a Quantification phase, and a Damage Determination phase (April 29, 1991, *Federal Register*).

6.5.2.6 FS OU coordination/oversight

The objective of FS oversight activities is to provide review and technical input during the FS. The results ensure that the data and information obtained during the RI are incorporated properly into the FS report and that they are adequate for preparation of a Proposed Plan and support of development of the ROD.

6.5.2.7 Proposed Plan development

The preferred alternatives for a site are presented to the public in a Proposed Plan. The Proposed Plan provides a brief summary of all the alternatives studied in the detailed analysis phase of the RI/FS, highlighting the key factors that led to the identification of the preferred alternative(s). The Proposed Plan is made available for public comment, in addition to the RI/FS and the other information, in the Administrative Record.

6.5.2.8 ROD development

The final step in the decision process for any remedial action for Chestnut Ridge OU 1 will be preparation of the ROD. This legal document formally describes the preferred remediation alternative and establishes the remediation schedule and monitoring plan for the site. The Chestnut Ridge OU 1 ROD will be written in accordance with the statutory requirements of CERCLA and applicable federal and state requirements. It will contain a decision summary outlining the nature and extent of the contamination and associated risks at Chestnut Ridge OU 1, the evaluation and analysis of the Remedial Action (RA) alternatives considered, and an explanation of how the selected alternative(s) will meet statutory requirements. The ROD will also contain a responsiveness summary addressing the public comments obtained during public review of the Proposed Plan and public examination of the Administrative Record. The ROD is a primary FFA milestone.

6.6 REMEDIAL DESIGN AND RA PLAN

6.6.1 Remedial Design

This section presents the scope of the RD effort required to prepare an RD Work Plan; perform any required engineering studies; prepare a Title I 30% design package; and prepare Title II 50, 90, and 100% final design reports for Chestnut Ridge OU 1 remediation.

6.6.1.1 Scope and assumptions

The scope of the RD Work Plan for the remediation of Chestnut Ridge OU 1 is to provide necessary supporting documents for implementation of each RA activity. These documents require approval from TDEC and EPA. The following sections present details of the scope of work and assumptions associated with remediation of Chestnut Ridge OU 1.

6.6.1.2 RD Work Plan

The RD Work Plan will provide the technical and managemental approaches for the RD work. The RD contractor will prepare a draft RD Work Plan based on the scope and design criteria specified in the Proposed Plan and the ROD. The RD Work Plan will include the detailed design process and schedule for the design effort and will be prepared in accordance with CERCLA/NEPA regulations. The RD contractor will incorporate comments from EPA and TDEC and submit the final RD Work Plan for approval.

6.6.1.3 RD Work Plan oversight activities

During the preparation of the RD Work Plan, DOE will provide review and technical input to ensure that the scope of work is adequately defined in accordance with the criteria specified in the ROD. Review of the draft RD Work Plan will also ensure that the selected technologies do not violate the intent of the ROD and that the Work Plan meets all regulatory and administrative requirements.

6.6.1.4 RD report Title I design

Based on the engineering studies and other information available from the RI/FS, the RD contractor will prepare Title I (30%) design/construction drawings for remedial activities that will show the extent of remedial activities, site plan, details, and outline of specifications for the work involved.

6.6.1.5 RD report Title II design

Upon approval of the Title I design document, the RD contractor will prepare Title II engineering designs, analyses, and calculations required for all civil, structural, mechanical, and electrical construction; construction drawings; technical specifications; and cost estimates.

All documents will be submitted to Energy Systems for comment at 60% completion. Upon resolution of comments, the 90% design package will be submitted to Energy Systems and DOE for review and comment. Upon resolution of 90% of the comments, the final design report (100%) for remedial activities will be submitted to EPA and TDEC for review and approval. Agency comments will then be incorporated during preparation of the design documents certified for construction.

6.6.1.6 RD oversight activities

During the review of the Title I design documents at 30% and the Title II design documents at 60 and 90%, all participants will provide their review and technical input to ensure submission of the final design document to TDEC and EPA in the given time frame.

6.6.2 Remedial Action

This section presents the scope of the RA activities required for preparation of an RA Work Plan and implementation of the remediation of Chestnut Ridge OU 1. The risk, uncertainties, and communication issues for the remedial activities are also identified in this section.

6.6.2.1 Scope and assumptions

The scope of the RA includes the RA Work Plan, construction management, Title III construction services, construction of one remediation design package, construction support, independent certification, and verification.

6.6.2.2 RA Work Plan

The RA Work Plan will (1) define the scope and objectives of the RA based on the ROD and final RD; (2) document the specific construction components of the RA; and (3) present the RA schedule, subcontracting strategy, QA plan, health and safety plan, and RA monitoring plan.

After comments from EPA and TDEC are incorporated, the final RA Work Plan will be prepared for approval and implementation.

6.6.2.3 RA Work Plan oversight activities

The purpose of this activity is to provide technical input and review during the preparation of the RA Work Plan. During this time, all the DOE prime contractors will review the work plan. This will ensure that the proposed construction efforts implement the selected remedial action consistent with the ROD and the final RD report. This oversight activity will also ensure that the bid process and implementation plans comply with administrative and regulatory requirements.

6.6.2.4 RA integration

The objective of this element is to provide construction management, independent certification, Title III services, and construction support as required.

RA integration for Chestnut Ridge OU 1 remedial activities includes the following tasks:

- ensure that subcontracted work is performed on schedule, in accordance with all technical requirements and in compliance with the Environmental Safety and Health Program, the QA Program, the Waste Management Program, and the Security Program;
- perform field inspections, provide as-built drawings, approve Design Change Notices and Field Change Requests as applicable, and ensure that construction is accomplished according to final design requirements.

FIELD AND LABORATORY QUALITY ASSURANCE PROJECT PLAN

Project Title: REMEDIAL INVESTIGATION WORK PLAN FOR CHESTNUT RIDGE OPERABLE UNIT 1 (CHESTNUT RIDGE SECURITY PITS) AT THE OAK RIDGE Y-12 PLANT, OAK RIDGE, TENNESSEE

Prepared By: CDM Federal Programs Corporation

_____ Date:_____
Technical Support Contractor
Program Manager

Approved By: _____ Date:_____
Technical Support Contractor
Quality Assurance/Quality Control
Officer Concurrence

Approved By: _____ Date:_____
DOE-ER Division Site Program Manager

Approved By: _____ Date:_____
DOE-ER Division QA Program Manager

Approved By: _____ Date:_____
Energy Systems ER Site Program Manager

Approved By: _____ Date:_____
Energy Systems ER Site Project Manager

Approved By: _____ Date:_____
Energy Systems ER Site
Quality Assurance Specialist

7. FIELD AND LABORATORY QUALITY ASSURANCE PROJECT PLAN

7.1 INTRODUCTION

Work on this assignment will be performed in accordance with the Energy Systems *Environmental Restoration Quality Program Plan* (ES/ER/TM-4/R3) (Energy Systems 1993) and the CDM Federal *Quality Assurance Manual* (CDM 1993). This QAPjP has been prepared in accordance with EPA *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005/80) (EPA 1983); the EPA Region IV *Standard Operating Procedures and Quality Assurance Manual*, (EPA 1991); the *Environmental Restoration Quality Program Plan* (ES/ER/TM-4/R3) (Energy Systems 1993); and *Environmental Surveillance Procedures, Quality Control Program* (ES/ESH/INT-14). This QAPjP has been reviewed for QA/QC requirements by the CDM Federal QA staff, who will maintain QA oversight for the duration of this project. Energy Systems will also maintain oversight during this project to ensure compliance with all applicable QA requirements. In addition, all deliverables will be subject to technical review by CDM Federal technical specialists, and all deliverables presenting measurement data will also be reviewed by the CDM Federal QA staff. A description of the project can be found in Chaps. 1 through 3 of this RI Work Plan.

7.2 QUALITY ASSURANCE/PROJECT ORGANIZATION

The principal CDM Federal personnel assigned to prepare and review the Work Plan are Richard C. Johnson, P.E., P.G. (program manager); Mary Leslie (Y-12 Program Coordinator); Charles T. Lutz, Ph.D. (Project Manager); Charles Meyers (Health and Safety Manager); the Site Health and Safety Coordinator; the Field Task Manager; RoseMary Ellersick (Corporate QA Director); and David O. Johnson (Contract QA Specialist). Figure 7.1 shows the project organization, reporting relationships, and lines of authority for this project. General responsibilities of key individuals are discussed in this section. Other personnel will be assigned as necessary.

7.2.1 Program Manager Roles and Responsibilities

7.2.1.1 CDM Federal Program manager

The CDM Federal Program Manager, Richard C. Johnson, has responsibility for the successful preparation of this project plan and for ensuring that adequate resources are available as needed. He also has overall responsibility for implementing the CDM Federal QA Program and for ensuring that effective corrective action is taken to address quality problems should they occur.

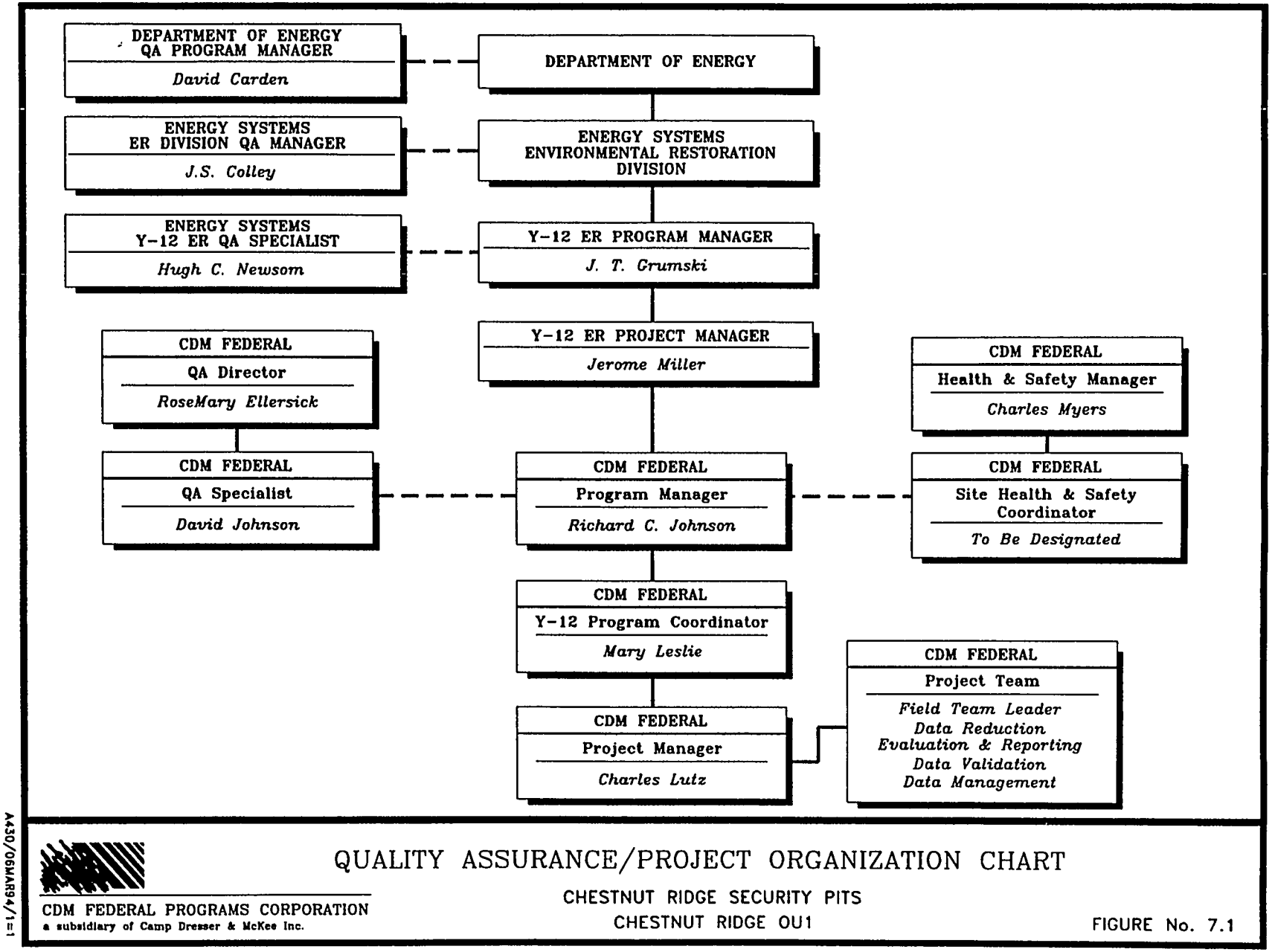


Fig. 7.1. Quality assurance/project organization chart.

7.2.1.2 CDM Federal Y-12 Program coordinator

The Y-12 Program Coordinator, Mary Leslie, is responsible for oversight and coordination of all active task orders with the Y-12 Plant ER Division. Ms. Leslie assists Project Managers in scoping meetings, preparing and reviewing documents, and resolving problems. The Program Coordinator performs an overview function that ensures consistency of approach among Y-12 Plant ER projects performed by CDM Federal and a mechanism for actively benefiting from lessons learned from projects. Ms. Leslie is also responsible for ensuring that adequate resources are available for Y-12 Plant projects and that task orders are completed on budget and schedule.

7.2.1.3 Energy Systems Y-12 ER Program manager

The Energy Systems Y-12 ER Program Manager, J. T. Grumski, is responsible for ensuring that the quality requirements of this project are met and that operating procedures are effectively implemented. He is also responsible for interfacing with and directing the activities of the assigned ER QA Specialist on all quality-related matters and for stopping work when the severity of conditions adverse to quality warrants such actions.

7.2.2 Project Manager Roles and Responsibilities

7.2.2.1 CDM Federal Project Manager

The Project Manager, Charles T. Lutz, will be the prime point of contact with Energy Systems and will have primary responsibility for technical, financial, and scheduling matters. His duties will include the following:

- implementing the CDM Federal QA program;
- preparing, reviewing, and approving all project documents;
- assigning duties to the project staff and orienting the staff to the needs and requirements of the project;
- obtaining the approval or guidance from Energy Systems for proposed major changes to the QAPjP and Field Sampling Plan;
- supervising the performance of project team members;
- evaluating training needs for the project staff;
- providing budget and schedule control;
- reviewing subcontractor work and approving subcontractor invoices;
- establishing a project record system;
- ensuring that major project deliverables are reviewed for technical accuracy and completeness before their release;
- ensuring that the requirements of the RI Work Plan are satisfied; and
- regularly communicating project status, progress, and any problems to the Energy Systems Project Manager.

7.2.2.2 Energy Systems Y-12 ER Project Manager

The Energy Systems ER Project Manager, Judy Hodgins, will be the prime point of contact between Energy Systems ER and CDM Federal and will have primary responsibility for technical, financial, and scheduling matters and coordinating with the various Energy Systems divisions and organizations participating in this project. Duties will include the following:

- implementing the Energy Systems ER Quality Program Plan (QPP) (Energy Systems 1993);
- preparing, reviewing, and approving all project documents generated by Energy Systems personnel;
- reviewing and approving all deliverables prepared by CDM Federal;
- assigning duties to the Energy Systems project staff and orienting the staff to the needs and requirements of the project;
- providing review and approvals or guidance for proposed changes to the QAPjP and Field Sampling Plan;
- supervising the performance of Energy Systems project team members;
- evaluating training for the Energy Systems project staff;
- providing overall budget tracking and schedule control;
- establishing a project record system that meets the ER QPP record requirements;
- ensuring that major project deliverables are reviewed for technical accuracy and completeness before their release to DOE and regulatory agencies;
- ensuring that all project requirements are satisfied;
- regularly communicating project status, progress, and any problems with Y-12 Plant ER management staff; and
- initiating stop-work actions when the severity of conditions adverse to quality warrants immediate action.

7.2.3 CDM Federal Health and Safety Roles and Responsibilities

7.2.3.1 CDM Federal Health and Safety Manager

CDM Federal Health and Safety Manager, Charles Myers, is responsible for all health and safety issues and will be available 24 h a day for consultation on such issues. His responsibilities include the following:

- ensuring that the corporate Health and Safety Manual is followed,
- reviewing health and safety plans,
- maintaining all health and safety records and files, and
- conducting safety training.

7.2.3.2 Site Health and Safety Coordinator

The Site Health and Safety Coordinator is responsible for implementation of the Health and Safety Plan at the site. The responsibilities are as follows:

- ensuring that the health and safety of personnel are maintained,
- conducting site safety training,
- conducting daily health and safety briefings,
- ensuring that all monitoring equipment is operating properly,
- reporting any health and safety issues to the Health and Safety Manager, and
- stopping work if safety issues arise.

7.2.4 Field Task Manager Roles and Responsibilities

The CDM Federal Field Task Manager will be responsible for execution of all field activities by CDM Federal personnel and will have authority to direct activities of subcontractors, including stopping work and/or taking appropriate emergency actions. The Field Task Manager's duties and responsibilities are as follows:

- reviewing and implementing the Field Sampling Plan and QAPjP;
- notifying the Project Manager and QA staff of problems encountered in the field and implementing corrective action;
- providing orientation and any necessary training to field personnel (including subcontractors) on the requirements of the RI Work Plan and the QAPjP before work begins;
- providing direction and supervision to CDM Federal and subcontract personnel to ensure that all on-site sampling and activities adhere to the QAPjP and the RI Work Plan;
- ensuring the use of calibrated measurement and test equipment;
- establishing and maintaining a field records management system;
- coordinating activities with the Project Manager;
- overseeing field data documentation;
- reviewing reports for compliance with applicable requirements; and
- assigning the duties of the Site Health and Safety Coordinator to a qualified on-site individual, if necessary.

7.2.5 Quality Assurance Management Roles and Responsibilities

The Corporate QA Director, RoseMary Ellersick, is responsible for ensuring and assessing the implementation of the CDM Federal QA program. The CDM Federal Corporate QA Director is independent of the technical staff and reports to the CDM Federal Office of the President. The Corporate QA Director thus has the authority to review and identify problems and to bring corporate resources to bear in solving problems, if necessary.

The Corporate QA Director is assisted by the Contract QA Specialist and other QA staff, who report directly to the Corporate QA Director on quality matters.

7.2.5.1 CDM Federal Corporate QA Director

The CDM Federal Corporate QA Director, RoseMary Ellersick, is responsible for the following:

- actively identifying and responding to QA/QC needs, resolving problems, and answering requests for guidance or assistance;
- preparing and submitting QA/QC reports to CDM Federal senior management;
- conducting an annual trend analysis to identify potential problem areas;
- verifying that appropriate corrective actions are taken for all nonconformances; and
- scheduling, on a quarterly basis, appropriate QA audits or surveillances for significant activities to ensure compliance with requirements and procedures.

7.2.5.2 CDM Federal Contract QA Specialist

The CDM Federal Contract QA Specialist, David Johnson, is responsible for the following:

- reviewing and approving the Field Sampling Plan and QAPjP and all subsequent changes to these documents,
- actively tracking the progress of QA requirements in this plan and consulting periodically with the Project Manager,
- arranging or conducting training of project personnel,
- preparing a monthly QA status report for submittal to the Corporate QA Director,
- arranging or performing audits or surveillances, and
- participating in field planning sessions for field activities.

7.2.5.3 Energy Systems ER QA Manager

The ER Division QA Manager, James Colley, is responsible for directing and verifying the implementation of the ER Quality Program. Specific responsibilities are given in the ER QPP (ES/ER/TM-4/R3), Sect. 1.5.3. (Energy Systems 1993)

7.2.5.4 Energy Systems Y-12 ER QA Specialist

The ER QA Specialists, Hugh Newson and Don White, are responsible for supporting the development and implementation of the ER Quality Program. Specific responsibilities are given in the ER QPP, Sect. 1.5.4. (Energy Systems 1993)

7.2.5.5 DOE QA Program manager

The DOE QA Program Manager, David Carden, is responsible for oversight of QA Program implementation, including:

- reviewing and approving QAPjPs;
- reviewing summary reports;
- performing audits, surveillances, and appraisals;
- following up on corrective action; and
- informing the DOE program manager of QA Program status.

7.2.6 Technical Review Committee

The Technical Review Committee (TRC) is a forum for peer review that is composed of individuals with fields of expertise appropriate to the project. The TRC for this project includes Robert Kasper, Fletcher Armstrong, and James Wedekind. The TRC has reviewed the entire RI Work Plan (including this QAPjP) and will review future major deliverables. Compliance with internal TRC requirements is checked in audits or surveillances.

7.3 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

7.3.1 Data Quality Objectives

DQOs for measurement data are qualitative and quantitative statements developed by data users to specify the quality of data from field and laboratory data collection activities to support specific decisions or regulatory actions. DQOs describe what data are needed, why the data are needed, and how the data will be used to address the problem being investigated. DQOs also establish numeric limits for the data to allow the data user (or reviewers) to determine whether data collected are of sufficient quality for use in their intended application. Some of the tests to be performed in support of the ERA and ecological characterization of the site do not have applicable QC levels for measurement data (e.g., toxicity testing and the various surveys to be performed). Although QC levels do not apply, DQOs do. For toxicity testing, DQOs are frequently defined by the method in terms of percent survival in the control samples and percent error among replicates. For field surveys, DQOs are tangible in terms of the time of year of the survey, the minimum number of species encountered, the expertise level of the surveyor, and so on. Although more subjective, these DQOs are real and in many cases, such as toxicity testing, are formalized in the standard operating procedures (SOPs).

7.3.2 Intended Uses of Acquired Data

The intended uses of the acquired data are to

- characterize the nature and extent of contamination in soil and groundwater at the CRSP;
- characterize the hydrologic system at the site based on results of a dye tracer study;

- characterize the nature of contaminated media (the source) at the site to drive the alternatives assessment and FS;
- characterize soil, surface water, and sediment contaminant concentrations to determine whether human and environmental receptors are at risk from exposure to contaminants; and
- characterize the ecological communities at the site and perform tests and collect data on the levels of contaminants in flora and fauna to support an ERA.

Data objectives to accomplish this are as follows.

- Scientific data generated will be of sufficient quality to withstand technical and scientific scrutiny. QC Levels C and D are designated for analytical data.
- Data will be gathered or developed in accordance with procedures appropriate for their intended use. All field and laboratory methods/procedures specified for this project comply with or exceed the EPA requirement for CERCLA investigations.
- Data will be of known PARCC within the limits of the project. Specific criteria for PARCC parameters have been established, as appropriate, and are presented in Sect. 7.3.5.

7.3.3 Intended Users of Data

The primary users of data acquired during this investigation will be the following:

- the Field Task Manager, who will use field data for well purging, sample location selection, and health and safety monitoring;
- the Project Team, which will use the data to determine the nature, extent, transport, and fate of contaminants and present these results in an RI Report;
- the risk assessor(s), who will use the data to complete the risk assessment data base and to conduct an HHRA and an ERA;
- the engineers/scientists, who are involved in development of alternatives and conducting the FS; and
- the state of Tennessee and EPA, who will use the data to review and compare with the risk assessment data base.

7.3.4 Levels of Quality Control

Five general levels of analytical options to support data collection are specified by the EPA as QC levels (Levels I, II, III, IV, and V). Energy Systems has defined QC Levels in Chap. 3 of *Requirements for Quality Control of Analytical Data* (Energy Systems 1990b) as Levels A, B, C, D, and E; these are generally analogous to the EPA levels. These levels are based on the type of site to be investigated, the level of accuracy and precision required, and the intended use of the data.

Level A QC is designated for field screening. The objective of Level A analysis is to generate data that are generally used to refine sampling plans and monitor health and safety. Level A is also used for screening samples that will be subject to further analysis. No data

quality criteria are specified for Level A, because this level is characterized by the use of hand-held instrumentation that is not conducive to the generation of quantitative data. An organic vapor meter or photoionization detector is an example of such instrumentation. However, a calibration or performance check of the instrument is required.

Level B QC is designed to provide real-time data for ongoing field activities or to provide initial data that will be the basis for seeking laboratory analytical support. Level B QC data typically are confirmed by submission of some duplicate samples to a fixed-base laboratory. Level B analysis is used for on-site, real-time screening; baseline data development; extent of contamination determination; and on-site remedial activities. Field analysis involves the use of portable or transportable instruments that are based at or near a sampling site and can provide data from the analysis of air, soil, and water samples for organic and inorganic compounds. Examples of those instruments include portable gas chromatographs, pH meters, and conductivity meters. Because Level B analyses are performed in the field, the amount and type of documentation available will vary with the type of analysis and SOPs used. Field and analysis logbooks also would be a source of additional documentation.

Level C QC applies to data produced by a laboratory meeting Energy Systems QA/QC requirements. Level C QC includes review and approval of the laboratory QA Plan, the Field Sampling Plan, and the field QA Plan. Level C allows the use of non-CLP methods but requires that the methods be EPA-approved or EPA-equivalent ones. The laboratory is required to provide the summary CLP package with the analytical results (not the full CLP package). Level C QC results in technically defensible data, which can be used for risk assessment purposes.

Level D QC field and laboratory requirements are similar to Level C for the basic laboratory QA/QC, Field Sampling Plan, and QAPjP development and approvals. However, for Level D QC, the laboratory is required to submit the full CLP data package (or equivalent) with analytical results. This QC level typically applies to sites on the NPL and results in very defensible data.

Level E QC requires the use of EPA or EPA-equivalent analytical methods. It generally is method-specific and applies to unique materials such as pure waste, biota, and explosives.

QC Levels A, B, C, and D will apply to data collected during this investigation. Level C deliverables will be requested for 90% of the data packages; 10% will be Level D packages. Table 7.1 identifies the intended use, intended users, and QC level for various field activities or types of data.

7.3.5 Precision, Accuracy, Representativeness, Completeness, and Comparability

The PARCC parameters are tools by which data sets can be evaluated. PARCC parameters can help ensure that DQOs are met. Definitions of the parameters and procedures for assessing them are provided below.

Precision refers to the level of agreement among repeated measurements of the same characteristic, usually under a given set of conditions. To determine the precision of the laboratory analysis, a routine program of replicate analyses in accordance with the analytical

Table 7.1. Data uses and quality control levels

Field activity/media	Existing data	Rationale for data needs	Data quality needs	Intended users	Analytical QC[a] level
H&S[b] monitoring during all sampling activities	None	Determination of appropriate personal protection levels	Accuracy—low Precision—not needed Completeness—90%	Field personnel	A
OVA[c]/HNu analysis (soil samples only)	None	Identify presence or absence of VOCs[d]	Accuracy—low Precision—medium Completeness—90% Detection limits—>1 ppm	Field personnel Project team Risk assessment team FS[e] team	A
Spring/seep survey	None	Design of dye tracer study	Visual observation adequate	Project team Risk assessment team FS team Regulatory personnel	NA[f]
Dye tracer study	Two previous studies; inconclusive results	Clarification of groundwater system	Accuracy—medium Precision—not needed Completeness—90%	Project team Risk assessment team Regulatory team	B
Field screening (during groundwater sampling)	None	Measurement of indicator parameters	Accuracy—medium Precision—not needed Completeness—90%	Field personnel	B
Groundwater (off-site lab analysis)	Extensive VOCs, Rad,[g] and metals; little SVOCs[h] and PCBs[i]/pesticides	Site Characterization Risk Assessment FS	Accuracy—high Precision—high Completeness—90% Detection limits—<MCLs[j]	Project team Risk assessment team FS team Regulatory personnel	C/D
Surface soil (off-site lab analysis)	None	Site Characterization Risk Assessment FS	Accuracy—high Precision—high Completeness—90% Detection limits—CLP[k]	Project team Risk assessment team FS team Regulatory personnel	C/D
Subsurface soil (off-site lab analysis)	Minimal data from a soil gas survey; VOCs present at low concentrations	Site Characterization Risk Assessment FS	Accuracy—high Precision—high Completeness—90% Detection limits—CLP	Project team Risk assessment team FS team Regulatory personnel	C/D

Table 7.1 (continued)

Field activity/media	Existing data	Rationale for data needs	Data quality needs	Intended users	Analytical QC[a] level
H&S[b] monitoring during all sampling activities	None	Determination of appropriate personal protection levels	Accuracy—low Precision—not needed Completeness—90%	Field personnel	A
Surface water/sediment	None	Site Characterization Risk Assessment Feasibility Study	Accuracy—high Precision—high Completeness—90% Detection limits—CLP	Project team Risk assessment team FS team Regulatory personnel	C/D
Wetland/endangered species survey	ORR[l]-wide data; no site-specific data	Risk Assessment	Visual observation	Project team Risk assessment team	E
Biotoxicity testing	None	Risk Assessment	Accuracy—NA Precision—NA Completeness—90%	Project team Risk assessment team	E

[a]Quality control
[b]Health & safety
[c]Organic vapor analyzer
[d]Volatile organic compounds
[e]Feasibility Study
[f]Not applicable
[g]Radionuclides
[h]Semivolatile organic compounds
[i]Polychlorinated biphenyls
[j]Maximum contaminant limits
[k]Contract Laboratory Program
[l]Oak Ridge Reservation

method requirements is performed by the laboratory. The results of replicate analyses are used to calculate the relative percent difference, which is used to assess laboratory precision. For replicate results C_1 and C_2,

$$\text{Relative percent difference} = \frac{|C_1 - C_2|}{\frac{C_1 + C_2}{2}} \times 100 .$$

Precision of the total sampling and analytical measurement process will be assessed from field duplicates. Although a quantitative goal cannot be set because of field variability, CDM Federal will review field duplicate relative percent difference values to estimate precision.

Accuracy refers to the nearness of a measurement to an accepted reference or true value. To determine the accuracy of an analytical method and/or the laboratory analysis, a periodic program of sample spiking is conducted (minimum 1 spike and 1 spike duplicate per 20 samples). The results of sample spiking are used to calculate the QC parameter for accuracy evaluation, the percent recovery (%R). For surrogate spikes and QC samples,

$$\%R = \frac{C_s}{C_t} \times 100 ,$$

where

C_s = measured spiked sample concentration (or amount),
C_t = true spiked concentration (or amount).

For matrix spikes,

$$\%R = \frac{|C_s - C_o|}{C_t} \times 100 ,$$

where

C_s = measured spiked sample concentration,
C_o = sample concentration (not spiked),
C_t = true concentration of the spike.

Objectives for accuracy and precision for this project are shown in Tables 7.2 and 7.3.

Accuracy of the total sampling and analytical measurement process will not be determined. This would require the addition of chemical spiking compounds to the samples in the field.

Representativeness is the degree to which discrete samples accurately and precisely reflect a characteristic of a population, variations at a sampling location, or an environmental condition. Representativeness is a qualitative parameter and will be achieved through careful, informed selection of sampling sites and analytical parameters and through the proper

Table 7.2. Quality assurance objectives for laboratory measurements

Parameter	Method	Matrix	Precision[a]	Accuracy[b]	Completeness
TCL[c] volatiles	CLP method[d]	Soil/sediment	CLP	CLP	90%
		Water	524.1	524.1	90%
TCL semivolatiles	CLP method	Soil/sediment/tissue	CLP	CLP	90%
		Water	CLP	CLP	90%
TAL[e] metals	CLP method	Soil/sediment/tissue	CLP	CLP	90%
		Water	CLP	CLP	90%
Chromium - hexavalent	SW-846[f] 7196	Water	20%	75–125%	90%
Gross alpha	SW-846 9310	Water	20%	80–120%	90%
Gross beta	SW-846 9310	Water	20%	80–120%	90%
Isotopic thorium	alpha spectroscopy[d]	Soil/sediment	30%	70–130%	90%
		Water	20%	70–130%	90%
Isotopic uranium	alpha spectroscopy[d]	Soil/sediment	30%	70–130%	90%
		Water	20%	70–130%	90%
Gamma	gamma spectroscopy	Soil/sediment	30%	70–130%	90%
		Water	20%	70–130%	90%
Pesticides/PCB[g]	CLP	Soil/sediment/tissue	CLP	CLP	90%
		Water	CLP	CLP	90%
TOC[h]	EPA 415.1	Water	30%	80–120%	90%
	ASA-SSSA Monograph No. 9	Soil	40%	60–140%	90%
TSS[i], TDS[j]	EPA 160.1/160.2	Water	NA[k]	NA	90%
Alkalinity	EPA 310.1	Water	15%	NA	90%
BOD[l]	EPA 405.1	Water	NA	NA	90%
COD[m]	EPA 410.2	Water	30%	80–120%	90%
Oil and grease	EPA 413.1	Water	30%	80–120%	90%
	SW846-9071	Soil	40%	60–140%	90%

Note: Precision and accuracy values shown for radionuclides represent levels of 5 pCi/L and 5 pCi/g and above. Lower levels will have substantially greater precision and accuracy limits. Precision given as a relative percent difference based on laboratory replicates.

[a]Precision for Contract Laboratory Program (CLP) methods based on matrix spike/matrix spike duplicate (organics) or laboratory duplicate (inorganics); objectives are as given in the most recent CLP Statement of Work.

[b]Accuracy given as Percent Recovery based on laboratory spikes. For CLP methods, accuracy is based on matrix spikes; objectives are as given in the most recent CLP Statement of Work. In addition, accuracy will be dependent on matrix effects from the site.

[c]Target Compound List.

[d]EPA CLP, 1990a and 1990b.

[e]Target Analyte List.

[f]EPA 1986.

[g]Polychlorinated biphenyl.

[h]Total organic carbon.

[i]Total suspended solids.

[j]Total dissolved solids.

[k]Not applicable.

collection and handling of samples to avoid interferences and to minimize contamination and sample loss.

Completeness is a measure of the percentage of valid, viable data obtained from a measurement system compared to the amount expected under normal conditions. The goal of completeness is to generate a sufficient amount of valid data to satisfy project needs. For this project, the completeness objective, 90%, is shown in Tables 7.2 and 7.3.

Comparability is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. Comparability will be achieved through the use of SOPs, analytical methods, QC, and data reporting. In addition, data validation evaluates processes employed by the laboratory that affect data comparability.

Table 7.3. Quality assurance objectives for field measurements

Parameter	Matrix	Precision	Accuracy	Completeness (%)
pH	Aqueous	ND[a]	±0.05 unit	90
Conductivity	Aqueous	ND	±50 units	90
Temperature	Aqueous	ND	±1°C	90
Dissolved oxygen	Aqueous	ND	±0.1 ppm	90
Total organic vapors	Gas	ND	±10 ppm	90
Water level	Aqueous	ND	±0.01 ft	90

[a]Precision, as assessed by replicate measurements, will not be performed in the field.

7.4 SAMPLE COLLECTION AND ANALYSIS PROCEDURES

Sampling locations and rationales are discussed in Chap. 6 (Site Data Needs) of this Work Plan. The Energy Systems document *Environmental Surveillance Procedures, Quality Control Program*, (Energy Systems 1990a), will be followed where applicable. Environmental Surveillance Procedures (ESPs) from this document that are applicable to this investigation include those listed below.

- Water Sampling Using a Dipper: ESP-301-1
- Sediment Sampling Procedures: Stream Bed: ESP-304-1
- Groundwater Sampling Procedures: Water Level Measurements Using Water Level Indicator: ESP-302-1
- Groundwater Sampling Procedures: Guidelines for Well Purging: ESP-302-2
- Groundwater Sampling: Energy Systems SOP No. 8102.R2
- Groundwater Sampling Procedures: Using a Bailer: ESP-302-3
- Groundwater Sampling Procedures: Using a Gas Driven Piston Pump: ESP-302-4
- Groundwater Sampling Procedures: Using a Bladder Pump: ESP-302-5

- Field Measurements Procedures: Temperature: ESP-307-1
- Field Measurements Procedures: pH (Hydrogen Ion Concentration): ESP-307-2
- Field Measurements Procedures: Oxidation/Reduction Potential of Water: ESP-307-5
- Field Measurements Procedures: Specific Conductance (IAD): ESP-307-8
- Field Sampling and Analytical Processes Within Environmental Restoration: ER/C-S2301
- Sample Classifying, Packaging, Marking, Labeling, and Shipping for Analysis Through the K-25 and Y-12 Environmental Restoration Programs: ER/C-P2302 (IAD), Rev. 0
- Cleaning and Decontaminating Sample Containers and Sampling Devices: ESP-900
- Equipment Decontamination: ESP-901
- Waste Management: ESP-1000
- Waste Removal and Disposition through the Y-12 ER Program: ER/Y-P2102

Any modification of or deviation from these procedures will be documented and approved by the Energy Systems Project Manager. Soil sampling with a Geoprobe is not included in the environmental surveillance SOPs. A procedure for this method of sampling, entitled "Geoprobe Soil Sampling Survey" (SOP 3-1), is provided in Appendix C.

For a majority of the biological/ecological samples to be collected, there are no environmental surveillance SOPs. In cases where they are available, they are referenced accordingly. If SOPs are not available, methods are described or specific methods and procedures are provided in Appendix C. These methods are also described below.

Threatened and Endangered Species and Wetlands Surveys. Although there are no standard methods for conducting these surveys, but rather conventions by which biologists/ ecologists approach the work, compliance with federal legislation concerning threatened and endangered species on the ORR has been formally addressed, and the program has been reviewed with both the U.S. Fish and Wildlife Service (USFWS) and the appropriate state of Tennessee agencies (Kroodsma 1987), none are known to occur at the CRSP.***previous sentence makes no sense*** Several state-listed species do occur on the ORR and may be present in the study area. Wooded areas adjacent to the site will be surveyed to determine whether the federally and/or state-listed species are present or likely to be present. The surveys will be conducted by biologists familiar with the species that may be expected to live in habitats similar to the site and will be conducted when species that are expected to occur on the ORR are likely to be most readily observed. For plants, the surveys will be scheduled to coincide with the flowering season. Because there are no federally listed threatened or endangered wildlife species known to occur on the ORR, the animal survey will be limited to identifying suitable habitat. The surveys may provide only evidence of the presence or absence of the species; quantitative information on population status will not be obtained. In addition, wetlands areas will be delineated, and wetlands plant species will be identified based on nationally accepted standards (Federal Interagency Committee for Wetland Delineation 1989; Reed 1988; and USFWS 1979).

Aquatic Toxicity Tests. Water samples for aquatic toxicity testing will be collected in accordance with SOP-7 of the ESD Toxicology Laboratory Quality Assurance Program, which describes a method of collecting grab samples. At the time of sample collection, field

measurements for temperature, pH, and dissolved oxygen will be performed. Laboratory measurements for pH, conductivity, and dissolved oxygen will be performed after samples have been warmed to test temperature (25 ± 2°C) in accordance with EPA test methods. Water chemistry analyses will be conducted in accordance with SOP-11. The ESD Toxicology Laboratory will conduct the cladoceran (*C. dubia)* survival and reproduction test (EPA Method 1002.0) and the fathead minnow (*P. promelas)* larval survival and growth test (EPA Method 1000.0). All tests will be conducted according to standard operating procedures (SOPs) located in the ESD Toxicology Laboratory Quality Assurance Program Manual (QAP-X-89-ES-002; Kszos et al., 1989). Toxicity tests may be conducted using water collected daily or a minimum of three samples collected during the 7-d test period. Toxicity tests will be initiated so as not to exceed the EPA recommended 36-h holding time. A copy of the ESD Toxicology Laboratory quality assurance program and referenced SOPs are included in Appendix C. This document discusses the specific QA procedures applicable to the toxicity testing to be performed.

Soil Toxicity Testing Using Earthworms and Seedlings. Soil samples for toxicity testing will be collected using ESP-303-1 (spade or scoop) and ESP-303-2 (hand auger) methods. Approximately 8 L of soil are needed from each site for toxicity testing. Grab samples will be collected from the surface down through the root zone to ensure an adequate volume for testing. Earthworms, *Eisenis foetida*, and cabbage seedlings will be tested using the methods described in EPA/600/3-88/029. ***is this Greene et al. 1988? or EPA 1986?*** The holding time for soil for toxicity testing is less than 24 h. Toxicity tests will be run on natural soil and on soil that has been autoclaved under an inert atmosphere to destroy all pathogens. A copy of the test method is included in Appendix C.

Bioaccumlation Testing. Soil invertebrate samples will be collected from each sampling area (sampling locations and number to be determined) by establishing 1- by 1-m quadrants, excavating soil from the root zone (top 12 in.) using a shovel or trowel, and sieving for invertebrates using a standard No. 30 sieve. The sample size will be ~1 g of tissue.

Table 6.1 lists sample totals for all media. Analytical methods, sample preservation requirements, and sample container requirements are summarized in Table 7.4.

7.5 SAMPLE AND DOCUMENT CUSTODY PROCEDURES

Field documentation will be maintained throughout this project in various formats, including field logbooks, sample tags, chain-of-custody forms, field data sheets, and field calibration and maintenance data. Records of all field activities, including sampling locations, site conditions, types of samples taken, and analyses requested, will be documented in appropriate field logbooks and on field data sheets. The laboratory will be responsible for maintaining chain-of-custody samples received for analysis. Laboratory custody procedures will be discussed in detail in the laboratory QA Plan, prepared by the contract laboratory, and reviewed and approved by Energy Systems.

Documentation will follow requirements outlined in procedure ESP-500 of ES/ESH/INT-14 (Energy Systems 1990a). The following general guidelines for maintaining field documentation will be followed.

Table 7.4. Analytical methods and sample requirements

Environmental samples					
Parameter	**Method No.**	**Matrix**	**Holding time (from time of collection)**	**Sample container[a]**	**Preservation**
Volatile organic compounds	EPA TO-14	Air	14 d	Summa canisters	None (do not cool)
	EPA 524.2	Aqueous	14 d	Three 40-mL amber glass vials with Teflon-lined septum	HCl to pH<2[b]
	CLP[c] method[d]	Soil/ sediment		4-oz. glass jar with Teflon-lined closure	Cool to 4°C
Semivolatile organic compounds	CLP method	Aqueous	7 d to extraction; 40 d to analysis	1-L amber glass with Teflon-lined closure	Cool to 4°C
		Soil/ sediment/ tissue	14 d to extraction; 40 d to analysis	8-oz. widemouthed glass jar with Teflon-lined closure	Cool to 4°C
Metals[e] (other than mercury), total and dissolved	CLP method	Aqueous	180 d	1-L polyethylene with polyethylene-lined closure	HNO_3 to pH<2
	CLP method	Soil/ Sediment/ tissue	180 d	8-oz. widemouthed glass with Teflon-lined closure	Cool to 4°C
Mercury, total and dissolved	CLP method	Aqueous	28 d	1-L polyethylene with polyethylene-lined closure	HNO_3 to pH<2
	CLP method	Soil/ Sediment/ tissue	28 d	8-oz. widemouthed glass with Teflon-lined closure	Cool to 4°C
Pesticides/PCBs[f]	CLP method	Aqueous	7 d to extraction; 40 d to analysis	1-L amber glass with Teflon-lined closure	Cool to 4°C
		Soil/ sediment/ tissue	14 d to extraction; 40 d to analysis	8-oz. widemouthed glass jar with Teflon-lined closure	Cool to 4°C
Gross alpha and gross beta	SW-846, 9310[g]	Aqueous	6 months	Two 1-gal polyethylene with polyethylene-lined closure	HNO_3 to pH<2

Table 7.4 (continued)

Environmental samples					
Parameter	Method No.	Matrix	Holding time (from time of collection)	Sample container[a]	Preservation
Volatile organic compounds	EPA TO-14	Air	14 d	Summa canisters	None (do not cool)
	EPA 524.2	Aqueous	14 d	Three 40-mL amber glass vials with Teflon-lined septum	HCl to pH<2[b]
	CLP[c] method[d]	Soil/ sediment		4-oz. glass jar with Teflon-lined closure	Cool to 4°C
Isotopic uranium and thorium	EPA 908.0[h] and EPA 907.0[h]	Aqueous	6 months	Two 1-gal polyethylene with polyethylene-lined closure	HNO_3 to pH<2
		Soil/ sediment	6 months	8-oz. widemouthed glass jar with Teflon-lined closure	None
TOC[i]	EPA 415.1	Water	28 d	250-mL amber glass bottle	Cool to 4°C H_2SO_4 to pH<2
TDS[j]	EPA 160.1	Water	7 d t	1-L polyethylene with polyethylene closure	Cool to 4°C
TSS[k]	EPA 160.2	Water	7 d	Can use from TDS bottle	Cool to 4°C
Alkalinity	EPA 310.1	Water	14 d	1-L polyethylene with polyethylene closure	Cool to 4°C

[a]Additional volume needed for aqueous matrix spike/matrix spike duplicate samples (triple volume for organics; double volume for metals).
[b]The first sample for volatile analysis will be tested for pH by first adding four drops of HCl to a spare 40-mL vial, adding the water sample, and testing with pH paper. If pH>2, additional acid will be added until pH<2 is achieved. Once this determination has been made, remaining volatile organic analysis vials will be pre-preserved before sample collection.
[c]Contract Laboratory Program.
[d]EPA 1990b.
[e]Samples for these parameters can occupy the same sample containers.
[f]Polychlorinated biphenyls.
[g]EPA 1986.
[h]EPA 1984.
[i]Total organic compounds.
[j]Total dissolved solids.
[k]Total suspended solids.

- Documentation will be completed in permanent black ink.
- All entries will be legible.
- Errors will be crossed out with a single line, dated, and initialed.
- Unused space on a page will be marked through with a diagonal line, dated, and initialed.
- None of the documents will be altered, destroyed, or discarded, even if they are illegible or contain inaccuracies that require correction. They will be maintained on-site and referenced in the site logbook.

7.5.1 Field Logbooks

Field team personnel will use bound field logbooks with sequentially numbered pages for the maintenance of field records and for documenting any information pertinent to field activities. Information identified in the field logbook will be obtained from site exploration, observation, and sampling activities and will be recorded by the Field Task Manager or his/her designee.

The front cover of the logbook will list the contract name and number, the task order number, the site name, the names of subcontractors, the name of the client, the name of the Field Task Manager, the start date, and, when complete, the finish date. The logbooks will be sequentially numbered, and if a logbook is dedicated to a particular task or site, that information will be noted on the cover.

The field logbook will be included as an appendix to the appropriate site investigation report. Specific information to be recorded in field logbooks is provided in procedure ESP-500 of ES/ESH/INT-14 (Energy Systems 1990a).

7.5.2 Field Data Sheets

Field data sheets will be maintained as appropriate and will include the following logs and forms:

- water-level measurement log,
- environmental survey forms,
- surface water/sediment sampling log,
- well-purging log,
- groundwater sampling log,
- chain-of-custody form, and
- instrument calibration log.

Data to be recorded will include such information as the sample location (e.g., depth, sampling station, elevation, and field coordinates) and applicable sample analysis to be conducted. If necessary, field-generated data forms will be prepared based on the appropriate requirements. The same information may be included in the field logbook.

7.5.3 Sample Identification, Numbering, and Labeling

In addition to field logbooks and field data sheets, the sampling team will use labels to track sample holding times, to ensure sample traceability, and to initiate the chain-of-custody record on the environmental samples. Custody seals will also be used to ensure traceability and to prevent tampering. Figure 7.2 is an example of a sample label and chain-of-custody seal. A completed label will be secured to each sample container, including duplicates and trip or field blanks, at or before the completion of collection of that sample. Sample labels will be waterproof or will be sealed to the sample container with clear acetate tape after all information has been written on the label. Labels will include the project code number; the station number and location for the sampling site; the type of sample, the analyses required, and date and time of sampling; and the signature of the sampler. The person who physically collects each sample is the sampler and will sign the sample label. Information to be included on sample labels and seals is provided in ESP-500 (Energy Systems 1990a).

The sample numbers will be recorded in the field logbook along with the time of collection and descriptive information of the sampling conditions.

Samples will be identified and numbered according to the following system:

SP-BB-XX-ZZ,

where

SP identifies the site as the Y-12 Plant, CRSP.

BB identifies the media using the following codes:

- GW (groundwater),
- SW (surface water),
- TB (trip blank),
- FB (field blank),
- SO (soil),
- SD (sediments),
- BW (bioaccumulation worms),
- EB (equipment blank).

XX identifies the location of the sample, which will be consistent with the Y-12 Plant identification system.

ZZ is the sample number at that location.

Therefore, the sample number SP-GW-10-01 designates a groundwater sample from monitoring well 10. The 01 at the end of the sample number indicates that it is the first sample taken at this location. The actual location where this sample was collected is specified in the field logbook along with a complete description of the sample.

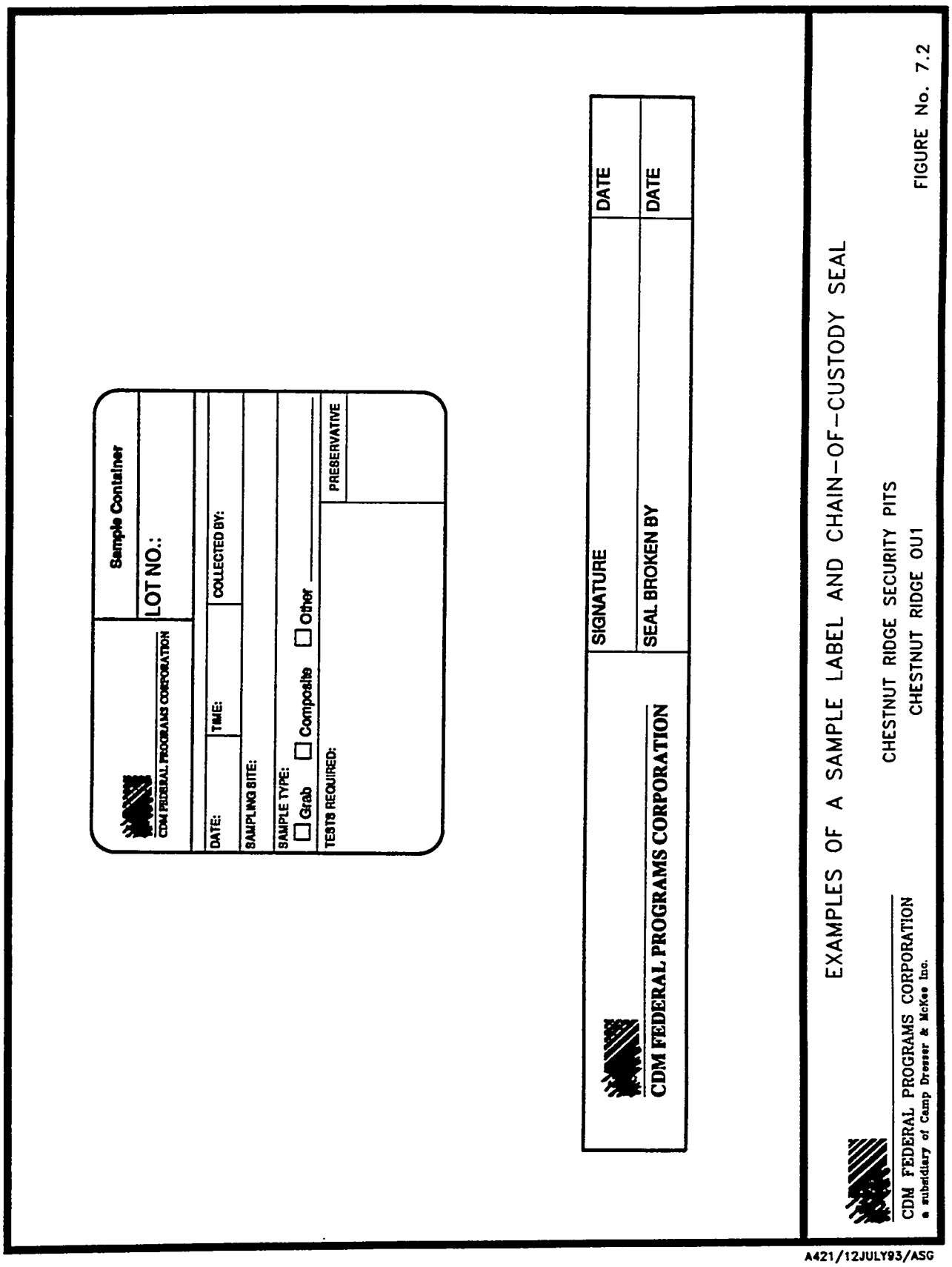


Fig. 7.2. Examples of a sample label and chain-of-custody seal.

QC samples are numbered in the same manner as the other samples using the above symbols. Duplicate samples, however, will be assigned a unique sample number by the sampling team, and this number will be recorded in the field logbook along with sample information such as the time of collection, matrix type, analysis requested, and corresponding sample. This procedure ensures that subsequent tracking of the QC sample results is facilitated. The data validators and users will be told which of the samples were duplicates, spikes, or blanks. A list of analyzed samples, including QC samples, and their locations will also be included in the draft RI report.

7.5.4 Sample Chain of Custody

Chain-of-custody procedures will document sample possession from the time of collection through all transfers of custody to receipt at the laboratory and subsequent analysis. Chain-of-custody records will accompany each packaged lot of samples; the laboratory will not analyze samples without a correctly prepared Chain-of-Custody Record Form. Internal laboratory records will document the custody of the sample through its final disposition. The QC level for individual samples also will be communicated to the laboratory on the chain-of-custody record.

Custody records following the National Enforcement Investigation Center format will be used for this project. The multipart carbonless copy forms will be correlated with the sample collection tags; requested information will have the same heading on both. Figure 7.3 presents an example of a Chain-of-Custody Record Form. One similar to this will be used by CDM Federal throughout this field effort. ESD personnel will use their existing chain-of-custody records, which may vary from the one shown in Fig. 7.3. The sampler or sample custodian will complete a chain-of-custody record form to accompany each sample shipment from the field to the laboratory.

The custody records will be used for a packaged lot of samples; more than one sample will usually be recorded on one form. More than one custody record sheet may be used for one package, if necessary. The purpose of the sheets is to document the transfer of a group of samples traveling together; when the group of samples change, a new custody record is initiated. The original custody record travels with the samples; the initiator of the record keeps a copy. When custody of the same group of samples changes hand, several people will not have a copy of the custody record. This is acceptable as long as the original custody record shows that each person who received custody has properly relinquished it.

The sampling event will have a designated sample custodian with overall responsibility for sample custody and for field document control. The custodian will ensure that the sampling teams have used the appropriate identification and custody records, resolved custody problems in the field, and handled the shipment of samples to the analytical laboratories. The analytical laboratory will have an identified sample custodian and document control officer.

The following procedures are used to complete the Chain-of-Custody Record Form.

1. The originator (e.g., sample custodian) fills in all requested information from the sample label. The bill-of-lading number obtained from the overnight carrier is recorded in the comments section of the form, and it also is recorded in the field

CDM FEDERAL PROGRAMS CORPORATION

CHAIN OF CUSTODY RECORD

PROJECT No.	PROJECT LEADER	REMARKS
PROJECT NAME/LOCATION		
	SAMPLERS *(sign)*	

STATION No.	SAMPLE TYPE	19__ DATE	TIME	COMP	GRAB	STATION LOCATION/DESCRIPTION	TOTAL CONTAINERS	CIRCLE/ADD parameters desired. List no. of containers submitted	ANALYSES: COD, TOC, NUTRIENTS	BOD, SOLIDS	METALS	EXT ORG/PESTICIDES	VOA	CYANIDE	TAG No./REMARKS	LAB USE ONLY

Relinquished by: (print) / (sign)	Date/Time	Received by: (print) / (sign)	Date/Time	Relinquished by: (print) / (sign)	Date/Time	Received by: (print) / (sign)	Date/Time
Relinquished by: (print) / (sign)	Date/Time	Received by: (print) / (sign)	Date/Time	Relinquished by: (print) / (sign)	Date/Time	Received by: (print) / (sign)	Date/Time

DISTRIBUTION: White and Pink copies to accompany sample shipment to laboratory. Pink copy retained by laboratory. White copy is returned to sampler. Yellow copy retained by sampler.

EXAMPLE OF A CHAIN-OF-CUSTODY RECORD FORM

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 7.3

A420/12/JULY93/ASG

Fig. 7.3. Example of a Chain-of-Custody Record Form.

2. The originator signs in the top left "Relinquished by" box and keeps a copy.

3. The original record sheet and remaining copies travel with the samples.

4. The laboratory sample custodian receiving the samples checks the sample label information against the custody record. He/she also checks the sample condition and notes anything unusual under "Comments" on the Chain-of-Custody Record Form. The laboratory custodian receiving custody signs in the adjacent "Received by" box and keeps a copy. The original and the additional copy are returned to the originator.

5. The date/time will be the same for both signatures because custody must be transferred to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the form. The original form travels with the samples, and the shipper (e.g., field sample custodian) keeps the copy. The shipper also keeps all shipping papers, bills of lading, etc.

In all cases, it must be apparent that the same person who received custody has relinquished it to the next custodian. If samples are left unattended or if a person refuses to sign, this occurrence must be documented and explained on the custody record.

To enable tracking of the shipment of samples from the field to the laboratory, the field sample custodian will promptly telephone the laboratory following shipment and provide the following information:

- the exact number and types of samples collected and the sample identification numbers;
- air carrier and air bill number(s);
- estimated date and time of arrival at each designated laboratory; and
- other pertinent information including special handling instructions, changes in scheduled sampling activity, or deviations from established sampling procedures.

Internal laboratory custody procedures will be specified in the laboratory QA plan.

Custody seals are narrow strips of adhesive paper that are used to demonstrate that no tampering has occurred (see Fig. 7.2). Custody seals will be placed on coolers used for sample shipment. Seals will not be placed on individual sample containers. The sampler must sign and date each custody seal.

7.5.5 Sample Shipment

Each sample shipped will be packed in accordance with the SOP, "Sample Classifying, Packaging, Marking, Labeling, and Shipping for Analysis through the K-25 and Y-12 Environmental Restoration Programs," ER/C-P2302(IAD), Rev. 0. All shipping procedures will comply with Department of Transportation (DOT) regulations. In addition, each sample will be identified with a sample identification label and will be listed on the chain-of-custody record completed for each sample shipping container. The field sample custodian will notify the laboratory sample custodian of sample shipment.

7.5.6 Document Control

Document control is the act of ensuring that documents, including revisions, are reviewed for adequacy, approved for release by authorized personnel, and distributed to and used at the locations where the prescribed activities are performed. CDM Federal's document control procedure is given in the CDM Federal *Quality Assurance Manual*, QP 3. The Project Manager will develop distribution lists for the various types of documents to be issued during this project.

Procedures have been established for the inventory, control, filing, storage, and retrieval of data collected and of reports/documents generated under this program. CDM Federal's record control procedures are given in the CDM Federal *Quality Assurance Manual.* The Field Task Manager will forward field documentation to the CDM Federal document control center for processing as QA records. The project files will be maintained in the Oak Ridge office.

7.6 EQUIPMENT CALIBRATION AND FREQUENCIES

7.6.1 Equipment Calibration Procedures and Frequencies

All field equipment, including pH, conductivity, dissolved oxygen, radiation, and organic vapor (or equivalent) meters will be calibrated daily (or more frequently, if necessary) by the user according to the manufacturer's specifications. The off-site laboratory or laboratories will use written, standard procedures for equipment calibration and frequency. These procedures are based on EPA guidance or manufacturer's recommendations and are given in the laboratory QA Plan or in the EPA-approved analytical methods. The laboratory QA Plan will then be reviewed and accepted by CDM Federal and Energy Systems as part of the laboratory review process. The appropriate references for all analyses are included in the reference section of this document. All standards used for calibration will be National Institute of Standards and Technology-traceable. Procedures for improperly functioning equipment will be addressed in the laboratory QA Plan and in factory manuals for equipment.

7.6.2 Calibration Records

Calibration records (Fig. 7.4) will be maintained for each piece of field measuring and test equipment and each piece of reference equipment. The records will indicate that established calibration procedures have been followed. The frequency of calibration against a traceable standard will be specified on the Equipment Calibration Form. The lot number of all calibration gases will be recorded on the Equipment Calibration Form. Records of equipment use will be kept in the project files. The off-site laboratory will use written, standard procedures for calibration records. These procedures are based on EPA guidance and are given in the laboratory QA Plan. The laboratory QA Plan will be reviewed and accepted by CDM Federal and Energy Systems as part of the laboratory review process.

7.7 PREVENTIVE MAINTENANCE

Periodic preventive maintenance is required for all equipment. CDM Federal will keep a maintenance log for each piece of field equipment. Appendix C contains forms that will be

CALIBRATION LOG *for* _____ Required calibration frequency: _____
equipment used

Project Name _____ Project # _____ Page____ of ____

DATE	TIME	SERIAL #	STANDARD(S) USED	STANDARD LOT NO.	READING	COMMENTS	INITIALS

EXAMPLE OF AN EQUIPMENT CALIBRATION FORM

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CHESTNUT RIDGE SECURITY PITS
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FIGURE No. 7.4

A416/12JUL93/ASG

Fig. 7.4. Example of an Equipment Calibration Form.

used to log the maintenance record of each field instrument. Specific preventive maintenance practices, frequency, and spare parts are described in the factory manual for each instrument. The troubleshooting section of factory manuals will be used to assist personnel in performing maintenance tasks. CDM Federal keeps on hand critical spare parts to minimize equipment downtime.

Preventive maintenance procedures for laboratory equipment and instruments are provided in laboratory QA Plans. All maintenance activities will be recorded in maintenance logs. Laboratories will be required to maintain an adequate inventory of spare parts and consumables to prevent downtime as a result of minor problems.

7.8 ANALYTICAL PROCEDURES

Table 7.4 summarized the analytical methods, sample container requirements, and sample preservation requirements for sampling required during this investigation. A complete list of TCL/TAL parameters is included in Appendix D. A discussion of method detection limits follows.

Method detection limits (MDLs) describe the extent to which the equipment or analytical process can provide accurate, minimum data measurements of a reliable quality for specific constituents in replicate field samples. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the value is above zero. The actual quantitation limit for a given analysis will vary depending on instrument sensitivity and matrix effects. MDLs for this project are shown in Table 7.5. The MDLs for aqueous media are equal to or lower than the established MCLs used to evaluate potential risks to human health and the environment. Detection limits will not be established for analyses performed using field instruments. The detection limits established by the manufacturer will be used as guidelines.

7.9 DATA REDUCTION AND REPORTING

To ensure that data management activities provide an accurate and controlled flow of data generated by the laboratory, it is important that the following data reduction and reporting steps be defined and implemented. Data management procedures applicable to field-generated data are discussed in the Field Sampling Plan.

7.9.1 Data Reduction

Field program data will be produced through visual observation, direct-reading instrumentation, measuring devices, and laboratory chemical analyses. All field activities, direct-reading instruments, and measuring devices will occur or be used in accordance with the procedures in Energy Systems' document ES/ESH/INT-14 and the specifications in the manufacturers' operations and maintenance manuals, as appropriate.

To present field data in a report, the data recorded in data books and forms will need to be summarized and transferred to tables, figures, maps, or logs. To analyze data, some data will need to be entered into computer data bases or onto spreadsheets. The Field

Table 7.5. Method detection limits for laboratory analysis

Water (µg/L)	Soil/sediment (µg/kg)	Volatile organic compounds CLP[a] method[b]		
10	10	Acetone	1,1-Dichloroethane	1,1,2,2-Tetrachloroethane
		Benzene	1,2-Dichloroethane	Tetrachloroethene
		Bromodichloromethane	1,1-Dichloroethene	Toluene
		Bromoform	1,2-Dichloroethene (Total)	1,1,1-Trichloroethane
		Bromomethane	1,2-Dichloropropane	1,1,2-Trichloroethane
		2-Butanone	Cis-1,3-dichloropropene	Trichloroethene
		Carbon disulfide	Trans-1,2-dichloropropene	Vinyl acetate
		Carbon tetrachloride	Ethyl benzene	Vinyl chloride
		Chlorobenzene	2-Hexanone	Xylenes (Total)
		Chloroethane	Methylene chloride	
		2-Chloroethyl vinyl ether	4-Methyl-2-pentanone	
		Chloroform	Styrene	
		Chloromethane		
		Dibromochloromethane		

Water (µg/L)	Soil/sediment/tissue (µg/kg)	Semivolatile organic compounds[c] (including polynuclear aromatic hydrocarbons) CLP method
10	330	Acenaphthene
10	330	Acenaphthylene
10	330	Anthracene
10	330	Benzo(a)anthracene
10	330	Benzo(a)pyrene
10	330	Benzo(b)fluoranthene
10	330	Benzo(g,h,i)perylene
10	330	Benzo(k)fluoranthene
10	330	Carbazole
10	330	2-Chloronaphthalene
10	330	Chrysene
10	330	Dibenzo(a,h)anthracene
10	330	Dibenzofuran
10	330	Fluoranthene
10	330	Fluorene
10	330	Indeno(1,2,3-cd)pyrene
10	330	2-Methylnaphthalene
10	330	Naphthalene
10	330	Phenanthrene
10	330	Pyrene
CLP	CLP	Other target compound list semivolatiles

Table 7.5 (continued)

Water (µg/L)	Soil/sediment/tissue (mg/kg)	Metals CLP method
200	40	Aluminum
60	12	Antimony
10	2	Arsenic
200	40	Barium
5	1	Beryllium
5	1	Cadmium
5000	1000	Calcium
10	2	Chromium
50	10	Cobalt
25	5	Copper
100	20	Iron
3	0.6	Lead
5000	1000	Magnesium
15	3	Manganese
0.2	0.04	Mercury
40	8	Nickel
5000	1000	Potassium
5	1	Selenium
10	2	Silver
5000	1000	Sodium
10	2	Thallium
50	10	Vanadium
20	4	Zinc

Table 7.5 (continued)

Water (µg/L)	Soil(µg/kg)	Pesticides and PCBs CLP		
0.10	3.3	Dieldrin		
0.05	1.7	Alpha-BHC	Beta-BHC	Delta-BHC Gamma-BHC
0.05	1.7	Aldrin		
0.10	3.3	4,4'-DDD	4,4'-DDE	4,4'-DDT
0.05	1.7	Alpha-chlordane	Gamma-chlordane	
0.10	3.3	Endrin	Endrin Ketone	Endrin aldehyde
0.05	1.7	Endosulfan I		
Not analyzed	44.2	Endosulfan sulfate	Endosulfan II	
0.05	1.7	Heptachlor	Heptachlor epoxide	
0.5	17.0	Methoxychlor		
5.0	170.0	Toxaphene		
2.0	67.0	Aroclor 1221		
Not analyzed	ND[d]	Aroclor 1016 Aroclor 1232	Aroclor 1242 Aroclor 1248 Aroclor 1254	Aroclor 1260

Radionuclides

Water (pCi/L)	Sediment (pCi/g)	Analytes	Method
3	10	Gross alpha and beta	SW-846, Method 9310[e]
0.1	0.1	Isotopic thorium	EPA 907.0[f]
0.1	0.1	Isotopic uranium	EPA 908.0[f]
5	0.5	Gamma	Gamma spectroscopy

Wet chemistry

Water (mg/L)	Soil(mg/kg)	Analytes	Method
ND	NA	TDS[h]	EPA 160.1
ND	NA	TSS[i]	EPA 160.2
ND	5	TOC[j]	ASA/SSSA Monograph No. 8 EPA 415.1 (water)

[a]Contract Laboratory Program (CLP).
[b]EPA 1990a and 1990b.
[c]All target compound list semivolatiles will be analyzed and reported. Only polynuclear aromatic hydrocarbons are listed here; detection limits for other semivolatiles will be the CLP contract required detection limits.
[d]ND = Not determined.
[e]EPA 1986.
[f]EPA 1984.
[g]NA = Not applicable.
[h]Total dissolved solids.
[i]Total suspended solids.
[j]Total organic carbon.

Task Manager and other team members are responsible for data transfer activities pertinent to their roles on the project. The data manager will be responsible for ensuring that data transfers are performed accurately and will perform spot checks of the transfer activities.

Data generated by laboratories will be reduced using the format specified by EPA or other standard analytical methods. The analytical data packages will be checked by CDM Federal for completeness (i.e., all deliverables required for data validation must be in the package) and reasonableness. CDM Federal will contact the laboratory if deliverables are absent from the data packages or if discrepancies are noted. Laboratory data will be reconciled with field records before data validation.

It will be the responsibility of the data manager to ensure that all data transferred to tables, spreadsheets, logs, maps, figures, or into computerized data bases are transferred correctly. All data transferred, both hard copy and electronic copy, will be checked at least once for completeness and accuracy of transfer. Checking will be performed by comparing the raw data with the transferred data. All computer programs used for calculation or analysis will be checked at least once with a data set of known results before the program is used to process data for any site.

7.9.2 Data Reporting

For data produced following Level D QC, the laboratory is required to report data in accordance with ES/ER/TM-16.

The appropriate CLP forms are presented in the latest revision of the EPA CLP *Statement of Work for Inorganics Analysis* (1990a) and the *Statement of Work for Organics Analysis* (1990b). The other Level C parameters will be reported in CLP-type format. The laboratory also is required to submit control charts for the blank spike analyses for each method and matrix and, if requested, calculations used to obtain results. Two copies of each data package will be required. Equivalent information, in accordance with ES/ER/TM-16, will be reported for radionuclides and other parameters.

7.10 FIELD QUALITY CONTROL SAMPLES

QC sampling will be conducted to check sampling and analytical accuracy and precision for both laboratory and field analyses of the original samples. If contaminants are found in the blanks, attempts will be made to identify the source of contamination, and corrective action will be initiated in accordance with Sect. 7.13. The laboratory analyzing the samples will also include QC samples. These samples will be discussed in the laboratory QA Plan. The QC samples and frequency specified in ES/ER/TM-11 (Energy Systems 1991) will be used for this task. All QC samples will be shipped according to the chain-of-custody procedures specified in the Field Sampling Plan and in ESP-500 (ES/ESH/INT-14).

QC samples will have sample numbers as described in the Field Sampling Plan. Duplicates will be submitted as "blind" to the laboratories. These samples will be analyzed for the parameters of interest. Results of these samples will be included in the analytical report. Table 7.6 summarizes QC samples necessary for this investigation.

Table 7.6. Summary of quality control sample requirements

	Trip blanks	Duplicates	Matrix spike/ matrix spike duplicate	Equipment rinseates	Total[a]
Groundwater	6	2	2	3	13
Surface water/ sediment	TBD[b]	TBD	TBD	TBD	TBD
Subsurface soil	6	2	1	2	11
Surface soil	6	2	1	2	11
Tissue		TBD	TBD		TBD

[a]Field blanks will also be taken for each water source at the beginning and end of each sampling event.
[b]TBD = To be determined.

- A **trip blank** consists of a sealed container of American Society for Testing and Materials (ASTM) Type II water that travels from the field to the laboratory with the samples to be analyzed for VOCs. The trip blank identifies contamination that may have been contributed to the field samples during transport (receives same treatment as sample containers). One trip blank will be placed in each cooler containing samples to be analyzed for VOCs.
- An **equipment rinseate** is collected in the field from a final ASTM Type II organic-free water rinse of decontaminated field sampling equipment. The field rinseate determines whether the decontamination procedure is adequate to avoid carryover of contamination from one sampling location to another. One field rinseate will be collected for every 10 samples (per matrix) for each equipment type during each sampling event (sampling period without a 48-h interruption).
- A **field blank** consists of water used for rinse during field decontamination. One field blank will be collected from each source of rinse water (ASTM Type II and tap water) at the beginning of the sampling program and at the end.
- The **field duplicate** samples are collected from the composited sample matrix in a separate set of containers and labeled with a different sample numbers. They indicate whether the field sampling and measurement technique is reproducible and are collected at a frequency of one for every 10 samples.
- **Matrix spike (MS)/matrix spike duplicate (MSD)** samples may require the collection of additional sample volume and are often collected at the same location as duplicates. Samples are split into duplicates. The laboratory adds predetermined quantities of spiking solutions to the samples before preparation and analysis. The relative percent difference between samples is used to evaluate analytical precision. Percent recoveries are used to evaluate accuracy. MS/MSD samples will be collected at a minimum frequency of 1 for every 20 samples. For inorganics, a laboratory duplicate will be analyzed instead of the MSD.

7.11 DATA VALIDATION

Data validation is the process of screening data and accepting, rejecting, or qualifying them on the basis of sound criteria. Data validation will be performed in accordance with EPA procedures and ES/ER/TM-16, *Requirements for Quality Control of Analytical Data*. Data will be validated, as appropriate, based on holding times, initial calibration, continuing calibration, blank results, and other QC sample results. All data packages will be validated (i.e., 90% Level C and 10% Level D).

The Field Task Manager will review all field documentation, and the CDM Federal data validation staff will review all laboratory documentation for completeness, legibility, consistency, and reasonable agreement with expected or typical results. Field measurements and observations will be checked against the field log and records and discussed with the individuals who collected the data to determine the possibility of error. However, checking of field instrument data is largely performed in the field at the time of analysis, based on equipment calibration and professional judgment.

All data packages received from the analytical laboratory will be reviewed and verified by CDM Federal project personnel to determine whether they are in compliance with all contractual requirements. Specific activities include checking for the following:

- invalid or missing key fields (Sample ID, Sample Delivery Group No.);
- missing forms;
- invalid reporting and analysis times;
- correct reporting units;
- cross-reference to field sample records; and
- valid method and analysis codes.

The data packages then will be validated by CDM Federal project personnel using ES/ER/TM-16 guidelines to determine whether the data can be used for their intended purpose as specified in the DQOs. Specific validation guidelines will be kept on file by CDM Federal. Results will be reviewed by a project chemist and reported to the Project Manager. Examples of QC information reviewed during data validation include

- holding times,
- calibrations,
- blanks,
- surrogates,
- internal standards,
- matrix spikes,
- duplicate analyses, and
- control charts.

The procedures used to assess the data from field measurements for PARCC are given in procedures specific to field measurements (ESP-307 series) in Energy Systems' ES/ESH/INT-14 and, more generally, in ESP-1100, *Statistical Sampling Design.*

The output from both the data verification and validation processes will be used by the data validators to assign data usability flags (e.g., U = not detected, J = estimated value, R = rejected) to each result as needed. A summary for each data package will be prepared, documenting the results that are not within the QC acceptance criteria and any other laboratory or field occurrences that affect the data quality. This report will explain the resulting data qualifiers applied to the data.

Deliverables to be supplied to the Energy Systems Project Manager on completion of the project include the following:

- completed and signed data compliance checklists,
- completed and signed data validation summary reports,
- completed and signed validation definitions and narrative, and
- copy of the Form I CLP report or equivalent with accompanying data flags.

Analytical data outliers, as defined in the laboratory QA Plan, will be discussed with the data validators, and possibly the analytical laboratory, to determine whether the outlier is a result of laboratory error. If necessary and possible, additional samples or measurements may be performed to confirm or disprove the outlier. If the outlier cannot be confirmed, it will be flagged as such and not used for decision purposes until subsequent analyses/measurements allow confirmation.

7.12 FIELD AUDITS, SURVEILLANCES, AND INSPECTIONS

Audits, surveillances, and inspections are conducted regularly by the CDM Federal QA staff:

- to check on adherence to the QA/QC requirements specified in the project documents;
- to evaluate the procedures used for data collection, data handling, and project management;
- to verify that the QA program developed for this project is being implemented according to the specified requirements;
- to assess the effectiveness of the QA program; and
- to verify that identified deficiencies are corrected.

CDM Federal's policies and procedures are given in the CDM Federal *Quality Assurance Manual.* Specific procedures for scheduling and performing audits are given in QP 6 (Audits) of the CDM Federal *Quality Assurance Manual.* Specific procedures for scheduling and performing surveillances (QP 19) and inspections (QP 17) also are presented in the *Quality Assurance Manual.*

The Corporate QA Director is responsible for scheduling audits, surveillances, and inspections and will prepare a quarterly schedule planned to coincide with appropriate activities on the project schedule and sampling plans. The Contract QA Specialist is responsible for conducting or arranging audits, surveillances, and inspections. Scheduled audits, surveillances, and inspections may be supplemented by additional audits, surveillances, and inspections for one or more of the following reasons:

- significant changes are made in the QAPjP,
- significant personnel changes occur,
- it is necessary to verify that corrective action has been taken on a deficiency reported in a previous audit, or
- the additions are requested by the Corporate QA Director.

7.12.1 Audits

Audits are qualitative reviews of project activity to check that the overall CDM Federal QA program is functioning. Audits are conducted for projects that involve significant effort and have a long duration (several quarters). Audits should be conducted early in the project so that problems can be corrected quickly. An audit involves the review of all available and relevant project and contract documents and includes an evaluation of QC measures for field, laboratory, and office work.

Office audits evaluate the following:

- recordkeeping, including appropriate available field documentation, training, problem prevention, corrective action, change control, monthly reports, and other documentation of project work and QA measures;
- preparation of deliverables specified in the work plan;
- proper technical and QA review of documents; and
- filing, storage, and completeness of documents in the central files.

For this project, one office audit will be conducted by the Contract QA Specialist (D. Johnson) when approximately 30 to 50% of the work has been completed.

Field audits examine the following:

- cleaning/decontamination and storage of sampling equipment and containers;
- sample collection, preservation, custody, and shipping procedures;
- preparation and frequency of collection of QC samples;
- calibration, operation, and maintenance procedures; and
- documentation of field activities in the field logbook or appropriate data forms.

A field audit will not be performed because the field effort is of relatively short duration. However, a field surveillance will be conducted as discussed below.

Laboratory audits are conducted to verify that QA/QC measures specified in the QAPjP, laboratory QA Plan or other project documents are followed in the laboratory. The following items are reviewed during the laboratory audit:

- documentation of training, nonconformance reporting, and corrective action;
- frequency of QC checks, such as blanks and spikes;
- calibration and preventive maintenance records;
- chain-of-custody forms; and
- data review and filing procedures.

All laboratories used for this project will have been audited by Energy Systems and/or CDM Federal before initiation of fieldwork. Additional laboratory audits may be conducted during the performance of work.

7.12.2 Surveillances

Surveillances follow the same general format as an audit, but they are less detailed and require a less formal report. A surveillance is designed to provide rapid feedback to the project staff concerning QA compliance and to facilitate corrective action. Further discussion of surveillances is found in QP 19 of the CDM Federal *Quality Assurance Manual.*

Office surveillances may be performed as scheduled by the CDM Federal QA Director. For this project, one field surveillance is planned and will take place shortly after mobilization. Additional field surveillances will be conducted at ~4- to 6-week intervals or at critical milestones. The following activities and documentation will be subject to surveillance:

- soil sampling;
- groundwater sampling;
- surface water and sediment sampling;
- air sampling;
- equipment and supplies related to sampling, measurements, and calibration;
- chain-of-custody documentation;
- field documentation;
- field training records; and
- field QC procedures.

7.12.3 Inspections

An inspection is defined as an examination or measurement to verify whether an item or activity conforms to specified requirements. Inspections focus on field procedures, equipment, and supplies and are conducted early in the field effort to identify and resolve problems quickly. No stand-alone inspections are planned for this project because the field surveillance discussed in Sect. 7.12.2 will include a review of procedures, equipment, and

supplies. However, field inspections may be conducted if deemed necessary by the Corporate QA Director.

7.13 CORRECTIVE ACTION PROCEDURES

7.13.1 Nonconformances

Nonconforming equipment, items, activities, and conditions and unusual incidents that could affect compliance with project requirements will be identified, controlled, and reported in a timely manner. The Field Task Manager or Project Manager initiates the nonconformance reporting and corrective action process by completing a Nonconformance Report Form. The Y-12 ER Product Manager will be notified of any nonconformances and will be provided with a copy of the Nonconformance Report Form. An example of a Nonconformance Report Form is shown in Fig. 7.5. Nonconforming equipment will be immediately labeled or tagged and segregated, if possible. Specific procedures for controlling nonconforming items are described in the CDM Federal *Quality Assurance Manual* (QP 4, Control of Nonconforming Items). All work performed by ORNL ESD, which will include ecological risk assessment activities, will conform with requirements described in appropriate Energy Systems QA procedures.

7.13.2 Corrective Action

CDM Federal's corrective action system is described in the CDM Federal *Quality Assurance Manual* (QP 13, Corrective Action). This procedure requires that conditions adverse to quality be identified and documented and that corrective action be taken and verified. Specific procedures for controlling nonconforming items and the corrective action systems of the subcontract laboratories are contained in the respective laboratory QA Plans. Other team subcontractors (drilling and surveying) are required to follow equivalent corrective action procedures.

Each CDM Federal Team staff member is responsible for notifying the Field Task Manager, the Project Manager, the QA staff, or other responsible persons when he/she discovers a condition that may affect the quality of the work being performed. The staff and their specific corrective action responsibilities are the following:

- CDM Federal program manager has overall responsibility for implementing corrective actions.
- CDM Federal Corporate QA Director has overall responsibility for tracking and accepting corrective actions.
- CDM Federal Project Manager is responsible for implementing task-specific corrective actions.
- CDM Federal Field Task Manager is responsible for identifying and implementing corrective actions during field activities and for notifying the Project Manager and QA Director of conditions not immediately corrected.

NONCONFORMANCE REPORT

Job/Task Order No./Site location: _____

Name/ID No. of nonconforming item: _____

Nature of nonconformance: _____

_____

_____

_____

_____

Requirement/Specification not met: _____

_____

Identified by: _____ Date: _____

[Forward to property manager; copy to QA manager]

[Below for use by property manager]

Method of identification of nonconforming item (label, tag, etc.): _____

_____

Storage or hold location: _____

Disposition: *(circle)* Use-as-is Repair Rework Reject

Justification: _____

_____

Approved by: _____ *(Tech. Spec.)* Date: _____

Approved by: _____ *(Property Mgr.)* Date: _____

If item was repaired or reworked:
Reinspected and accepted by: _____ Date: _____

Information copies to: _____

EXAMPLE OF A NONCONFORMANCE REPORT FORM

CDM FEDERAL PROGRAMS CORPORATION
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CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 7.5

A417/121UI03/ASG

Fig. 7.5. Example of a Nonconformance Report Form.

- Subcontractor Laboratory Supervisor is responsible for identifying and implementing corrective action during analysis and for notifying the CDM Federal Project Manager and QA Director when applicable acceptance criteria or DQOs are not satisfied.

Immediate corrective actions will be noted in task notebooks. Deficiencies or nonconformances not immediately corrected will require formal corrective action as described in QP 13 (Corrective Action) in the CDM Federal *Quality Assurance Manual.* Deficiencies or nonconformances will be submitted to the ER Division for review.

7.14 QUALITY ASSURANCE REPORTS

As described in the CDM Federal *Quality Assurance Manual,* all levels of the CDM Federal Team QA staff are responsible for preparing QA reports. These reports include those described below.

- **Weekly Quality Status Reports**—The project manager is responsible for reporting quality problems to the program manager and QA director on a weekly basis.
- **Monthly QA Staff Reports**—The Contract QA Specialist (David O. Johnson) will submit a monthly activity report to the CDM Federal Corporate QA Director.
- **Laboratory Monthly Progress Report**—The subcontract laboratory will submit a report in accordance with ES/ER/TM-16 to the CDM Federal Project Manager by the 15th of the month following each month in which work is performed. This report will be forwarded to the Energy Systems Project Manager and the Energy Systems Analytical Project Office.
- **Audit, Surveillance, and Inspection Reports**—The results of each QA audit, surveillance, or inspection will be documented in a report that is distributed within 30 working days of the audit, surveillance, or inspection.
- **QA Sections in Project Reports**—All reports that present measurement data generated during the work assignment require a QA section addressing the quality of the data and its limitations. Each QA section will address, at a minimum:

  — precision, accuracy, and completeness achieved for reported measurement data in relation to goals for these indicators;

  — results of performance and system audits of the measurement work;

  — quality problems found and corrective actions taken; and

  — deviations from Field Sampling Plan and QAPjP.

All reviews and document checks will be documented. All deliverables produced for this project will be subject to at least the three QC reviews described below.

- **The technical review** will be performed by senior professionals who have not been involved in project management or data collection activities. This technical review will focus on technical statements, conclusions, and recommendations to ensure that they are justifiable and defensible.

- **The QA review** will be conducted by the QA staff to ensure that QA/QC requirements have been addressed.
- **The final review** will be performed by the Project Manager. This review will be conducted to ensure that the document addresses all contractual requirements.

7.15 QUALIFICATIONS AND TRAINING OF PERSONNEL

Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented on appropriate forms and placed in the project file as a record. At a minimum, the following records will be maintained in the project file:

- required reading reports;
- attendance lists; and
- certificates of qualification, as appropriate.

Project personnel will receive an orientation to the Work Plan, QAPjP, relevant ESPs, Health and Safety Plan, and their roles and responsibilities before participation in project activities. The field planning meeting will be the forum for the orientation. All field personnel will be required to read and familiarize themselves with the Work Plan, QAPjP, and Health and Safety Plan before completing any work at the site. A copy of the following documents will be available to all field personnel while in the field:

- CDM Federal *Quality Assurance Program Plan for Environmental Restoration Activities at the Y-12 Plant, Oak Ridge, Tennessee;*
- CDM Federal *Health and Safety Assurance Manual—Hazardous Waste Projects;*
- CDM Federal *Field Equipment Operation, Calibration, and Maintenance Manual*;
- RI Work Plan for Chestnut Ridge OU 1;
- RI Work Plan for Chestnut Ridge OU 1, which includes:
  - Site Data Needs (Chap. 6),
  - QAPjP (Chap. 7),
  - Health and Safety Plan (Chap. 8), and
  - Waste Management Plan (Chap. 9); and
- relevant Energy Systems ESPs.

In addition, during the field planning meeting the ESPs and other SOPs to be followed during field activities will be reviewed and/or demonstrated to serve as a methods refresher session. At a minimum, the records to be maintained include required reading reports, attendance lists, and certificates of qualification.

7.16 FIELD CHANGES

The CDM Federal *Quality Assurance Manual* requires that field changes be governed by control measures commensurate with those applied to the documentation of the original design. The procedures for control of field changes are the following:

- Major changes from approved field operating procedures, project scope, cost, or schedule will be documented on a Field Change Request Form (FCRF). An example FCRF is shown in Fig. 7.6. The Field Task Manager will initiate and maintain the FCRFs.

- Each FCRF requires the approval of the Energy Systems Project Manager before work proceeds. Approval by the Energy Systems Project Manager can be initiated on a verbal basis via telephone with follow-up sign-off. In no case will a subcontractor initiate a field change. If a field change is proposed by the client, it will be so recorded. Copies of the FCRFs will be kept on-site until the fieldwork is complete and then will be sent to the project files. Weekly reports prepared by the CDM Federal Project Manager serve as the mechanism for notifying the QA staff of field changes.
- Variances or minor changes to field operating procedures will be documented in the field logbook and reported on a weekly basis.
- If deemed necessary, the Field Sampling Plan, QAPjP, Health and Safety Plan, or other relevant documents will be revised, reviewed, approved, and reissued in accordance with CDM Federal's document control procedures. The Energy Systems Project Manager must approve each FCRF before work proceeds.
- For the ecological risk assessment tasks to be conducted by ORNL ESD, field changes will be recorded directly in the registered field notebooks. These are controlled documents.

FIELD CHANGE REQUEST FORM

Project No. _____ Field Change No. _____ Page__of__

Project: _____

Applicable Document: _____

Description: _____

_____

_____

_____

Reason for change: _____

_____

_____

_____

Recommended disposition: _____

_____

_____

_____

Impact on present and completed work: _____

_____

_____

_____

Requested by: _____ *(Field/Project Manager)*

Approval: _____ *(Energy Systems Project Manager)*

NOTE: the Energy Systems Project manager is notified of the need for change in project cost, schedule direction, or scope. This form does NOT satisfy Section 3, "Changes", of contract Terms and Conditions.

EXAMPLE OF FIELD CHANGE REQUEST FORM

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

CHESTNUT RIDGE SECURITY PITS
CHESTNUT RIDGE OU1

FIGURE No. 7.6

A1B/112JUN93/ASG

Fig. 7.6. Example of a Field Change Request Form.

ENVIRONMENTAL RESTORATION PROGRAM
HEALTH AND SAFETY PLAN

Revision No. 0

Project Title: REMEDIAL INVESTIGATION WORK PLAN FOR CHESTNUT RIDGE OPERABLE UNIT 1 (CHESTNUT RIDGE SECURITY PITS) AT THE OAK RIDGE Y-12 PLANT, OAK RIDGE, TENNESSEE

Prepared By: CDM Federal Programs Corporation

_____ Date:_____
Technical Support Contractor
Program Manager

Approved By: _____ Date:_____
Technical Support Contractor
Quality Assurance/Quality Control Officer

Approved By: _____ Date:_____
DOE-ER Division
Program Manager

Approved By: _____ Date:_____
DOE-ER Division
QA Program Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Program Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Project Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Quality Assurance Specialist

Approved By: _____ Date:_____
DOE-ER Division
Health and Safety Manager

Approved By: _____ Date:_____
Energy Systems-ER Division
Health and Safety Manager

8. ENVIRONMENTAL RESTORATION PROGRAM HEALTH AND SAFETY PLAN

8.1 HEAT AND COLD STRESS

Stress can contribute significantly to accidents or harm workers in other ways. The term *stress* denotes the physical (gravity, mechanical force, heat, cold, pathogen, injury) and psychological (fear, anxiety, crisis, joy) forces that are experienced by individuals. The body's response to stress occurs in the following three stages:

- **alarm reaction**—the body recognizes the stressor and the pituitary-adreno-cortical system responds by increasing the heart rate and blood sugar level, decreasing digestive activity, and dilating the pupils;
- **adaptive stage**—the body repairs the effects of stimulation and the stress symptoms disappear; and
- **exhaustion stage**—the body can no longer adapt to stress and the individual may develop emotional disturbances and cardiovascular and renal diseases.

The most common types of stress that affect field personnel are heat and cold stress. Current thinking is that heat and cold stress may be the most serious hazards to workers at waste sites.

8.1.1 Heat Stress

For field workers, heat stress usually is a result of protective clothing decreasing natural body ventilation, although it may occur at any time work is being performed at elevated temperatures.

If the body's physiological processes fail to maintain a normal body temperature because of excessive heat, a number of physical reactions can occur, ranging from mild (such as fatigue, irritability, anxiety, and decreased concentration, dexterity, or movement) to fatal. Because heat stress is one of the most common and potentially serious illnesses at hazardous waste sites, regular monitoring and other preventive measures are vital.

Site workers must learn to recognize and treat the various forms of heat stress. The best approach is preventive heat stress management. In general, the following steps should be undertaken.

- Drink 16 oz. of water before beginning work, such as in the morning or after lunch. Provide disposable, 4-oz. cups and water that is maintained at 50 to 60°F. Urge workers to drink one to two cups of water every 20 min, for a total of 1 to 2 gal/d. Provide a cool, shaded area for rest breaks. Discourage the use of alcohol in nonwork hours and discourage the intake of coffee during work hours. Monitor for signs of heat stress.
- Acclimate workers to site work conditions by slowly increasing workloads; that is, do not begin site work with extremely demanding activities.

- Provide cooling devices to aid natural body ventilation. These devices, however, add weight, and their use should be balanced against worker efficiency. An example of a cooling aid is long cotton underwear, which acts as a wick to help absorb moisture and protect the skin from direct contact with heat-absorbing protective clothing.
- Install mobile showers and/or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening in hot weather.
- Ensure that adequate shelter is available to protect personnel against heat, as well as cold, rain, snow, and so forth, which can decrease physical efficiency and increase the probability of both heat and cold stress. If possible, set up the command post in the shade.
- Rotate shifts of workers wearing impervious clothing in hot weather.
- Maintain good hygienic standards by frequently changing clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should immediately consult medical personnel.

8.1.1.1 Heat stroke

Heat stroke is an acute and dangerous reaction to heat stress caused by a failure of the heat regulating mechanisms of the body—the individual's temperature control system that causes sweating stops working correctly. Body temperature rises so high that brain damage and death will result if the person is not cooled quickly.

- Symptoms: Red, hot, dry skin, although victim may have been sweating earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rates; unconsciousness or coma.
- Treatment: Cool the patient quickly. If the body temperature is not brought down fast, permanent brain damage or death will result. Soak the patient in cool but not cold water, sponge the body with cool water, or pour water on the body to reduce the temperature to a safe level (102°F). Observe the patient and obtain medical help. Do not give the patient coffee, tea, or alcoholic beverages.

8.1.1.2 Heat exhaustion

Heat exhaustion is a state of very definite weakness or exhaustion caused by the loss of fluids from the body. This condition is much less dangerous than heat stroke, but it nonetheless must be treated.

- Symptoms: Pale, clammy, moist skin, profuse perspiration, and extreme weakness. Normal body temperature, weak and rapid pulse, and shallow breathing. The victim may have a headache, may vomit, and may be dizzy.
- Treatment: Remove the patient to a cool, air-conditioned place; loosen the clothing; place in a head-low position; and provide bed rest. Consult a physician, especially in severe cases. The normal thirst mechanism is not sensitive enough to ensure body fluid replacement. Have patient drink one to two cups of water immediately, and every 20 min thereafter, until symptoms subside. Total water consumption should be about 1 to 2 gal/d.

8.1.1.3 Heat cramps

Heat cramps are caused by perspiration that is not balanced by adequate fluid intake. Heat cramps are often the first sign of a condition that can lead to a heat stroke.

- Symptoms: Acute painful spasms of voluntary muscles (e.g., abdomen and extremities).
- Treatment: Remove patient to a cool area and loosen clothing. Have patient drink one to two cups of water immediately, and every 20 min thereafter, until symptoms subside. Total water consumption should be 1 to 2 gal/d. Consult a physician.

8.1.1.4 Heat rash

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by chafing clothes. The condition decreases the ability to tolerate heat.

- Symptoms: Mild red rash, especially in areas of the body in contact with protective gear.
- Treatment: Decrease the amount of time in protective gear and provide the patient with some powder to help absorb moisture and decrease chafing.

8.1.1.5 Heat stress monitoring and work cycle management

For strenuous field activities that are part of ongoing site work activities in hot weather, the following procedures will be used to monitor the body's physiological response to heat and to manage the work cycle, even if workers are not wearing impervious clothing. These procedures are to be instituted when the temperature exceeds 70°F.

- Measure heart rate—Heart rate should be measured by the radial pulse for 30 s as early as possible in the resting period. The heart rate at the beginning of the rest period should not exceed 110 beats/min. If the heart rate is higher, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the pulse rate still exceeds 110 beats/min at the beginning of the next rest period, the following work cycle should be further shortened by 33%. The procedure is continued until the rate is maintained below 110 beats/min.
- Measure body temperature—Body temperature should be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period should not exceed 99.6°F. If it does, the next work period should be shortened by 33%, while the length of the rest period stays the same. If the temperature exceeds 99.6°F at the beginning of the next period, the following work cycle should be further shortened by 33%. The procedure is continued until the body temperature is maintained below 99.6°F.
- Manage a work/rest schedule—The following work/rest schedule should be used as a guideline:

Adjusted temperature (°F)	*Active work time (min/h) using Level B/C protective gear*
75 or less	50
80	40

85	30
90	20
95	10
100	0

— Calculate the adjusted temperature:

T (adjusted) = T (actual) + (13 × fraction sunshine).

— Measure the air temperature with a standard thermometer. Estimate fraction of sunshine by judging what percent the sun is out:

100% sunshine = no cloud cover = 1.0
50% sunshine = 50% cloud cover = 0.5
0% sunshine = full cloud cover = 0.0.

— Reduce or increase the work cycle according to the guidelines under the heart rate and body temperature sections.

8.1.2 Cold Stress

Persons working outdoors in low temperatures, especially at or below freezing, are subject to cold stress. Exposure to extreme cold for a short time may cause severe injury to the surface of the body or result in profound generalized cooling, causing death. Areas of the body that have high surface area-to-volume ratios, such as fingers, toes, and ears, are the most susceptible.

Protective clothing generally does not afford protection against cold stress. In many instances, it *increases* susceptibility.

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. The term *wind chill* is used to describe the chilling effect of moving air in combination with low temperature. As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is soaked with perspiration.

8.1.2.1 Frostbite

Local injury resulting from cold is included in the generic term *frostbite*. Frostbite of the extremities can be categorized into the categories described below.

- Frost nip or incipient frostbite is characterized by sudden blanching or whitening of skin.
- Superficial frostbite is characterized by skin with a waxy or white appearance that is firm to the touch, but the tissue beneath is resilient.
- Deep frostbite is characterized by tissues that are cold, pale, and solid.

To administer first aid for frostbite, take the victim indoors and rewarm the affected areas *quickly* in water that is between 39 and 41°C (102 and 105°F). Give the victim a warm

drink—**not coffee, tea, or alcohol.** The victim must not smoke. Keep the frozen parts of the victim's body in warm water or covered with warm clothes for 30 min even though the tissue will be very painful as it thaws. Then elevate the injured area and protect it from injury. Do not allow blisters to be broken. Use sterile, soft material to cover the injured areas. Keep the victim warm and get immediate medical care.

After thawing, the victim should try to move the injured areas a little, but no more than can be done alone, without help.

- Do *not* rub the frostbitten part (this may cause gangrene).
- Do *not* use ice, snow, gasoline, or anything cold on the frostbitten area.
- Do *not* use heat lamps or hot water bottles to rewarm the part.
- Do *not* place the part near a hot stove.

8.1.2.2 Hypothermia

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in the following five stages:

- shivering;
- apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to <95°F;
- unconsciousness, glassy stare, slow pulse, and slow respiratory rate;
- freezing of the extremities; and
- death.

As a general rule, field activities shall be curtailed if equivalent chill temperature (°F), as defined by the U.S. Army Research Institute of Environmental Medicine, is below 0°F unless the activity is of an emergency nature.

8.2 HEALTH AND SAFETY PLAN

The Health and Safety Plan for the CRSP project is given on the following pages.

HEALTH AND SAFETY PLAN FORM CDM Federal Health and Safety Program	This document is for the exclusive use of CDM Federal, Energy Systems, DOE, and their subcontractors.	CDM FEDERAL PROGRAMS CORPORATION PROJECT DOCUMENT NO.: 7907-007-WP-BBLL

PROJECT NAME Chestnut Ridge Security Pits	WORK ASSIGNMENT NO. NA REGION SED
JOB SITE ADDRESS Oak Ridge Y-12 Plant approximately 800 ft southeast of central plant area.	CLIENT Martin Marietta Energy Systems, Inc. PROJECT NO. 7907-007
SITE CONTACT Charles T. Lutz	CLIENT CONTACT Judy Hodgins
PHONE NO. 482-1065	PHONE NO. 576-2368
( ) AMENDMENT NO. ____ TO EXISTING APPROVED HSP - DATE EXISTING APPROVED HSP _____	

OBJECTIVES OF FIELD WORK:

To obtain samples of surface waters/sediments, surface soils, subsurface soil, groundwater, and a variety of biological samples for chemical analysis and toxicity testing.

TYPE: Check as many as applicable

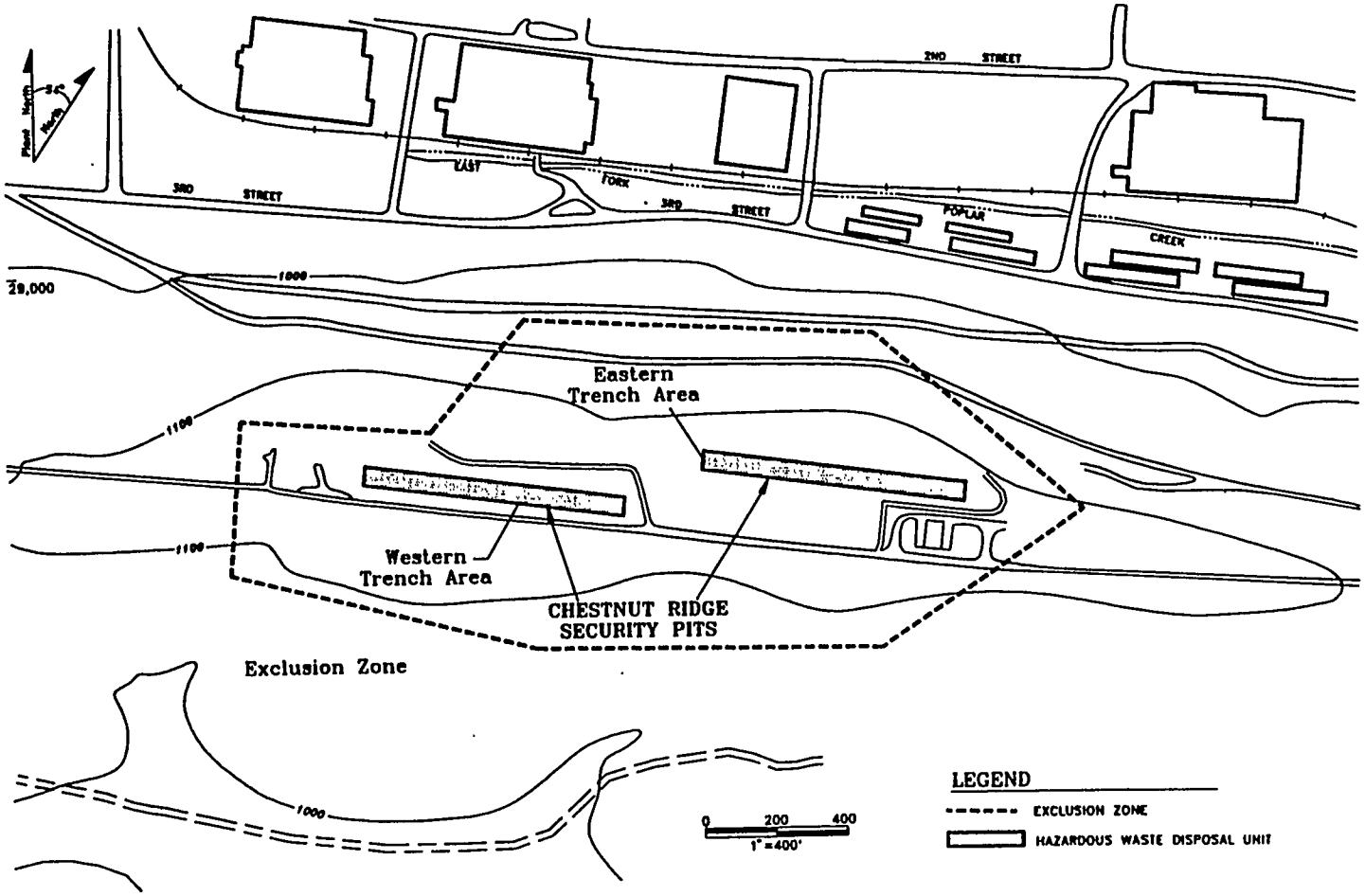
( ) Active	( ) Landfill	( ) Unknown
(X) Inactive	( ) Uncontrolled	( ) Military
(X) Secure	( ) Industrial	( ) Other specify:
( ) Unsecure	( ) Recovery	
( ) Enclosed space	( ) Well Field	

DESCRIPTION AND FEATURES: Summarize below. Include principal operations and unusual features (containers, buildings, dikes, power lines, hills, slopes, river)

The Chestnut Ridge Security Pits (CRSP) are located atop Chestnut Ridge southeast of the central portion of the Y-12 Plant. The CRSP consist of a series of trenches used for disposal of hazardous and nonhazardous materials, much of which were classified. The trenches are about 8 to 10 ft wide and 10 to 18 ft deep and were excavated in sections and filled as needed for waste disposal activities. After a trench was filled, it was covered with 6 to 12 inches of soil. Trenches range in length from 690 to 780 ft. Disposal in the pits ended in 1988, and the pits subsequently were closed with an engineered multi-layer cap.

SURROUNDING POPULATION: ( ) Residential (X) Industrial (X) Rural ( ) Urban ( ) OTHER:

THIS PAGE RESERVED FOR MAP (Show Exclusion, Contamination Reduction, and Support Zones. Indicate evacuation and reassembly points.)



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HISTORY: Summarize below. In addition to history, include complaints from public, previous agency actions, known exposures or injuries, etc.

The CRSP are located on the crest of Chestnut Ridge, southeast of the central portion of the Y-12 Plant. The site was operated from 1973 to 1988 and consists of a series of trenches that were used for disposal of hazardous waste materials. Disposal of hazardous waste was discontinued in December 1984, and nonhazardous waste disposal was discontinued in November 1988. The pits were subsequently capped and closed and are now covered with grass. The trenches are located in two adjacent areas. The eastern trench area consists of three trenches (Nos 1, 2, and 3). Associated with these three trenches were six auger holes, each approximately 2 ft in diameter and 10 ft deep. Auger holes were used for the disposal of reactive metals. The western trench area consists of four trenches (Nos. 4 through 7). Because of the secure nature of the wastes, detailed inventories are classified. An unclassified inventory of materials disposed at the pits show 11 major categories of waste, acids, fiberglass, beryllium, biologicals, debris, heavy metals, inorganics, organics, thorium, and uranium. The estimated tonnage disposed in the CRSP is approximately 3950 tons. Uranium represents about 1740 tons; ferrous materials, 501 tons; thorium, 444 tons; debris, 390 tons; inorganics, 383 tons; and all other categories of waste about 500 tons.

WASTE TYPES: (X) Liquid (X) Solid ( ) Sludge ( ) Gas (X) Unknown ( ) Other specify:

WASTE CHARACTERISTICS: Check as many as applicable.

(X) Corrosive ( ) Flammable (X) Radioactive

(X) Toxic (X) Volatile (X) Reactive

( ) Inert Gas (X) Unknown ( ) Other specify:

WORK ZONES: Describe the Exclusion and Contamination Reduction in terms onsite personnel will recognize.

The exclusion zone will be considered to be approximately 15 ft in radius at any sampling location. Adequate distance will be allowed so the activities can be accomplished easily. At all drilling locations the rig and the 15-ft radius around the sample location will be included in the exclusion zone. A contamination reduction zone will be set up just outside of the exclusion zone for personnel and sampling equipment. A contamination reduction zone will be set up for large equipment just east of the pits. The exclusion and contamination reduction zones will be color coded to identify waste characteristics.

HAZARDS OF CONCERN:

(X) Heat Stress attach guidelines (X) Noise

(X) Cold Stress attach guidelines (X) Inorganic Chemicals

( ) Explosive/Flammable (X) Organic Chemicals

( ) Oxygen Deficient (X) Motorized Traffic

(X) Radiological (X) Heavy Machinery

(X) Biological (X) Slips, Trips, & Falls

(X) Other specify: snakes, poison ivy, inclement weather

PRINCIPAL DISPOSAL METHODS AND PRACTICES: Summarize below:

Trenches were excavated for disposal of hazardous and nonhazardous materials. Trenches were backfilled and covered after disposal of wastes.

HEALTH AND SAFETY PLAN FORM

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HAZARDOUS MATERIAL SUMMARY: Circle waste type and estimate amounts by category

CHEMICALS Amounts/Units:	SOLIDS Amounts/Units:	SLUDGES Amounts/Units:	SOLVENTS Amounts/Units:	OILS Amounts/Units:	OTHER Amounts/Units:
[Acids]	Flyash	Paint	Halogenated (chloro, bromo) Solvents	Oily Wastes	Laboratory
Pickling Liquors	Asbestos	Pigments	Hydrocarbons	Gasoline	Pharmaceutical
Caustics	Milling/Mine Tailings	Metal Sludges	Alcohols	Diesel Oil	Hospital
Pesticides	Ferrous Smelter	POTW Sludge	Ketones	Lubricants	[Radiological]
Dyes/Inks	Nonferrous Smelter	Aluminum	Esters	PCBs	Municipal
Cyanides	[Metals]	Distillation Bottoms	Ethers	Polynuclear Aromatics	[Construction]
Phenols	Other	Other	Other	Other	Munitions
Halogens	**Specify:**	**Specify:**	**Specify:**	**Specify:**	Other
Dioxins					**Specify:**
Other					
Specify:					
[Unknown]					

OVERALL HAZARD EVALUATION: ( ) High (X) Medium ( ) Low ( ) Unknown (Where tasks have different hazards, evaluate each. Attach additional sheets if necessary.)

JUSTIFICATION: Slightly elevated concentrations of heavy metals and organics have been detected in the groundwater. Medium potential for inhalation hazard in that materials may be exposed during investigation activities. Because of the unknown materials, the overall hazard rating is medium although groundwater data do not exhibit high hazard.

FIRE/EXPLOSION POTENTIAL: ( ) High ( ) Medium (X) Low ( ) Unknown

BACKGROUND REVIEW: (X) COMPLETE ( ) INCOMPLETE

KNOWN CONTAMINANTS	HIGHEST OBSERVED CONCENTRATION	PEL/TLV	IDLH	SYMPTOMS/EFFECTS OF ACUTE EXPOSURE	PHOTOIONIZATION POTENTIAL
1,1,1-trichloroethane	230 ppb	350 ppm	1000 ppm	irritated eyes and nose	11.00
tetrachloroethene	73 ppb	25 ppm/CA	CA	irritated eyes, nose, and throat	9.32
1,1-dichloroethane	99 ppb	100 ppm	4000 ppm	CNS depression	11.06
1,1-dichloroethene	44 ppb	None	None		
1,2-dichloroethene	6 ppb	None	None		
trichloroethene	2 ppb	50 ppm/CA	CA	headache, visual disturbance	9.45
1,2-dichloroethane	2 ppb	None	None		
carbon tetrachloride	40 ppb	2 ppm/CA	CA	nausea, vomiting	11.47
methylene chloride	1 ppb	500 ppm/CA	CA	fatigue, weakness	11.32
acetone	3 ppb	750 ppm	20,000 ppm	irritated eyes, headache	9.69
aluminum	1.1 ppm	5 /m^3	NE	eyes, nose, throat irritated	NA
barium	.069 ppm	0.5 mg/m^3	1100 mg/m^3	muscle spasms	NA
boron	.89 ppm	10 mg/m^3	NE	nausea, skin rash	NA
chromium	.033 ppm	0.5 mg/m^3	250 μg/m^3	lung damage, skin sensitization	NA
copper	.12 ppm	1 mg/m^3	NE	metal taste	NA
iron	8.4 ppm	5 mg/m^3	NE	cough	NA
lead	.093 ppm	0.5 mg/m^3	700 mg/m^3	fatigue, insomnia	NA
nickel	.025 ppm	0.1 mg/m^3/CA	CA	skin sensitivity	NA
silicon	6.8 pm	5 mg/m^3	NE	pulmonary fibrosis	NA
strontium	.091 ppm	2 pCi/L	NE	none	NA
zinc	.53 ppm	10 mg/m^3	NE	metal taste, cough	NA
Uranium-234 -235 -238		0.2 mg/m^3/CA	CA	none	NA

NA=Not Available NE=None Established U=Unknown CA = Chemical should be treated as occupational carcinogen.

S=Soil SW=Surface Water T=Tailings W=Waste SD=Sediment
A=Air GW=Groundwater SL=Sludge D=Drums OFF=Offsite

HEALTH AND SAFETY PLAN FORM

CDM Federal Health and Safety Program

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CDM FEDERAL PROGRAMS CORPORATION

FIELD ACTIVITIES COVERED UNDER THIS PLAN				HAZARD
ACTIVITY DESCRIPTION/SPECIFIC TECHNIQUE-STANDARD OPERATING PROCEDURES/SITE LOCATION(Attach additional sheets as necessary)	Type	Primary	Contingency	SCHEDULE
1 Surface water/sediment sampling	Intrusive	D	C	Low
		Modified		
2 Groundwater sampling		D	C	Low
	Nonintrusive			
3 Biological Sampling		D		Low
	Nonintrusive		Exit Area	
4 Surface soil/subsurface soil sampling	Intrusive	D	C	Med
		Modified		
5 Surveying			D	Low
	Nonintrusive		Exit Area	

PERSONNEL* AND RESPONSIBILITIES (Include subcontractors)

NAME	FIRM/REGION	CDM Federal HEALTH CLEARANCE	RESPONSIBILITIES	ONSITE?
Charles Lutz	CDM FPC/SED	BT	WORK ASSIGNMENT MGR	1 - 2 - 3 - 4 - 5
Del R. Baird	CDM FPC/SED	BT-CS	SITE HEALTH & SAFETY COORDINATOR	1 - 2 - 3 - 4 - 5
Keith Owens	CDM FPC/SED	BT	ALTERNATE SITE H&S COORDINATOR	1 - 2 - 3 - 4 - 5
Angela Luckie	CDM FPC/SED	BT	STAFF	1 - 2 - 3 - 4 - 5
Brian Jenks	CDM FPC/SED	BT-DS	STAFF	1 - 2 - 3 - 4 - 5
Laurie Wylie	CDM FPC/SED	BT-DS	STAFF	1 - 2 - 3 - 4 - 5
Driller				- 4
Surveyor				- 5

All personnel must be 40-h OSHA 1910.120 trained with current refresher and be involved in a medical surveillance program.

HEALTH AND SAFETY PLAN FORM CDM Federal Health and Safety Program	This document is for the exclusive use of CDM Federal, Energy Systems, DOE, and their subcontractors.	CDM FEDERAL PROGRAMS CORPORATION

PROTECTIVE EQUIPMENT: Specify by activity. Indicate type and/or material as necessary. Use copies of this sheet if needed.

BLOCK A ACTIVITIES: 1 & 4 LEVEL: D - Modified (X) Primary ( ) Contingency

Respiratory: (X) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
(X) Safety Glasses:
( ) Face Shield:
( ) Goggles:
(X) Hard Hat: Drilling only
( ) Other:

Boots: ( ) Not Needed
(X) Boots: Leather steel-toed work boots
(X) Overboots: Nitrile
(X) Rubber: Surface water/sediment sampling only

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
(X) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
(X) Undergloves:
(X) Gloves: Nitril (Drilling)
( ) Overgloves:

( ) Other - specify below:

BLOCK B ACTIVITIES: 1 & 4 LEVEL: C ( ) Primary (X) Contingency

Respiratory: ( ) Not Needed
( ) SCBA, Airline:
(X) APR:
(X) Cartridge: Dust Filter/GMC-H
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
(X) Safety Glasses:
( ) Face Shield:
( ) Goggles:
(X) Hard Hat: Drilling only
( ) Other:

Boots: ( ) Not Needed
(X) Boots: Leather steel-toed work boots
(X) Overboots:
(X) Rubber: Surface water/sediment sampling only

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
(X) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
(X) Undergloves:
(X) Gloves: Nitril Drilling
0 Overgloves:

( ) Other - specify below:

BLOCK C ACTIVITIES: 2 LEVEL: D (X) Primary ( ) Contingency

Respiratory: (X) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
(X) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
(X) Boots: Leather steel-toed work boots
(X) Overboots: Nitrile
( ) Rubber:

Prot. Clothing: (X) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
( ) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
(X) Undergloves:
( ) Gloves:
( ) Overgloves:

( ) Other - specify below:

BLOCK D ACTIVITIES: 2 LEVEL: C ( ) Primary (X) Contingency

Respiratory: (X) Not Needed
( ) SCBA, Airline:
(X) APR:
(X) Cartridge: GMC-H
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
(X) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
(X) Boots: Leather steel-toed work boots
(X) Overboots: Nitrile
( ) Rubber:

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
(X) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
(X) Undergloves:
(X) Gloves: Nitrile
( ) Overgloves:

( ) Other - specify below:

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PROTECTIVE EQUIPMENT: Specify by activity. Indicate type and/or material as necessary. Use copies of this sheet if needed.

BLOCK E ACTIVITIES: 3 & 5 (X) Primary
LEVEL: D ( ) Contingency

Respiratory: (X) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
(X) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
(X) Boots: Leather steel-toed work boots
(X) Overboots:
( ) Rubber:

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
( ) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
(X) Undergloves:
(X) Gloves:
( ) Overgloves:

( ) Other - specify below:

BLOCK F ACTIVITIES: 1 - 2 - 3 - 4 - 5 - 6 ( ) Primary
LEVEL: A - B - C - D - Modified ( ) Contingency

Respiratory: ( ) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
( ) Boots:
( ) Overboots:
( ) Rubber:

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
( ) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

( ) Other - specify below:

BLOCK G ACTIVITIES: 1 - 2 - 3 - 4 - 5 - 6 ( ) Primary
LEVEL: A - B - C - D - Modified ( ) Contingency

Respiratory: ( ) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
( ) Boots:
( ) Overboots:
( ) Rubber:

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
( ) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

( ) Other - specify below:

BLOCK H ACTIVITIES: 1 - 2 - 3 - 4 - 5 - 6 ( ) Primary
LEVEL: A - B - C - D - Modified ( ) Contingency

Respiratory: ( ) Not Needed
( ) SCBA, Airline:
( ) APR:
( ) Cartridge:
( ) Escape Mask:
( ) Other:

Head and Eye: ( ) Not Needed
( ) Safety Glasses:
( ) Face Shield:
( ) Goggles:
( ) Hard Hat:
( ) Other:

Boots: ( ) Not Needed
( ) Boots:
( ) Overboots:
( ) Rubber:

Prot. Clothing: ( ) Not Needed
( ) Encapsulated Suit:
( ) Splash Suit:
( ) Apron:
( ) Tyvek Coverall:
( ) Saranex Coverall:
( ) Cloth Coverall:
( ) Other:

Gloves: ( ) Not Needed
( ) Undergloves:
( ) Gloves:
( ) Overgloves:

( ) Other - specify below:

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MONITORING EQUIPMENT: Specify by activity. Indicate type as necessary. Attach additional sheets as necessary.

INSTRUMENT	ACTIVITY	ACTION GUIDELINES	COMMENTS (Includes schedules of use)
Combustible Gas Indicator	4	0-10% LEL — No explosion hazard 10-25% LEL — Potential explosion hazard; notify SHSC. **>25% LEL — Explosion hazard; interrupt task/evacuate** 21.0% 02 — Oxygen normal <21.0% 02 — Oxygen deficient; notify SHSC **<19.5% 02 — Interrupt task/evacuate**	(X) Not Needed
Radiation Survey Meter	1 - 2 - 3 - 4 - 5	3X Background — Notify SHSC **>2mR/hr — Interrupt task/evacuate** >150 counts/min above background: — Interrupt Task	Alpha, beta, and gamma detectors will be used. ( ) Not Needed
Photoionization Detector Type HNu meter ( ) 11.7 ev ( ) 10.2 ev ( ) 9.8 ev ( ) ___ ev	1 - 2 - 3 - 4 (X) 11.7 ev ( ) 10.2 ev ( ) 9.8 ev ( ) ___ ev	Level D: Less than 2 ppm above background Level C: From 2 to 25 ppm above background	HNu will be used for screening during monitoring well opening and sampling activities. ( ) Not Needed
Flame Ionization Detector Type _____		**Specify:**	(X) Not Needed
Detector Tubes/Monitor Type Carbon Tetrachloride Type _____	1 - 2 - 4	Level D: Less than 2 ppm Level C: From 2 to 25 ppm	( ) Not Needed
Respirable Dust Monitor Type _____ Type _____		**Specify:**	(X) Not Needed
Other **Specify**		**Specify:**	

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DECONTAMINATION PROCEDURES

ATTACH SITE MAP INDICATING EXCLUSION, DECONTAMINATION, AND SUPPORT ZONES AS PAGE TWO

Personalized Decontamination Summarize below and/or attach diagram; discuss use of work zones. Discard disposable booties and gloves at CRZ as appropriate. Hands and face washed on leaving site. Shower stations will be identified at the initial safety meeting with the facility employees. ( ) Not Needed	Sampling Equipment Decontamination Summarize below and/or attach diagram; discuss use of work zones. Air monitoring equipment will require sponge wash and rinse if in contact with surfaces on-site. Mixing bowls, bailers, and spoons will be washed with non-ionic detergent, rinsed with tap water, rinsed with organic-free water, then rinsed with pesticide-grade isopropanol and allowed to air dry before wrapping in aluminum foil. Personnel will wear neoprene or nitrile gloves, apron, and safety glasses during equipment decontamination. ( ) Not Needed	Heavy Equipment Decontamination Summarize below and/or attach diagram; discuss use of work zones. Drilling rig will have no new paint surfaces, will be free of friable oxidation, will not have any oil or hydraulic leaks, and will be inspected before initial use on-site. Decontamination of all down-the-hole equipment will include the following steps: 1. Steam cleaning 2. Organic-free water rinse 3. Isopropanol rinse 4. Air dry 5. Transportation in visqueen (X) Not Needed
Containment and Disposal Method Contaminated personal protective equipment will be collected into contractor garbage bags and drummed into DOT-approved 17H 55-gal drums. Drums will be properly labeled and marked for storage on-site and subsequent disposal.	Containment and Disposal Method Excess soil cuttings will be returned to borehole or drummed and stored on-site for later disposal. Drums will be properly labeled and marked for storage on-site and subsequent disposal.	Containment and Disposal Method Decontamination liquids and solids will be contained in a bermed or sump area for pumping into 55-gal 17H or 17E DOT-approved drums. Drums will be properly labeled and marked for storage on-site and subsequent disposal.

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EMERGENCY CONTACTS		
Water Supply	On-site Storage Tanks	
Site Telephone	Currently unknown	
EPA Release Report No.	1-800-424-8802	
CDM 24-Hour Emergency:	1-800-55-PAGE	062180#
Facility Management	(615) 574-7172	Plant Shift Superintendent
Other (specify)		
CHEMTREC Emergency	1-800-424-9300	

EMERGENCY CONTACTS	NAME	PHONE
Health and Safety Manager	Chuck Myers	(703) 968-0900
Project Manager	Charles Lutz	(615) 482-1065
Health & Safety Coordinator		
Client Contact	Judy Hodgins	(615) 576-2368
Other (specify)		
Environmental Agency	TDEC	(615) 481-0995
State Spill Number		
Fire Department	Plant Fire Department	911
Police Department	Plant Security	(615) 574-7272
State Police	THP	(615) 693-7311
Health Department	Tenn. Health Department (Regional Office)	(615) 546-9221
Poison Control Center		911
Occupational Physician	David Barnes	(800) 229-3674

CONTINGENCY PLANS Summarize below:

Contingency will be based on field instrument readings and evaluation of hazard by the site safety officer. Upgrades in PPE are outlined on Page 6 of 11.

HEALTH AND SAFETY PLAN APPROVALS	
Prepared by:	Date:
SHSC Signature:	Date:
HSM Signature:	Date:

MEDICAL EMERGENCY	
Hospital Name: Methodist Medical Center	Phone: (615) 481-1000
Hospital Address: 990 Oak Ridge Turnpike, Oak Ridge, TN	
Name of Contact at Hospital:	
Name of 24-Hour Ambulance: Oak Ridge/Anderson County	Phone: (615) 457-2520

Route to Hospital (Attach map with route to hospital):
Exit site, turn right onto South Patrol Road. Proceed to Bear Creek Valley Road and exit the Y-12 Plant at Scarboro Road. Turn left onto Scarboro Road. Scarboro Road merges with Lafayette Drive just north of Bear Creek Road. Bear right onto Lafayette Drive. Follow Lafayette to Oak Ridge Turnpike. Turn right onto Turnpike, left at the first light into hospital.

Distance to Hospital: 3.5 - 4.0 miles

THIS PAGE RESERVED FOR HOSPITAL ROUTE MAP

The following personnel have read and fully understand the contents of this Health and Safety Plan and further agree to all requirements contained herein.

Name	Affiliation	Date	Signature

ENVIRONMENTAL RESTORATION PROGRAM
WASTE MANAGEMENT PLAN

Project Title: REMEDIAL INVESTIGATION WORK PLAN FOR CHESTNUT RIDGE OPERABLE UNIT 1 (CHESTNUT RIDGE SECURITY PITS) AT THE Y-12 PLANT, OAK RIDGE, TENNESSEE

Prepared By: CDM Federal Programs Corporation

_____ Date:_____
Technical Support Contractor
Program Manager

Approved By: _____ Date:_____
Technical Support Contractor
Quality Assurance/Quality Control Officer

Approved By: _____ Date:_____
DOE-ER Division
Program Manager

Approved By: _____ Date:_____
DOE-ER Division
QA Program Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Program Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Project Manager

Approved By: _____ Date:_____
Energy Systems
ER Site Quality Assurance Specialist

9. ENVIRONMENTAL RESTORATION PROGRAM WASTE MANAGEMENT PLAN

9.1 SCOPE

This Waste Management Plan outlines the procedures to be followed for the handling and management of investigation-derived waste (IDW) generated during the implementation of the RI Work Plan at Chestnut Ridge OU 1. Waste minimization will be practiced during both the generation and disposal of waste. Every attempt will be made to minimize the amount of waste generated during field sampling activities. Plastic sheeting will be reused as long as sample integrity is not compromised. Use of Tyvek coveralls will be limited to those activities presenting a threat of external contamination to the participant. While coveralls are not to be worn longer than a single work shift, every attempt will be made to minimize changes during the shift. Sediments and surface water not used for samples will be returned to the original collection location. Liquid wastes will be minimized by a combination of evaporation and sparing usage. Other waste minimization and reduction techniques will include segregation, decontamination, compaction, selection of personal protective equipment (PPE), material recycling, and selection of equipment. Every attempt will be made to keep waste types (low-level wastes, hazardous, etc.) segregated so that no mixed wastes are generated.

Waste minimization techniques will be documented in project logs and records. All waste streams will be assessed to implement minimization/prevention activities. Audits of the project waste minimization will be conducted to ensure adequacy and effective implementation. A waste generator evaluation score sheet for numerical evaluation of this project's waste minimization program will be completed and submitted to ER Central Waste Management.

Practices included in waste management will comply with procedures for the ER Program at the Y-12 Plant, *Waste Removal and Disposition through the Y-12 ER Program*, ER/Y-P2102 (IAD), Rev. 0, and with procedures outlined in the Energy Systems document *Environmental Surveillance Procedures, Quality Control Program*, ESH/Sub/87-21706/1, Rev. 1 (1990a), Method ESP-1000, *Waste Management*. In addition, a waste management planning checklist will be prepared in coordination with ER Waste Management.

Previous work at the site indicated that the primary COCs are VOCs. These contaminants have exceeded background levels in several monitoring wells at the CRSP; MCL exceedences have also occurred. The VOCs of greatest concern are 1,1,1-trichloroethane; tetrachloroethene; 1,1-dichloroethane; and 1,1-dichloroethene. Metals and radionuclides have also been detected in groundwater at the CRSP, although the concentrations were not excessively high. Exceedences of MCLs by metals and radionuclides have been reported only occasionally. Neither SVOCs (except for presumed laboratory contaminants) nor pesticides/polychlorinated biphenyls have been detected at the site. The generation of listed waste during this investigation is not anticipated.

9.2 PROJECT CONTACTS

The project contacts for this site are Jerome Miller, Energy Systems Project Manager, 574-3680; Chris Smith, Y-12 ER Waste Management, 576-6526; Charles Lutz, CDM Federal Project Manager, 482-1065

9.3 WASTE TYPES

A variety of IDW will be generated during the investigation. All IDW will be handled in accordance with Energy Systems Procedure ER/C-2101. An identification of each type of waste and activities responsible for its generation follow.

Soil Cuttings. All soil cuttings from all sampling locations, including those sampled with the Geoprobe, will be returned to the borehole. It is anticipated that no waste will be generated from the borings. If cuttings remain after the borehole is filled, they will be containerized.

Purge Water. Each monitoring well will be purged of three to five well volumes before sampling to ensure that samples taken for analysis are representative of formation water. Water generated during purging will be discharged to the ground surface in accordance with the Y-12 Plant policy. Field personnel will maintain continuous monitoring for VOCs and radionuclides during purging using an organic vapor analyzer; HNu; and an alpha, beta, gamma detector.

Decontamination Water. Decontamination water will be generated each time the sampling equipment is cleaned. This water will contain any solvents used for decontamination and may contain contaminants present at the site. Decontamination water will be placed in drums on-site in accordance with procedures outlined in Energy Systems Y-12 Procedure 70-903, *Transfer, Storage, and Disposal of Waste*. Steel, 55-gal, 17E DOT-approved drums will be used to store the decontamination water on-site. Filled drums will be taken to the West End Treatment Facility, where the contents will be emptied and treated.

Personal Protective Equipment. Although the suspected hazards at Chestnut Ridge OU 1 are low, on-site personnel will be required to wear PPE. Types of disposable PPE include Tyvek coveralls, gloves, plastic sheeting, and tape. These items will be bagged on-site and subsequently taken to a trash dumpster designated by ER personnel. The contents of the dumpster will ultimately be taken to the sanitary landfill at the Y-12 Plant.

During the field activities, additional Energy Systems and DOE requirements may be identified. Necessary revisions to the Waste Management Plan will ensure the inclusion of these additional requirements in the daily activities performed by each of the waste management personnel.

Analytical Waste. Analyses of samples taken during the RI will generate two types of waste: laboratory extracts and digestates and excess sample material. The contract laboratory will dispose of extracts, digestates, and excess sample material. Energy Systems has ultimate determination of the disposal of analytical wastes.

9.4 WASTE ESTIMATES

Only PPE is expected to be generated under this investigation. It will be disposed of in a designated dumpster then be disposed of at the Y-12 Plant Landfill.

9.5 WASTE STAGING AND STORAGE REQUIREMENTS

No wastes will be stored permanently at the site. All wastes will be transported to a storage area within the ORR. No public roads will be used for transportation of the wastes from the site.

10. REFERENCES

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APPENDIX A

GROUNDWATER QUALITY DATA

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Key to Water Quality Data for Chestnut Ridge Security Pits

Organic Compounds	G - 5 ug/L N - 10 ug/L V - 20 ug/L M - 50 ug/L X - 80 ug/L
Turbidity	G - Greater than 200 NTU
Coliform	N - None Found
All Parameters	<# - Not Detected, # = Detection Limit
Analytical Methods	ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy AAS - Atomic Absorption Spectroscopy FL - Fluorimetry

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RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-173 TOTAL	GW-173 TOTAL	GW-173 TOTAL	GW-173 TOTAL
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	5.1	0.36	0.86	0.61
ANTIMONY	.	.	<0.05	<0.05
BARIUM	0.021	0.017	0.0069	0.0074
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.041	0.11	0.062	0.044
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	39	38	39	41
CHROMIUM	0.032	<0.01	0.013	<0.01
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	0.13	<0.004	0.042	0.053
IRON	43	1.3	4.7	7.5
LITHIUM	<0.004	<0.004	<0.004	<0.004
MAGNESIUM	28	23	23	24
MANGANESE	0.13	0.015	0.031	0.033
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01
NICKEL	0.098	<0.01	0.026	0.027
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	0.35	<0.2	<0.2	<0.2
POTASSIUM	1.8	2.9	2.1	1.3
SILICON	15	4.2	4.8	5.1
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	2.4	1.4	1.6	1.6
STRONTIUM	0.0088	5.0E-04	<0.0004	0.018
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	0.11	0.0036	0.019	0.0055
VANADIUM	0.0054	<0.005	<0.005	<0.005
ZINC	0.069	<0.001	<0.001	0.025
ZIRCONIUM	<0.005	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	0.006	<0.005	<0.005	<0.005
LEAD	0.073	0.016	0.011	0.019
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	4.0E-04	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	73	<1	2	<2
BETA ACTIVITY (PCI/L)	135	2.93	4	<2
URANIUM	0.015	1.0E-03	0.003	0.002
RADIUM (BQ/L)	<0.1	<0.1	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-173 DISSOLVED	GW-173 DISSOLVED	GW-173 DISSOLVED	GW-173 DISSOLVED
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	0.064	<0.02	<0.02	0.038
ANTIMONY	<0.05	.	<0.05	<0.05
BARIUM	0.0048	0.013	0.0041	0.0044
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.027	<0.004	0.026	0.031
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	32	38	36	38
CHROMIUM	<0.01	<0.01	<0.01	<0.01
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	<0.004	<0.004	0.014	<0.004
IRON	0.051	<0.004	<0.004	0.027
LITHIUM	<0.004	<0.004	<0.004	<0.004
MAGNESIUM	25	23	23	23
MANGANESE	0.033	0.0016	0.0045	0.0025
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01
NICKEL	0.023	<0.01	<0.01	<0.01
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	2	1.9	1.7	1.8
SILICON	3.6	3.6	3.6	3.7
SILVER	<0.006	0.14	<0.006	<0.006
SODIUM	2.5	1.3	1.5	1.7
STRONTIUM	0.0025	<0.0004	<0.0004	0.016
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	0.0074	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005	<0.005
ZINC	<0.001	<0.001	<0.001	<0.001
ZIRCONIUM	0.0073	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005	<0.005
LEAD	<0.004	<0.004	<0.004	0.009
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.	.
URANIUM	0.01	0.002	0.002	0.002
RADIUM (BQ/L)	.	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
WATER LEVEL (FT +/- GRADE)	.	-144.9	-158	-155
WATER TEMP (DEG. CENT.)	15.3	19.7	22.8	20.2
DISSOLVED OXYGEN	4	11.2	9.5	7.4
CONDUCTIVITY (IN UMHOS/CM)	270	330	360	340
PH (IN PH UNITS)	8.3	7.5	8.2	8.4
REDOX (IN MV)	72	197	175	192
ALKALINITY (CO3)	.	.	.	.
ALKALINITY (HCO3)	.	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.	.
AMMONIA - N	.	.	.	.
TURBIDITY (IN NTU)	.	.	.	.
COLIFORM (CC/100 MLS)	G	24	111	74
FLUORIDE	N	N	N	N
PHENOLS	0.18	<0.1	0.2	0.1
CHLORIDE	0.003	0.002	0.007	0.006
NITRATE NITROGEN	<1	2.2	3.1	3.7
NITRATE	.	1.11	1.06	1
NITRITE	3.4	.	.	.
SULFATE	.	.	.	.
	9.3	5.7	5.9	7.6

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
CHLOROMETHANE	N	N	N	N
BROMOMETHANE	N	N	N	N
VINYL CHLORIDE	N	N	N	N
CHLOROETHANE	N	N	N	N
METHYLENE CHLORIDE	G	G	G	G
ACETONE	N	N	N	N
CARBON DISULFIDE	G	G	G	G
1,1-DICHLOROETHENE	G	G	G	G
1,1-DICHLOROETHANE	G	G	G	G
TRANS-1,2-DICHLOROETHENE	G	G	G	G
CHLOROFORM	G	G	5	3
1,2-DICHLOROETHANE	G	G	G	G
2-BUTANONE	N	N	N	N
1,1,1-TRICHLOROETHANE	G	G	5	3
CARBON TETRACHLORIDE	G	G	G	G
VINYL ACETATE	N	N	N	N
BROMODICHLOROMETHANE	G	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	4	G
1,2-DICHLOROPROPANE	G	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G	G
TRICHLOROETHENE	G	G	G	2
CHLORODIBROMOMETHANE	G	G	G	G
1,1,2-TRICHLOROETHANE	G	G	G	G
BENZENE	G	G	G	G
CIS-1,3-DICHLOROPROPENE	G	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N	N
BROMOFORM	G	G	G	G
2-HEXANONE	N	N	N	N
4-METHYL-2-PENTANONE	N	N	N	N
TETRACHLOROETHENE	G	7	4	22
TOLUENE	G	G	13	1
CHLOROBENZENE	G	G	G	G
ETHYLBENZENE	G	G	G	G
STYRENE	G	G	G	G
XYLENES	G	G	G	1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
2,4-D	<1	<2	<2	<1
ENDRIN	<0.05	<0.1	<0.1	<0.1
LINDANE	<0.01	<0.02	<0.02	<0.02
METHOXYCHLOR	<0.04	<0.08	<0.08	<0.08
SILVEX	<0.1	<0.2	<0.2	<0.1
TOXAPHENE	<1	<2	<2	<2

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS.
UNIT IS UG/L

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
N-NITROSODIMETHYLAMINE	N	N	N	N
PHENOL	N	N	N	6
ANILINE	N	N	N	N
BIS(2-CHLOROETHYL) ETHER	N	N	N	N
2-CHLOROPHENOL	N	N	N	N
1,3-DICHLOROBENZENE	N	N	N	N
1,4-DICHLOROBENZENE	N	N	N	N
BENZYL ALCOHOL	N	N	N	N
1,2-DICHLOROBENZENE	N	N	N	N
2-METHYLPHENOL	N	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	N	N	N	N
4-METHYLPHENOL	N	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N	N
HEXACHLOROETHANE	N	N	N	N
NITROBENZENE	N	N	N	N
ISOPHORONE	N	N	N	N
2-NITROPHENOL	N	N	N	N
2,4-DIMETHYLPHENOL	N	N	N	N
BENZOIC ACID	N	N	N	N
BIS(2-CHLOROETHOXY) METHANE	N	N	N	N
2,4-DICHLOROPHENOL	N	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N	N
NAPHTHALENE	N	N	N	N
4-CHLOROANILINE	N	N	N	N
HEXACHLOROBUTADIENE	N	N	N	N
4-CHLORO-3-METHYLPHENOL	N	N	N	N
2-METHYLNAPHTHALENE	N	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N	N
2,4,5-TRICHLOROPHENOL	N	N	N	N
2-CHLORONAPHTHALENE	N	N	N	N
2-NITROANILINE	N	N	N	N
DIMETHYLPHTHALATE	N	N	N	N
ACENAPHTHYLENE	N	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
3-NITROANILINE	M	M	M	M
ACENAPHTHENE	M	M	M	M
2,4-DINITROPHENOL	M	M	M	M
4-NITROPHENOL	M	M	M	M
DIBENZOFURAN	M	M	M	M
2,4-DINITROTOLUENE	M	M	M	M
2,6-DINITROTOLUENE	M	M	M	M
DIETHYLPHTHALATE	M	M	M	M
4-CHLOROPHENYL PHENYL ETHER	M	M	M	M
FLUORENE	M	M	M	M
4-NITROANILINE	M	M	M	M
4,6-DINITRO-2-METHYLPHENOL	M	M	M	M
N-NITROSODIPHENYLAMINE	M	M	M	M
4-BROMOPHENYL PHENYL ETHER	M	M	M	M
HEXACHLOROBENZENE	M	M	M	M
PENTACHLOROPHENOL	M	M	M	M
PHENANTHRENE	M	M	M	M
ANTHRACENE	M	M	M	M
DI-N-BUTYLPHTHALATE	M	2	M	M
FLUORANTHENE	M	M	M	M
BENZIDINE	X	X	X	X
PYRENE	M	M	M	M
BUTYL BENZYL PHTHALATE	M	M	M	M
3,3'-DICHLOROBENZIDINE	V	V	V	V
BENZO (A) ANTHRACENE	M	M	M	M
BIS (2-ETHYLHEXYL) PHTHALATE	M	277	M	36
CHRYSENE	M	M	M	M
DI-N-OCTYLPHTHALATE	M	7	M	3
BENZO (B) FLUORANTHENE	M	M	M	M
BENZO (K) FLUORANTHENE	M	M	M	M
BENZO (A) PYRENE	M	M	M	M
INDENO (1,2,3-CD) PYRENE	M	M	M	M
DIBENZO (A,H) ANTHRACENE	M	M	M	M
BENZO (G,H,I) PERYLENE	M	M	M	M

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-173	GW-173	GW-173	GW-173
DATE SAMPLED	02/04/86	04/15/86	07/29/86	10/17/86
TIME SAMPLED	15:00:00	11:05:00	16:15:00	11:45:00
CONDUCTIVITY (IN UMHOS/CM)	322	324	389	377
	316	332	386	375
	326	333	384	374
	325	334	385	379
PH (IN PH UNITS)	7.8	7.7	7.8	8.3
	7.7	7.7	7.8	8.2
	7.7	7.7	7.8	8.2
	.	7.9	7.8	8.2
TOTAL ORGANIC CARBON	13	49	58	56
	12	50	57	57
	15	49	55	55
	.	49	47	59
TOTAL ORGANIC CHLORIDE	24	7	83	<10
	26	10	119	<10
	24	12	86	<10
	26	<5	111	<10

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-174 TOTAL
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
METHOD	ICAP
ALUMINUM	12
ANTIMONY	<0.05
BARIUM	0.14
BERYLLIUM	0.0012
BORON	0.093
CADMIUM	<0.003
CALCIUM	48
CHROMIUM	0.074
COBALT	<0.005
COPPER	0.084
IRON	110
LITHIUM	0.0076
MAGNESIUM	36
MANGANESE	0.42
MOLYBDENUM	<0.01
NICKEL	0.032
NIOBIUM	<0.007
PHOSPHOROUS	1.1
POTASSIUM	11
SILICON	35
SILVER	<0.006
SODIUM	10
STRONTIUM	0.1
THORIUM	<0.2
TITANIUM	0.084
VANADIUM	0.0072
ZINC	0.15
ZIRCONIUM	<0.005
METHOD	AAS
ARSENIC	0.021
LEAD	0.065
SELENIUM	<0.005
THALLIUM	<0.01
MERCURY	<0.0002
ALPHA ACTIVITY. (PCI/L)	51
BETA ACTIVITY (PCI/L)	108
URANIUM	0.008
RADIUM (BQ/L)	0.4

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-174 DISSOLVED
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
METHOD	ICAP
ALUMINUM	0.08
ANTIMONY	<0.05
BARIUM	0.0098
BERYLLIUM	<0.0003
BORON	0.021
CADMIUM	<0.003
CALCIUM	24
CHROMIUM	<0.01
COBALT	<0.005
COPPER	<0.004
IRON	0.015
LITHIUM	<0.004
MAGNESIUM	19
MANGANESE	0.05
MOLYBDENUM	<0.01
NICKEL	<0.01
NIOBIUM	<0.007
PHOSPHOROUS	<0.2
POTASSIUM	10
SILICON	3.8
SILVER	<0.006
SODIUM	9.9
STRONTIUM	0.039
THORIUM	<0.2
TITANIUM	0.006
VANADIUM	<0.005
ZINC	<0.001
ZIRCONIUM	0.007
METHOD	AAS
ARSENIC	<0.005
LEAD	<0.004
SELENIUM	<0.005
THALLIUM	<0.01
MERCURY	<0.0002
ALPHA ACTIVITY (PCI/L)	.
BETA ACTIVITY (PCI/L)	.
URANIUM	0.004
RADIUM (BQ/L)	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
WATER LEVEL (FT +/- GRADE)	-3
WATER TEMP (DEG. CENT.)	17
DISSOLVED OXYGEN	3.2
CONDUCTIVITY (IN UMHOS/CM)	270
PH (IN PH UNITS)	7.9
REDOX (IN MV)	110
ALKALINITY (CO3)	.
ALKALINITY (HCO3)	.
TOTAL SUSPENDED SOLIDS	.
TOTAL KJELDAHL NITROGEN	.
AMMONIA - N	.
TURBIDITY (IN NTU)	G
COLIFORM (CC/100 MLS)	N
FLUORIDE	0.14
PHENOLS	0.01
CHLORIDE	<1
NITRATE NITROGEN	0.16
NITRATE	.
NITRITE	.
SULFATE	9.8

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
CHLOROMETHANE	N
BROMOMETHANE	N
VINYL CHLORIDE	N
CHLOROETHANE	N
METHYLENE CHLORIDE	G
ACETONE	N
CARBON DISULFIDE	G
1,1-DICHLOROETHENE	G
1,1-DICHLOROETHANE	G
TRANS-1,2-DICHLOROETHENE	G
CHLOROFORM	G
1,2-DICHLOROETHANE	G
2-BUTANONE	N
1,1,1-TRICHLOROETHANE	G
CARBON TETRACHLORIDE	G
VINYL ACETATE	N
BROMODICHLOROMETHANE	G
1,1,2,2-TETRACHLOROETHANE	G
1,2-DICHLOROPROPANE	G
TRANS-1,3-DICHLOROPROPENE	G
TRICHLOROETHENE	G
CHLORODIBROMOMETHANE	G
1,1,2-TRICHLOROETHANE	G
BENZENE	G
CIS-1,3-DICHLOROPROPENE	G
2-CHLOROETHYLVINYL ETHER	N
BROMOFORM	G
2-HEXANONE	N
4-METHYL-2-PENTANONE	N
TETRACHLOROETHENE	20
TOLUENE	G
CHLOROBENZENE	G
ETHYLBENZENE	G
STYRENE	G
XYLENES	G

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
2,4-D	<1
ENDRIN	<0.05
LINDANE	<0.01
METHOXYCHLOR	<0.04
SILVEX	<0.1
TOXAPHENE	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
N-NITROSODIMETHYLAMINE	N
PHENOL	N
ANILINE	N
BIS(2-CHLOROETHYL) ETHER	N
2-CHLOROPHENOL	N
1,3-DICHLOROBENZENE	N
1,4-DICHLOROBENZENE	N
BENZYL ALCOHOL	N
1,2-DICHLOROBENZENE	N
2-METHYLPHENOL	N
BIS(2-CHLOROISOPROPYL) ETHER	N
4-METHYLPHENOL	N
N-NITROSODI-N-PROPYLAMINE	N
HEXACHLOROETHANE	N
NITROBENZENE	N
ISOPHORONE	N
2-NITROPHENOL	N
2,4-DIMETHYLPHENOL	N
BENZOIC ACID	N
BIS(2-CHLOROETHOXY) METHANE	N
2,4-DICHLOROPHENOL	N
1,2,4-TRICHLOROBENZENE	N
NAPHTHALENE	N
4-CHLOROANILINE	N
HEXACHLOROBUTADIENE	N
4-CHLORO-3-METHYLPHENOL	N
2-METHYLNAPHTHALENE	N
HEXACHLOROCYCLOPENTADIENE	N
2,4,6-TRICHLOROPHENOL	N
2,4,5-TRICHLOROPHENOL	N
2-CHLORONAPHTHALENE	N
2-NITROANILINE	N
DIMETHYLPHTHALATE	N
ACENAPHTHYLENE	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
3-NITROANILINE	N
ACENAPHTHENE	N
2,4-DINITROPHENOL	N
4-NITROPHENOL	N
DIBENZOFURAN	N
2,4-DINITROTOLUENE	N
2,6-DINITROTOLUENE	N
DIETHYLPHTHALATE	N
4-CHLOROPHENYL PHENYL ETHER	N
FLUORENE	N
4-NITROANILINE	N
4,6-DINITRO-2-METHYLPHENOL	N
N-NITROSODIPHENYLAMINE	N
4-BROMOPHENYL PHENYL ETHER	N
HEXACHLOROBENZENE	N
PENTACHLOROPHENOL	N
PHENANTHRENE	N
ANTHRACENE	N
DI-N-BUTYLPHTHALATE	N
FLUORANTHENE	N
BENZIDINE	X
PYRENE	N
BUTYL BENZYL PHTHALATE	N
3,3'-DICHLOROBENZIDINE	V
BENZO(A)ANTHRACENE	N
BIS(2-ETHYLHEXYL)PHTHALATE	N
CHRYSENE	N
DI-N-OCTYLPHTHALATE	N
BENZO(B)FLUORANTHENE	N
BENZO(K)FLUORANTHENE	N
BENZO(A)PYRENE	N
INDENO(1,2,3-CD)PYRENE	N
DIBENZO(A,H)ANTHRACENE	N
BENZO(G,H,I)PERYLENE	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-174
DATE SAMPLED	02/04/86
TIME SAMPLED	11:04:00
CONDUCTIVITY (IN UMHOS/CM)	320
	325
	320
	334
PH (IN PH UNITS)	7.9
	7.8
	7.9
	7.8
TOTAL ORGANIC CARBON	35
	37
	38
	38
TOTAL ORGANIC CHLORIDE	9
	8
	9
	11

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176 TOTAL	GW-176 TOTAL	GW-176 TOTAL FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
METHOD	ICAP	ICAP	ICAP
ALUMINUM	38	1	3.4
ANTIMONY	<0.05	.	.
BARIUM	0.11	0.013	0.023
BERYLLIUM	0.014	<0.0003	6.0E-04
BORON	2.6	1.6	1.6
CADMIUM	<0.003	<0.003	<0.003
CALCIUM	120	48	50
CHROMIUM	0.036	<0.01	<0.01
COBALT	0.029	<0.005	<0.005
COPPER	0.14	<0.004	0.015
IRON	97	1.6	5.2
LITHIUM	0.15	0.071	0.071
MAGNESIUM	69	30	31
MANGANESE	2.7	0.074	0.2
MOLYBDENUM	<0.01	<0.01	<0.01
NICKEL	0.17	<0.01	<0.01
NIOBIUM	<0.007	<0.007	<0.007
PHOSPHOROUS	1.7	<0.2	<0.2
POTASSIUM	5.1	1.4	1.5
SILICON	56	5.8	8.6
SILVER	<0.006	<0.006	<0.006
SODIUM	0.65	0.5	1.2
STRONTIUM	<0.0004	<0.0004	8.0E-04
THORIUM	<0.2	<0.2	<0.2
TITANIUM	0.58	0.024	0.058
VANADIUM	0.17	<0.005	<0.005
ZINC	1.2	0.0074	0.065
ZIRCONIUM	0.017	<0.005	<0.005
METHOD	AAS	AAS	AAS
ARSENIC	0.108	<0.005	<0.005
LEAD	0.219	0.013	0.011
SELENIUM	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01
MERCURY	6.0E-04	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	76	14.05	20.89
BETA ACTIVITY (PCI/L)	83	22.52	27.12
URANIUM	0.01	0.003	0.005
RADIUM (BQ/L)	0.24	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176 TOTAL	GW-176 TOTAL	GW-176 TOTAL FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
METHOD	ICAP	ICAP	ICAP
ALUMINUM	1	0.095	0.091
ANTIMONY	<0.05	<0.05	<0.05
BARIUM	0.011	0.012	0.012
BERYLLIUM	<0.0003	<0.0003	<0.0003
BORON	0.84	0.2	0.2
CADMIUM	<0.003	<0.003	<0.003
CALCIUM	47	39	39
CHROMIUM	<0.01	0.013	0.012
COBALT	<0.005	<0.005	<0.005
COPPER	0.03	<0.004	<0.004
IRON	1.2	0.064	0.063
LITHIUM	0.039	0.0069	0.0073
MAGNESIUM	30	23	23
MANGANESE	0.055	0.0049	0.0052
MOLYBDENUM	<0.01	<0.01	<0.01
NICKEL	0.012	<0.01	<0.01
NIOBIUM	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2
POTASSIUM	1.2	<0.6	<0.6
SILICON	5.8	4.6	4.6
SILVER	<0.006	<0.006	<0.006
SODIUM	0.62	0.75	0.75
STRONTIUM	<0.0004	0.022	0.022
THORIUM	<0.2	<0.2	<0.2
TITANIUM	0.024	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005
ZINC	<0.001	0.0077	0.0075
ZIRCONIUM	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005
LEAD	0.006	0.005	0.006
SELENIUM	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	2	<3	<3
BETA ACTIVITY (PCI/L)	3	5	5
URANIUM	<0.001	1.0E-03	<0.001
RADIUM (BQ/L)	<0.1	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176 DISSOLVED	GW-176 DISSOLVED	GW-176 DISSOLVED FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
METHOD	ICAP	ICAP	ICAP
ALUMINUM	0.051	<0.02	<0.02
ANTIMONY	<0.05	.	.
BARIUM	0.0084	0.01	0.017
BERYLLIUM	<0.0003	<0.0003	<0.0003
BORON	2.5	1.6	1.5
CADMIUM	<0.003	<0.003	<0.003
CALCIUM	46	49	47
CHROMIUM	<0.01	<0.01	<0.01
COBALT	<0.005	<0.005	<0.005
COPPER	<0.004	<0.004	<0.004
IRON	0.014	0.01	<0.004
LITHIUM	0.11	0.069	0.065
MAGNESIUM	32	30	29
MANGANESE	0.0041	0.016	0.05
MOLYBDENUM	<0.01	<0.01	<0.01
NICKEL	<0.01	<0.01	<0.01
NIOBIUM	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2
POTASSIUM	1.3	0.87	1.3
SILICON	5.7	4	4.4
SILVER	<0.006	<0.006	<0.006
SODIUM	0.59	0.65	0.59
STRONTIUM	<0.0004	<0.0004	0.0013
THORIUM	<0.2	<0.2	<0.2
TITANIUM	0.0053	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005
ZINC	<0.001	<0.001	<0.001
ZIRCONIUM	0.0051	<0.005	<0.005
METHOD	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005
LEAD	0.004	0.004	0.004
SELENIUM	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.
URANIUM	0.002	0.002	0.004
RADIUM (BQ/L)	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176 DISSOLVED	GW-176 DISSOLVED	GW-176 DISSOLVED FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
METHOD	ICAP	ICAP	ICAP
ALUMINUM	<0.02	0.059	0.082
ANTIMONY	<0.05	<0.05	<0.05
BARIUM	0.0087	0.012	0.012
BERYLLIUM	<0.0003	<0.0003	<0.0003
BORON	0.84	0.21	0.21
CADMIUM	<0.003	<0.003	<0.003
CALCIUM	45	38	39
CHROMIUM	<0.01	0.011	<0.01
COBALT	<0.005	<0.005	<0.005
COPPER	0.013	<0.004	<0.004
IRON	<0.004	0.0096	0.0085
LITHIUM	0.038	0.008	0.0076
MAGNESIUM	29	23	23
MANGANESE	0.013	<0.001	<0.001
MOLYBDENUM	<0.01	<0.01	<0.01
NICKEL	<0.01	<0.01	<0.01
NIOBIUM	0.018	0.019	0.01
PHOSPHOROUS	<0.2	<0.2	<0.2
POTASSIUM	1	<0.6	0.79
SILICON	4.4	4.5	4.5
SILVER	<0.006	<0.006	<0.006
SODIUM	0.71	0.76	0.71
STRONTIUM	<0.0004	0.021	0.021
THORIUM	<0.2	<0.2	<0.2
TITANIUM	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005
ZINC	<0.001	0.0058	0.0039
ZIRCONIUM	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005
LEAD	<0.004	<0.004	<0.004
SELENIUM	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.
URANIUM	<0.001	<0.001	<0.001
RADIUM (BQ/L)	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
WATER LEVEL (FT +/- GRADE)	-118.1	-113.2	.
WATER TEMP (DEG. CENT.)	14	27.6	.
DISSOLVED OXYGEN	5.8	8.6	.
CONDUCTIVITY (IN UMHOS/CM)	400	440	.
PH (IN PH UNITS)	7.42	7.4	.
REDOX (IN MV)	153	155	.
ALKALINITY (CO3)	.	.	.
ALKALINITY (HCO3)	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.
AMMONIA - N	.	.	.
TURBIDITY (IN NTU)	G	45	118
COLIFORM (CC/100 MLS)	N	N	N
FLUORIDE	0.1	<0.1	<0.1
PHENOLS	0.004	<0.001	1.0E-03
CHLORIDE	<1	1.7	1.8
NITRATE NITROGEN	0.27	0.41	0.43
NITRATE	.	.	.
NITRITE	.	.	.
SULFATE	1	<1	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMET
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
WATER LEVEL (FT +/- GRADE)	-115.3	-116.2	.
WATER TEMP (DEG. CENT.)	26.6	15.6	.
DISSOLVED OXYGEN	8.9	7.2	.
CONDUCTIVITY (IN UMHOS/CM)	390	330	.
PH (IN PH UNITS)	7.6	6.9	.
REDOX (IN MV)	230	256	.
ALKALINITY (CO3)	.	.	.
ALKALINITY (HCO3)	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.
AMMONIA - N	.	.	.
TURBIDITY (IN NTU)	27	1	1
COLIFORM (CC/100 MLS)	N	1	1
FLUORIDE	0.1	<0.1	<0.1
PHENOLS	0.005	0.016	0.005
CHLORIDE	1.5	1.8	1.8
NITRATE NITROGEN	0.43	1.7	1.8
NITRATE	.	.	.
NITRITE	.	.	.
SULFATE	1.3	<1	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
CHLOROMETHANE	N	N	N
BROMOMETHANE	N	N	N
VINYL CHLORIDE	N	N	N
CHLOROETHANE	N	N	N
METHYLENE CHLORIDE	G	G	G
ACETONE	N	N	92
CARBON DISULFIDE	G	G	G
1,1-DICHLOROETHENE	G	11	12
1,1-DICHLOROETHANE	22	26	31
TRANS-1,2-DICHLOROETHENE	G	G	G
CHLOROFORM	G	G	G
1,2-DICHLOROETHANE	G	G	G
2-BUTANONE	N	N	N
1,1,1-TRICHLOROETHANE	260	270	330
CARBON TETRACHLORIDE	37	G	G
VINYL ACETATE	N	N	N
BROMODICHLOROMETHANE	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	G
1,2-DICHLOROPROPANE	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G
TRICHLOROETHENE	G	7	G
CHLORODIBROMOMETHANE	G	G	G
1,1,2-TRICHLOROETHANE	G	G	G
BENZENE	G	G	G
CIS-1,3-DICHLOROPROPENE	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N
BROMOFORM	G	G	G
2-HEXANONE	N	N	N
4-METHYL-2-PENTANONE	N	N	N
TETRACHLOROETHENE	G	G	5
TOLUENE	G	G	G
CHLOROBENZENE	G	G	G
ETHYLBENZENE	G	G	G
STYRENE	G	G	G
XYLENES	G	G	G

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
CHLOROMETHANE	N	N	N
BROMOMETHANE	N	N	N
VINYL CHLORIDE	N	N	N
CHLOROETHANE	N	N	N
METHYLENE CHLORIDE	G	1	G
ACETONE	N	N	N
CARBON DISULFIDE	G	G	G
1,1-DICHLOROETHENE	10	6	5
1,1-DICHLOROETHANE	16	8	6
TRANS-1,2-DICHLOROETHENE	G	G	G
CHLOROFORM	3	3	3
1,2-DICHLOROETHANE	G	G	G
2-BUTANONE	N	N	N
1,1,1-TRICHLOROETHANE	200	115	112
CARBON TETRACHLORIDE	22	G	G
VINYL ACETATE	N	N	N
BROMODICHLOROMETHANE	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	G
1,2-DICHLOROPROPANE	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G
TRICHLOROETHENE	G	G	G
CHLORODIBROMOMETHANE	G	G	G
1,1,2-TRICHLOROETHANE	G	G	G
BENZENE	G	G	G
CIS-1,3-DICHLOROPROPENE	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N
BROMOFORM	G	G	G
2-HEXANONE	N	N	N
4-METHYL-2-PENTANONE	N	N	N
TETRACHLOROETHENE	7	11	10
TOLUENE	G	G	G
CHLOROBENZENE	G	G	G
ETHYLBENZENE	G	G	G
STYRENE	G	G	G
XYLENES	G	1	G

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
2,4-D	<1	<2	<2
ENDRIN	<0.05	<0.1	<0.1
LINDANE	<0.01	<0.02	<0.02
METHOXYCHLOR	<0.04	<0.08	<0.08
SILVEX	<0.1	<0.2	<0.2
TOXAPHENE	<1	<2	<2

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
2,4-D	<2	<1	<1
ENDRIN	<0.1	<0.05	<0.05
LINDANE	<0.02	<0.01	<0.01
METHOXYCHLOR	<0.08	<0.04	<0.04
SILVEX	<0.2	<0.1	<0.1
TOXAPHENE	<2	<1	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-I
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
N-NITROSODIMETHYLAMINE	N	N	N
PHENOL	N	9	N
ANILINE	N	N	N
BIS(2-CHLOROETHYL) ETHER	N	N	N
2-CHLOROPHENOL	N	N	N
1,3-DICHLOROBENZENE	N	N	N
1,4-DICHLOROBENZENE	N	N	N
BENZYL ALCOHOL	N	N	N
1,2-DICHLOROBENZENE	N	N	N
2-METHYLPHENOL	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	N	N	N
4-METHYLPHENOL	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N
HEXACHLOROETHANE	N	N	N
NITROBENZENE	N	N	N
ISOPHORONE	N	N	N
2-NITROPHENOL	N	N	N
2,4-DIMETHYLPHENOL	N	N	N
BENZOIC ACID	N	N	N
BIS(2-CHLOROETHOXY) METHANE	N	N	N
2,4-DICHLOROPHENOL	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N
NAPHTHALENE	N	N	N
4-CHLOROANILINE	N	N	N
HEXACHLOROBUTADIENE	N	N	N
4-CHLORO-3-METHYLPHENOL	N	N	N
2-METHYLNAPHTHALENE	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N
2,4,5-TRICHLOROPHENOL	N	N	N
2-CHLORONAPHTHALENE	N	N	N
2-NITROANILINE	N	N	N
DIMETHYLPHTHALATE	N	N	N
ACENAPHTHYLENE	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-I
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
N-NITROSODIMETHYLAMINE	N	N	N
PHENOL	N	N	1
ANILINE	N	N	N
BIS(2-CHLOROETHYL) ETHER	N	N	N
2-CHLOROPHENOL	N	N	N
1,3-DICHLOROBENZENE	N	N	N
1,4-DICHLOROBENZENE	N	N	N
BENZYL ALCOHOL	N	N	N
1,2-DICHLOROBENZENE	N	N	N
2-METHYLPHENOL	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	N	N	N
4-METHYLPHENOL	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N
HEXACHLOROETHANE	N	N	N
NITROBENZENE	N	N	N
ISOPHORONE	N	N	N
2-NITROPHENOL	N	N	N
2,4-DIMETHYLPHENOL	N	N	N
BENZOIC ACID	M	M	M
BIS(2-CHLOROETHOXY) METHANE	N	N	N
2,4-DICHLOROPHENOL	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N
NAPHTHALENE	N	N	N
4-CHLOROANILINE	N	N	N
HEXACHLOROBUTADIENE	N	N	N
4-CHLORO-3-METHYLPHENOL	N	N	N
2-METHYLNAPHTHALENE	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N
2,4,5-TRICHLOROPHENOL	M	M	M
2-CHLORONAPHTHALENE	N	N	N
2-NITROANILINE	M	M	M
DIMETHYLPHTHALATE	N	N	N
ACENAPHTHYLENE	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
3-NITROANILINE	M	M	M
ACENAPHTHENE	N	N	N
2,4-DINITROPHENOL	M	M	M
4-NITROPHENOL	M	M	M
DIBENZOFURAN	N	N	N
2,4-DINITROTOLUENE	N	N	N
2,6-DINITROTOLUENE	N	N	N
DIETHYLPHTHALATE	N	N	0.8
4-CHLOROPHENYL PHENYL ETHER	N	N	N
FLUORENE	N	N	N
4-NITROANILINE	M	M	M
4,6-DINITRO-2-METHYLPHENOL	M	M	M
N-NITROSODIPHENYLAMINE	N	N	N
4-BROMOPHENYL PHENYL ETHER	N	N	N
HEXACHLOROBENZENE	N	N	N
PENTACHLOROPHENOL	M	M	M
PHENANTHRENE	N	N	N
ANTHRACENE	N	N	N
DI-N-BUTYLPHTHALATE	N	N	1
FLUORANTHENE	N	N	N
BENZIDINE	X	X	X
PYRENE	N	N	N
BUTYL BENZYL PHTHALATE	N	N	N
3,3'-DICHLOROBENZIDINE	V	V	V
BENZO(A)ANTHRACENE	N	N	N
BIS(2-ETHYLHEXYL)PHTHALATE	N	9	1
CHRYSENE	N	N	N
DI-N-OCTYLPHTHALATE	N	N	N
BENZO(B)FLUORANTHENE	N	N	N
BENZO(K)FLUORANTHENE	N	N	N
BENZO(A)PYRENE	N	N	N
INDENO(1,2,3-CD)PYRENE	N	N	N
DIBENZO(A,H)ANTHRACENE	N	N	N
BENZO(G,H,I)PERYLENE	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS.
UNIT IS UG/L

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
3-NITROANILINE	M	M	M
ACENAPHTHENE	N	N	N
2,4-DINITROPHENOL	M	M	M
4-NITROPHENOL	M	M	M
DIBENZOFURAN	N	N	N
2,4-DINITROTOLUENE	N	N	N
2,6-DINITROTOLUENE	N	N	N
DIETHYLPHTHALATE	N	N	N
4-CHLOROPHENYL PHENYL ETHER	N	N	N
FLUORENE	N	N	N
4-NITROANILINE	M	M	M
4,6-DINITRO-2-METHYLPHENOL	M	M	M
N-NITROSODIPHENYLAMINE	N	N	N
4-BROMOPHENYL PHENYL ETHER	N	N	N
HEXACHLOROBENZENE	N	N	N
PENTACHLOROPHENOL	M	M	M
PHENANTHRENE	N	N	N
ANTHRACENE	N	N	N
DI-N-BUTYLPHTHALATE	2	N	N
FLUORANTHENE	N	N	N
BENZIDINE	X	X	X
PYRENE	N	N	N
BUTYL BENZYL PHTHALATE	N	N	N
3,3'-DICHLOROBENZIDINE	V	V	V
BENZO(A) ANTHRACENE	N	N	N
BIS(2-ETHYLHEXYL) PHTHALATE	N	3	34
CHRYSENE	N	N	N
DI-N-OCTYLPHTHALATE	0.1	N	N
BENZO(B) FLUORANTHENE	N	N	N
BENZO(K) FLUORANTHENE	N	N	N
BENZO(A) PYRENE	N	N	N
INDENO(1,2,3-CD) PYRENE	N	N	N
DIBENZO(A,H) ANTHRACENE	N	N	N
BENZO(G,H,I) PERYLENE	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	02/04/86	04/14/86	04/14/86
TIME SAMPLED	10:10:00	14:15:00	14:15:00
CONDUCTIVITY (IN UMHOS/CM)	464	415	401
	458	415	407
	456	414	408
	457	413	409
PH (IN PH UNITS)	7.1	7.6	7.4
	7.1	7.2	7.4
	7.1	7.2	7.4
	7.3	7.6	7.7
TOTAL ORGANIC CARBON	62	72	71
	57	71	72
	58	72	70
	59	71	72
TOTAL ORGANIC CHLORIDE	31	27	17
	30	15	21
	29	19	19
	30	18	17

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-176	GW-176	GW-176 FIELD DUPE
DATE SAMPLED	07/29/86	10/15/86	10/15/86
TIME SAMPLED	14:15:00	12:00:00	12:00:00
CONDUCTIVITY (IN UMHOS/CM)	480	376	374
	482	374	373
	482	376	373
	479	375	374
PH (IN PH UNITS)	7.2	6.9	6.9
	7.2	6.9	6.9
	7.2	6.9	6.9
	7.2	6.9	6.9
TOTAL ORGANIC CARBON	55	83	78
	43	85	86
	46	87	87
	41	87	86
TOTAL ORGANIC CHLORIDE	140	<10	<10
	120	<10	<10
	110	<10	<10
	140	<10	<10

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-177 TOTAL	GW-177 TOTAL	GW-177 TOTAL	GW-177 TOTAL
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	0.045	<0.02	0.27	0.072
ANTIMONY	<0.05	.	<0.05	<0.05
BARIUM	0.0062	0.0056	0.037	0.012
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.026	0.049	0.047	0.022
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	41	38	59	45
CHROMIUM	<0.01	<0.01	0.034	0.013
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	0.057	0.053	0.045	0.012
IRON	4.9	7.5	4.3	0.19
LITHIUM	<0.004	<0.004	0.0042	<0.004
MAGNESIUM	28	28	30	27
MANGANESE	0.15	0.16	0.098	0.033
MOLYBDENUM	<0.01	<0.01	0.01	<0.01
NICKEL	<0.01	<0.01	0.054	0.02
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	15	11	5.8	2.3
SILICON	4.8	2.9	3.3	4.3
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	3.4	4.2	5.9	1.3
STRONTIUM	0.031	0.033	0.077	0.041
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	<0.003	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005	<0.005
ZINC	<0.001	0.13	<0.001	0.0034
ZIRCONIUM	<0.005	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005	<0.005
LEAD	0.031	0.039	0.016	0.014
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	2.37	1.6	4	2
BETA ACTIVITY (PCI/L)	18.5	8.29	8	4
URANIUM	0.004	0.003	<0.001	0.007
RADIUM (BQ/L)	<0.1	<0.1	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-177 DISSOLVED	GW-177 DISSOLVED	GW-177 DISSOLVED	GW-177 DISSOLVED
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	0.054	<0.02	<0.02	0.064
ANTIMONY	<0.05	.	<0.05	<0.05
BARIUM	0.0049	0.0029	0.033	0.011
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.029	0.015	0.04	0.031
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	39	36	37	45
CHROMIUM	<0.01	<0.01	<0.01	0.011
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	<0.004	<0.004	0.015	0.006
IRON	0.057	0.086	<0.004	0.021
LITHIUM	0.0058	<0.004	<0.004	<0.004
MAGNESIUM	27	27	25	27
MANGANESE	0.14	0.13	0.036	0.017
MOLYBDENUM	<0.01	<0.01	0.01	<0.01
NICKEL	<0.01	<0.01	0.033	0.017
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	21	10	5.8	2.2
SILICON	3.8	2.8	2.5	4.5
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	4.2	4	6.1	1.4
STRONTIUM	0.034	0.03	0.029	0.04
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	0.0067	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005	<0.005
ZINC	<0.001	0.031	<0.001	0.0086
ZIRCONIUM	0.0054	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005	<0.005
LEAD	0.005	<0.004	0.005	0.004
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.	.
URANIUM	1.0E-03	1.0E-03	0.003	0.007
RADIUM (BQ/L)	.	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
WATER LEVEL (FT +/- GRADE)	-118	-114.7	-115.2	-116
WATER TEMP (DEG. CENT.)	15	12.4	21.9	24.3
DISSOLVED OXYGEN	1.4	7	12.3	16.4
CONDUCTIVITY (IN UMHOS/CM)	440	400	110	360
PH (IN PH UNITS)	7	7	6.3	7.1
REDOX (IN MV)	120	98	188	300
ALKALINITY (CO3)	.	.	.	.
ALKALINITY (HCO3)	.	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.	.
AMMONIA - N	.	.	.	.
TURBIDITY (IN NTU)	36	G	44	<1
COLIFORM (CC/100 MLS)	N	N	N	N
FLUORIDE	0.15	0.2	0.2	<0.1
PHENOLS	0.013	0.008	0.011	0.003
CHLORIDE	1.8	8.4	6.4	3
NITRATE NITROGEN	<0.11	<0.11	<0.11	0.16
NITRATE	.	.	.	.
NITRITE	.	.	.	.
SULFATE	24	24	24	10.2

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
CHLOROMETHANE	N	N	N	N
BROMOMETHANE	N	N	N	N
VINYL CHLORIDE	N	N	N	N
CHLOROETHANE	N	N	N	N
METHYLENE CHLORIDE	G	G	G	1
ACETONE	200	790	N	N
CARBON DISULFIDE	G	G	G	G
1,1-DICHLOROETHENE	G	G	G	G
1,1-DICHLOROETHANE	G	G	G	G
TRANS-1,2-DICHLOROETHENE	G	G	G	G
CHLOROFORM	G	G	3	3
1,2-DICHLOROETHANE	G	G	G	1
2-BUTANONE	N	N	N	N
1,1,1-TRICHLOROETHANE	G	6	12	17
CARBON TETRACHLORIDE	G	G	G	G
VINYL ACETATE	N	N	N	N
BROMODICHLOROMETHANE	G	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	G	G
1,2-DICHLOROPROPANE	G	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G	G
TRICHLOROETHENE	G	G	G	2
CHLORODIBROMOMETHANE	G	G	G	1
1,1,2-TRICHLOROETHANE	G	G	G	G
BENZENE	G	G	G	G
CIS-1,3-DICHLOROPROPENE	G	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N	N
BROMOFORM	G	G	G	2
2-HEXANONE	N	N	N	N
4-METHYL-2-PENTANONE	N	N	N	N
TETRACHLOROETHENE	G	G	G	6
TOLUENE	G	G	3	1
CHLOROBENZENE	G	G	G	G
ETHYLBENZENE	G	G	G	G
STYRENE	G	G	G	G
XYLENES	G	G	G	1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
2,4-D	<1	<2	<2	<1
ENDRIN	<0.05	<0.1	<0.1	<0.05
LINDANE	<0.01	<0.02	<0.02	<0.01
METHOXYCHLOR	<0.04	<0.08	<0.08	<0.04
SILVEX	<0.1	<0.2	<0.2	<0.1
TOXAPHENE	<1	<2	<2	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-
UNIT IS UG/L

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
N-NITROSODIMETHYLAMINE	N	N	N	N
PHENOL	N	1	N	N
ANILINE	N	N	N	N
BIS(2-CHLOROETHYL) ETHER	N	N	N	N
2-CHLOROPHENOL	N	N	N	N
1,3-DICHLOROBENZENE	N	N	N	N
1,4-DICHLOROBENZENE	N	N	N	N
BENZYL ALCOHOL	N	N	N	N
1,2-DICHLOROBENZENE	N	N	N	N
2-METHYLPHENOL	N	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	N	N	N	N
4-METHYLPHENOL	N	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N	N
HEXACHLOROETHANE	N	N	N	N
NITROBENZENE	N	N	N	N
ISOPHORONE	N	N	N	N
2-NITROPHENOL	N	N	N	N
2,4-DIMETHYLPHENOL	N	N	N	N
BENZOIC ACID	N	N	N	N
BIS(2-CHLOROETHOXY) METHANE	N	N	N	N
2,4-DICHLOROPHENOL	N	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N	N
NAPHTHALENE	N	N	N	N
4-CHLOROANILINE	N	N	N	N
HEXACHLOROBUTADIENE	N	N	N	N
4-CHLORO-3-METHYLPHENOL	N	N	N	N
2-METHYLNAPHTHALENE	N	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N	N
2,4,5-TRICHLOROPHENOL	N	N	N	N
2-CHLORONAPHTHALENE	N	N	N	N
2-NITROANILINE	N	N	N	N
DIMETHYLPHTHALATE	N	N	N	N
ACENAPHTHYLENE	N	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
3-NITROANILINE	M	M	M	M
ACENAPHTHENE	N	N	N	N
2,4-DINITROPHENOL	M	M	M	M
4-NITROPHENOL	M	M	M	M
DIBENZOFURAN	N	N	N	N
2,4-DINITROTOLUENE	N	N	N	N
2,6-DINITROTOLUENE	N	N	N	N
DIETHYLPHTHALATE	N	0.9	M	N
4-CHLOROPHENYL PHENYL ETHER	N	N	N	N
FLUORENE	N	N	N	N
4-NITROANILINE	M	M	M	M
4,6-DINITRO-2-METHYLPHENOL	M	M	M	M
N-NITROSODIPHENYLAMINE	N	N	N	N
4-BROMOPHENYL PHENYL ETHER	N	N	N	N
HEXACHLOROBENZENE	N	N	N	N
PENTACHLOROPHENOL	M	M	M	M
PHENANTHRENE	N	N	N	N
ANTHRACENE	N	N	N	N
DI-N-BUTYLPHTHALATE	N	2.2	M	N
FLUORANTHENE	N	N	N	N
BENZIDINE	X	X	X	X
PYRENE	N	N	N	N
BUTYL BENZYL PHTHALATE	N	1	N	N
3,3'-DICHLOROBENZIDINE	V	V	V	V
BENZO(A)ANTHRACENE	N	N	N	N
BIS(2-ETHYLHEXYL)PHTHALATE	N	2	N	9
CHRYSENE	N	N	N	N
DI-N-OCTYLPHTHALATE	N	N	0.1	N
BENZO(B)FLUORANTHENE	N	N	N	N
BENZO(K)FLUORANTHENE	N	N	N	N
BENZO(A)PYRENE	N	N	N	N
INDENO(1,2,3-CD)PYRENE	N	N	N	N
DIBENZO(A,H)ANTHRACENE	N	N	N	N
BENZO(G,H,I)PERYLENE	N	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-177	GW-177	GW-177	GW-177
DATE SAMPLED	02/04/86	04/17/86	07/29/86	10/10/86
TIME SAMPLED	14:45:00	16:10:00	16:00:00	13:30:00
CONDUCTIVITY (IN UMHOS/CM)	446	402	479	420
	478	425	478	424
	474	429	479	422
	486	427	478	423
PH (IN PH UNITS)	7.5	7.4	7.8	7.6
	7.4	7.5	7.8	7.6
	7.4	7.5	7.8	7.6
	7.4	7.5	7.8	7.8
TOTAL ORGANIC CARBON	52	59	47	68
	54	59	49	68
	57	60	43	70
	57	59	47	68
TOTAL ORGANIC CHLORIDE	510	6	38	<10
	480	195	40	<10
	530	166	41	16
	510	248	42	<10

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-179 TOTAL	GW-179 TOTAL	GW-179 TOTAL	GW-179 TOTAL
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	14	0.11	0.22	0.29
ANTIMONY	.	.	<0.05	<0.05
BARIUM	0.011	0.02	0.016	0.019
BERYLLIUM	0.0013	<0.0003	<0.0003	<0.0003
BORON	0.19	0.021	0.034	0.033
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	890	76	110	79
CHROMIUM	0.22	<0.01	0.012	<0.01
COBALT	0.013	<0.005	<0.005	<0.005
COPPER	0.66	0.12	0.077	0.041
IRON	38	0.52	1.1	1.1
LITHIUM	0.02	<0.004	<0.004	<0.004
MAGNESIUM	490	37	55	44
MANGANESE	0.99	0.042	0.072	0.047
MOLYBDENUM	<0.01	<0.01	<0.01	0.016
NICKEL	0.15	<0.01	<0.01	<0.01
NIOBIUM	0.0074	<0.007	<0.007	<0.007
PHOSPHOROUS	0.75	<0.2	<0.2	<0.2
POTASSIUM	9.9	<0.6	1.4	1.7
SILICON	24	4.1	4.7	4.5
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	1.3	1.3	1.7	1.5
STRONTIUM	0.0084	0.015	0.029	0.057
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	0.33	<0.003	0.0049	<0.003
VANADIUM	0.045	<0.005	<0.005	<0.005
ZINC	0.72	0.049	0.076	0.015
ZIRCONIUM	0.016	<0.005	0.008	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	0.013	<0.005	<0.005	<0.005
LEAD	0.069	0.022	0.007	0.015
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	3.0E-04	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	6.8	<3	4	<2
BETA ACTIVITY (PCI/L)	216	<7	4	<2
URANIUM	0.008	0.009	0.002	0.004
RADIUM (BQ/L)	0.15	<0.1	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-179 DISSOLVED	GW-179 DISSOLVED	GW-179 DISSOLVED	GW-179 DISSOLVED
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	0.042	<0.02	<0.02	0.052
ANTIMONY	.	.	<0.05	<0.05
BARIUM	0.021	0.021	0.018	0.02
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.034	0.0091	0.047	0.038
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	46	42	58	55
CHROMIUM	0.014	<0.01	0.011	<0.01
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	0.019	<0.004	<0.004	<0.004
IRON	0.14	0.032	0.0043	0.021
LITHIUM	0.0045	<0.004	<0.004	<0.004
MAGNESIUM	29	23	31	32
MANGANESE	0.026	0.011	0.016	0.0035
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01
NICKEL	<0.01	<0.01	<0.01	<0.01
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	7.2	<0.6	1.5	1.3
SILICON	4.4	3.6	4.3	4.2
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	1.2	1.4	1.8	1.4
STRONTIUM	0.049	0.011	0.024	0.047
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	<0.003	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005	<0.005
ZINC	0.014	0.028	0.015	0.0029
ZIRCONIUM	<0.005	<0.005	0.0061	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005	<0.005
LEAD	<0.004	0.022	<0.004	0.015
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.005	<0.01	<0.01
MERCURY	2.0E-04	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.	.
URANIUM	<0.001	0.008	1.0E-03	0.004
RADIUM (BQ/L)	.	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
WATER LEVEL (FT +/- GRADE)	-109	-110	-109.9	-110
WATER TEMP (DEG. CENT.)	8.2	14.8	19.6	20.7
DISSOLVED OXYGEN	9.5	10.4	8.1	7.4
CONDUCTIVITY (IN UMHOS/CM)	430	410	480	470
PH (IN PH UNITS)	8.6	8.1	7.2	7.8
REDOX (IN MV)	258	245	300	121
ALKALINITY (CO3)	.	.	.	.
ALKALINITY (HCO3)	.	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.	.
AMMONIA - N	.	.	.	.
TURBIDITY (IN NTU)	.	.	.	.
COLIFORM (CC/100 MLS)	G	99	G	123
FLUORIDE	N	N	N	N
PHENOLS	0.09	0.1	0.1	<0.1
CHLORIDE	0.003	0.002	0.004	0.005
NITRATE NITROGEN	1.4	1.8	1.4	1.5
NITRATE	<0.11	<0.11	0.14	<0.11
NITRITE	.	.	.	.
SULFATE	12	17	11	9.8

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
CHLOROMETHANE	.	N	N	N
BROMOMETHANE	.	N	N	N
VINYL CHLORIDE	.	N	N	N
CHLOROETHANE	N	N	6	6
METHYLENE CHLORIDE	G	G	1	G
ACETONE	N	N	N	N
CARBON DISULFIDE	G	G	G	G
1,1-DICHLOROETHENE	54	77	52	19
1,1-DICHLOROETHANE	160	190	240	240
TRANS-1,2-DICHLOROETHENE	G	G	1	G
CHLOROFORM	G	G	3	10
1,2-DICHLOROETHANE	G	G	G	2
2-BUTANONE	N	N	N	N
1,1,1-TRICHLOROETHANE	790	1100	790	500
CARBON TETRACHLORIDE	110	G	G	G
VINYL ACETATE	N	N	N	N
BROMODICHLOROMETHANE	G	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	G	G
1,2-DICHLOROPROPANE	G	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G	G
TRICHLOROETHENE	5	G	G	G
CHLORODIBROMOMETHANE	G	G	G	G
1,1,2-TRICHLOROETHANE	G	G	G	G
BENZENE	G	G	G	1
CIS-1,3-DICHLOROPROPENE	G	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N	N
BROMOFORM	G	G	G	G
2-HEXANONE	N	N	N	N
4-METHYL-2-PENTANONE	N	N	N	N
TETRACHLOROETHENE	42	8	11	4
TOLUENE	15	G	G	2
CHLOROBENZENE	G	G	G	G
ETHYLBENZENE	G	G	G	G
STYRENE	G	G	G	1
XYLENES	G	G	1	1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
2,4-D	<1	<2	<2	<1
ENDRIN	<0.05	<0.1	<0.1	<0.05
LINDANE	<0.01	<0.02	<0.02	<0.01
METHOXYCHLOR	<0.04	<0.08	<0.08	<0.05
SILVEX	<0.1	<0.2	<0.2	<0.1
TOXAPHENE	<1	<2	<2	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-I
UNIT IS UG/L

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
N-NITROSODIMETHYLAMINE	•	N	N	N
PHENOL	•	N	N	N
ANILINE	•	N	N	N
BIS(2-CHLOROETHYL) ETHER	•	N	N	N
2-CHLOROPHENOL	•	N	N	N
1,3-DICHLOROBENZENE	•	N	N	N
1,4-DICHLOROBENZENE	•	N	N	N
BENZYL ALCOHOL	•	N	N	N
1,2-DICHLOROBENZENE	•	N	N	N
2-METHYLPHENOL	•	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	•	N	N	N
4-METHYLPHENOL	•	N	N	N
N-NITROSODI-N-PROPYLAMINE	•	N	N	N
HEXACHLOROETHANE	•	N	N	N
NITROBENZENE	•	N	N	N
ISOPHORONE	•	N	N	N
2-NITROPHENOL	•	N	N	N
2,4-DIMETHYLPHENOL	•	N	N	N
BENZOIC ACID	•	N	N	N
BIS(2-CHLOROETHOXY) METHANE	•	N	N	N
2,4-DICHLOROPHENOL	•	N	N	N
1,2,4-TRICHLOROBENZENE	•	N	N	N
NAPHTHALENE	•	N	N	N
4-CHLOROANILINE	•	N	N	N
HEXACHLOROBUTADIENE	•	N	N	N
4-CHLORO-3-METHYLPHENOL	•	N	N	N
2-METHYLNAPHTHALENE	•	N	N	N
HEXACHLOROCYCLOPENTADIENE	•	N	N	N
2,4,6-TRICHLOROPHENOL	•	N	N	N
2,4,5-TRICHLOROPHENOL	•	N	N	N
2-CHLORONAPHTHALENE	•	N	N	N
2-NITROANILINE	•	N	N	N
DIMETHYLPHTHALATE	•	N	N	N
ACENAPHTHYLENE	•	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
3-NITROANILINE	.	M	M	M
ACENAPHTHENE	.	N	N	N
2,4-DINITROPHENOL	.	M	M	M
4-NITROPHENOL	.	M	M	M
DIBENZOFURAN	.	N	N	N
2,4-DINITROTOLUENE	.	N	N	N
2,6-DINITROTOLUENE	.	N	N	N
DIETHYLPHTHALATE	.	1	N	N
4-CHLOROPHENYL PHENYL ETHER	.	N	N	N
FLUORENE	.	N	N	N
4-NITROANILINE	.	M	M	M
4,6-DINITRO-2-METHYLPHENOL	.	M	M	M
N-NITROSODIPHENYLAMINE	.	N	N	N
4-BROMOPHENYL PHENYL ETHER	.	N	N	N
HEXACHLOROBENZENE	.	N	N	N
PENTACHLOROPHENOL	.	M	M	M
PHENANTHRENE	.	N	N	N
ANTHRACENE	.	N	N	N
DI-N-BUTYLPHTHALATE	.	3	N	N
FLUORANTHENE	.	N	N	N
BENZIDINE	.	X	X	X
PYRENE	.	N	N	N
BUTYL BENZYL PHTHALATE	.	0.8	N	N
3,3'-DICHLOROBENZIDINE	.	V	V	V
BENZO(A)ANTHRACENE	.	N	N	N
BIS(2-ETHYLHEXYL)PHTHALATE	.	656	N	N
CHRYSENE	.	N	N	N
DI-N-OCTYLPHTHALATE	.	15	N	N
BENZO(B)FLUORANTHENE	.	N	N	N
BENZO(K)FLUORANTHENE	.	N	N	N
BENZO(A)PYRENE	.	N	N	N
INDENO(1,2,3-CD)PYRENE	.	N	N	N
DIBENZO(A,H)ANTHRACENE	.	N	N	N
BENZO(G,H,I)PERYLENE	.	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	GW-179	GW-179	GW-179	GW-179
DATE SAMPLED	02/10/86	04/23/86	08/05/86	10/20/86
TIME SAMPLED	13:25:00	13:20:00	9:20:00	14:30:00
CONDUCTIVITY (IN UMHOS/CM)	380	476	452	492
	393	492	463	427
	433	492	464	491
	330	491	460	492
PH (IN PH UNITS)	7.7	8	7.9	8
	7.7	8	7.9	7.9
	7.8	8	7.9	7.9
	7.8	7.9	7.8	8.1
TOTAL ORGANIC CARBON	95	71	85	73
	120	74	86	72
	80	72	89	100
	158	73	87	99
TOTAL ORGANIC CHLORIDE	131	70	160	<10
	121	69	170	<10
	126	69	180	<10
	129	69	180	15

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

TOTAL METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	1080 TOTAL	1080 TOTAL	1080 TOTAL	1080 TOTAL
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	4.1	<0.02	0.044	3.8
ANTIMONY	.	.	<0.05	<0.05
BARIUM	0.013	0.0018	0.0031	0.017
BERYLLIUM	<0.0003	<0.0003	<0.0003	0.0012
BORON	0.85	0.23	0.14	0.16
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	45	38	33	42
CHROMIUM	<0.01	<0.01	<0.01	0.019
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	<0.004	<0.004	0.022	0.0065
IRON	6.7	0.055	0.023	7
LITHIUM	0.032	<0.004	<0.004	0.0041
MAGNESIUM	28	23	21	25
MANGANESE	0.32	0.0037	<0.001	0.32
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01
NICKEL	<0.01	<0.01	<0.01	0.024
NIOBIUM	<0.007	<0.007	<0.007	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	1.5	<0.6	0.72	1.9
SILICON	9.4	3.6	3.7	9.1
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	2.1	0.91	0.82	0.87
STRONTIUM	<0.0004	<0.0004	<0.0004	0.015
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	0.065	<0.003	<0.003	0.06
VANADIUM	0.0069	<0.005	<0.005	0.014
ZINC	0.086	<0.001	<0.001	0.076
ZIRCONIUM	<0.005	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	0.012	<0.005	<0.005	0.013
LEAD	0.019	0.005	<0.004	0.019
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	15	3.55	1	<3
BETA ACTIVITY (PCI/L)	21	7.34	<2	9
URANIUM	<0.001	0.002	0.004	<0.001
RADIUM (BQ/L)	<0.1	0.09	<0.1	<0.1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

DISSOLVED METALS-RADIOACTIVITY-RADIUM
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	1080 DISSOLVED	1080 DISSOLVED	1080 DISSOLVED	1080 DISSOLVED
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
METHOD	ICAP	ICAP	ICAP	ICAP
ALUMINUM	<0.02	<0.02	0.03	0.064
ANTIMONY	.	.	<0.05	0.055
BARIUM	0.0037	0.0013	0.0036	0.0035
BERYLLIUM	<0.0003	<0.0003	<0.0003	<0.0003
BORON	0.77	0.21	0.14	0.14
CADMIUM	<0.003	<0.003	<0.003	<0.003
CALCIUM	39	37	33	36
CHROMIUM	<0.01	<0.01	<0.01	0.01
COBALT	<0.005	<0.005	<0.005	<0.005
COPPER	<0.004	<0.004	0.11	<0.004
IRON	0.012	<0.004	0.071	0.017
LITHIUM	0.028	<0.004	<0.004	<0.004
MAGNESIUM	23	22	22	21
MANGANESE	<0.001	<0.001	0.0037	<0.001
MOLYBDENUM	<0.01	<0.01	<0.01	<0.01
NICKEL	<0.01	<0.01	0.019	<0.01
NIOBIUM	<0.007	<0.007	0.012	<0.007
PHOSPHOROUS	<0.2	<0.2	<0.2	<0.2
POTASSIUM	<0.6	<0.6	<0.6	<0.6
SILICON	3.8	3.9	3.9	4.1
SILVER	<0.006	<0.006	<0.006	<0.006
SODIUM	2	0.8	1	0.91
STRONTIUM	<0.0004	<0.0004	<0.0004	0.014
THORIUM	<0.2	<0.2	<0.2	<0.2
TITANIUM	<0.003	<0.003	<0.003	<0.003
VANADIUM	<0.005	<0.005	<0.005	<0.005
ZINC	0.0042	<0.001	<0.001	0.007
ZIRCONIUM	<0.005	<0.005	<0.005	<0.005
METHOD	AAS	AAS	AAS	AAS
ARSENIC	<0.005	<0.005	<0.005	<0.005
LEAD	0.008	0.005	0.004	<0.004
SELENIUM	<0.005	<0.005	<0.005	<0.005
THALLIUM	<0.01	<0.01	<0.01	<0.01
MERCURY	<0.0002	<0.0002	<0.0002	<0.0002
ALPHA ACTIVITY (PCI/L)	.	.	.	.
BETA ACTIVITY (PCI/L)	.	.	.	.
URANIUM	1.0E-03	0.012	<0.001	<0.001
RADIUM (BQ/L)	.	.	.	.

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS CONVENTIONAL AND NON-CONVENTIONAL POLLUTANTS AND RELATED PARAMETER
UNIT IS MG/L - UNLESS OTHERWISE STATED

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
WATER LEVEL (FT +/- GRADE)	-113.5	-117.5	-127.8	-131.7
WATER TEMP (DEG. CENT.)	14	16.4	22	16.7
DISSOLVED OXYGEN	6.2	12	8.2	7.1
CONDUCTIVITY (IN UMHOS/CM)	320	330	320	310
PH (IN PH UNITS)	6	7.5	7.9	8.4
REDOX (IN MV)	.	179.8	176	315
ALKALINITY (CO3)	.	.	.	.
ALKALINITY (HCO3)	.	.	.	.
TOTAL SUSPENDED SOLIDS	.	.	.	.
TOTAL KJELDAHL NITROGEN	.	.	.	.
AMMONIA - N	.	.	.	.
TURBIDITY (IN NTU)	135	<1	1.6	G
COLIFORM (CC/100 MLS)	N	N	N	N
FLUORIDE	0.08	<0.1	0.1	<0.1
PHENOLS	<0.001	<0.001	0.006	<0.001
CHLORIDE	2.4	1.8	1.6	1.6
NITRATE NITROGEN	0.47	0.32	0.29	0.2
NITRATE	.	.	.	.
NITRITE	.	.	.	.
SULFATE	2.2	<1	<1	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS
UNIT IS UG/L

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
CHLOROMETHANE	.	N	N	N
BROMOMETHANE	.	N	N	N
VINYL CHLORIDE	.	N	N	N
CHLOROETHANE	N	N	N	N
METHYLENE CHLORIDE	G	G	G	G
ACETONE	N	67	N	14
CARBON DISULFIDE	G	G	G	G
1,1-DICHLOROETHENE	22	6	7	5
1,1-DICHLOROETHANE	100	41	22	20
TRANS-1,2-DICHLOROETHENE	G	G	G	G
CHLOROFORM	G	G	3	3
1,2-DICHLOROETHANE	G	G	G	2
2-BUTANONE	N	N	N	N
1,1,1-TRICHLOROETHANE	680	370	240	190
CARBON TETRACHLORIDE	92	G	26	G
VINYL ACETATE	N	N	N	N
BROMODICHLOROMETHANE	G	G	G	G
1,1,2,2-TETRACHLOROETHANE	G	G	G	4
1,2-DICHLOROPROPANE	G	G	G	G
TRANS-1,3-DICHLOROPROPENE	G	G	G	G
TRICHLOROETHENE	G	G	G	2
CHLORODIBROMOMETHANE	G	G	G	1
1,1,2-TRICHLOROETHANE	G	G	G	2
BENZENE	G	G	G	G
CIS-1,3-DICHLOROPROPENE	G	G	G	G
2-CHLOROETHYLVINYL ETHER	N	N	N	N
BROMOFORM	G	G	G	3
2-HEXANONE	N	N	N	N
4-METHYL-2-PENTANONE	N	N	N	9
TETRACHLOROETHENE	13	G	3	3
TOLUENE	G	G	G	1
CHLOROBENZENE	G	G	G	G
ETHYLBENZENE	G	G	G	G
STYRENE	G	G	G	G
XYLENES	G	G	1	1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

HERBICIDES AND PESTICIDES
UNIT IS UG/L

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	
2,4-D	<1	<2	<2	<1
ENDRIN	<0.05	<0.1	<0.1	<0.05
LINDANE	<0.01	<0.02	<0.02	<0.01
METHOXYCHLOR	<0.04	<0.08	<0.08	<0.04
SILVEX	<0.1	<0.2	<0.2	<0.1
TOXAPHENE	<1	<2	<2	<1

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-
UNIT IS UG/L

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	
N-NITROSODIMETHYLAMINE	N	N	N	N
PHENOL	N	N	N	N
ANILINE	N	N	N	N
BIS(2-CHLOROETHYL) ETHER	N	N	N	N
2-CHLOROPHENOL	N	N	N	N
1,3-DICHLOROBENZENE	N	N	N	N
1,4-DICHLOROBENZENE	N	N	N	N
BENZYL ALCOHOL	N	N	N	N
1,2-DICHLOROBENZENE	N	N	N	N
2-METHYLPHENOL	N	N	N	N
BIS(2-CHLOROISOPROPYL) ETHER	N	N	N	N
4-METHYLPHENOL	N	N	N	N
N-NITROSODI-N-PROPYLAMINE	N	N	N	N
HEXACHLOROETHANE	N	N	N	N
NITROBENZENE	N	N	N	N
ISOPHORONE	N	N	N	N
2-NITROPHENOL	N	N	N	N
2,4-DIMETHYLPHENOL	N	N	N	N
BENZOIC ACID	N	N	N	N
BIS(2-CHLOROETHOXY) METHANE	N	N	N	N
2,4-DICHLOROPHENOL	N	N	N	N
1,2,4-TRICHLOROBENZENE	N	N	N	N
NAPHTHALENE	N	N	N	N
4-CHLOROANILINE	N	N	N	N
HEXACHLOROBUTADIENE	N	N	N	N
4-CHLORO-3-METHYLPHENOL	N	N	N	N
2-METHYLNAPHTHALENE	N	N	N	N
HEXACHLOROCYCLOPENTADIENE	N	N	N	N
2,4,6-TRICHLOROPHENOL	N	N	N	N
2,4,5-TRICHLOROPHENOL	N	N	N	N
2-CHLORONAPHTHALENE	N	N	N	N
2-NITROANILINE	N	N	N	N
DIMETHYLPHTHALATE	N	N	N	N
ACENAPHTHYLENE	N	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

ACID & BASE-NEUTRAL EXTRACTABLE ORGANIC PRIORITY AND NON-PRIORITY POLLUTANTS-II
UNIT IS UG/L

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
3-NITROANILINE	M	M	M	M
ACENAPHTHENE	N	N	N	N
2,4-DINITROPHENOL	M	M	M	N
4-NITROPHENOL	M	M	M	N
DIBENZOFURAN	N	N	N	N
2,4-DINITROTOLUENE	N	N	N	N
2,6-DINITROTOLUENE	N	N	N	N
DIETHYLPHTHALATE	N	N	N	N
4-CHLOROPHENYL PHENYL ETHER	N	N	N	N
FLUORENE	N	N	N	N
4-NITROANILINE	M	M	M	N
4,6-DINITRO-2-METHYLPHENOL	M	M	M	N
N-NITROSODIPHENYLAMINE	N	N	N	N
4-BROMOPHENYL PHENYL ETHER	N	N	N	N
HEXACHLOROBENZENE	N	N	N	N
PENTACHLOROPHENOL	M	M	M	N
PHENANTHRENE	N	N	N	N
ANTHRACENE	N	N	N	N
DI-N-BUTYLPHTHALATE	N	N	2	2
FLUORANTHENE	N	N	N	N
BENZIDINE	X	X	X	X
PYRENE	N	N	N	N
BUTYL BENZYL PHTHALATE	N	N	N	N
3,3'-DICHLOROBENZIDINE	V	V	V	N
BENZO(A)ANTHRACENE	N	N	N	N
BIS(2-ETHYLHEXYL)PHTHALATE	N	3	N	160
CHRYSENE	N	N	N	N
DI-N-OCTYLPHTHALATE	N	N	0.1	N
BENZO(B)FLUORANTHENE	N	N	N	N
BENZO(K)FLUORANTHENE	N	N	N	N
BENZO(A)PYRENE	N	N	N	N
INDENO(1,2,3-CD)PYRENE	N	N	N	N
DIBENZO(A,H)ANTHRACENE	N	N	N	N
BENZO(G,H,I)PERYLENE	N	N	N	N

RESULTS OF 1986 K25 GROUNDWATER SAMPLING
CHESTNUT RIDGE SECURITY PITS

LAB REPLICATES
UNIT IS UG/L FOR TOX - MG/L FOR TOC

WELL	1080	1080	1080	1080
DATE SAMPLED	02/19/86	04/15/86	07/29/86	10/14/86
TIME SAMPLED	9:45:00	16:00:00	11:05:00	.
CONDUCTIVITY (IN UMHOS/CM)	398	330	349	339
	398	327	346	340
	397	325	346	339
	399	326	349	340
PH (IN PH UNITS)	7.1	7.9	7.5	7.8
	7.2	7.6	7.5	7.7
	7.3	7.8	7.5	7.7
	7.9	7.9	7.5	7.7
TOTAL ORGANIC CARBON	78	42	40	60
	70	45	36	62
	72	53	40	59
	71	52	39	59
TOTAL ORGANIC CHLORIDE	490	441	480	<10
	460	183	410	<10
	520	329	380	<10
	530	460	410	<10

Water Quality Data for Monitor-Well GW-173

DATE SAMPLED:		2/4/86 Dissolved	2/4/86 Total	4/15/86 Dissolved	4/15/86 Total	7/29/86 Dissolved	7/29/86 Total	10/17/86 Dissolved	10/17/86 Total	1/8/87 Dissolved	1/8/87 Total	4/2/87 Dissolved	4/2/87 Total
PARAMETER													
METALS (mg/L)													
Aluminum	ICP	0.064	5.1	<0.02	0.36	<0.02	0.86	0.038	0.61	0.077	0.93	0.021	0.39
Antimony	ICP	<0.05	.	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0 05
Arsenic	AAS	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	ICP	0.0048	0.021	0.013	0.017	0.0041	0.0069	0.0044	0.0074	0.008	0.01	0.01	0.0092
Beryllium	ICP	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	ICP	0.027	0.041	<0.004	0.11	0.026	0.062	0.031	0.044	0.028	0.04	0.029	0.024
Cadmium	ICP	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Calcium	ICP	32	39	38	38	36	39	38	41	38	41	38	39
Chromium	ICP	<0.01	0.032	<0.01	<0.01	<0.01	0.013	<0.01	<0 01	0.012	0.013	<0.01	<0.01
Cobalt	ICP	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	ICP	<0.004	0.13	<0.004	<0.004	0.014	0.042	<0 004	0.053	0.011	0.042	<0.004	0.0045
Iron	ICP	0.051	43	<0.004	1.3	<0.004	4.7	0.027	7.5	0.027	3.4	<0.004	0.5
Lead	AAS	<0.004	0.073	<0.004	0.016	<0.004	0.011	0.009	0.019	<0.004	<0.004	<0.004	0.004
Lithium	ICP	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Magnesium	ICP	25	28	23	23	23	23	23	24	24	25	26	27
Manganese	ICP	0.033	0.13	0.0016	0.015	0.0045	0.031	0 0025	0.033	0.0031	0.036	0.0056	0.0077
Mercury	ICP	<0.0002	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01	<0.01	<0.01	<0.01	<0 01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	ICP	0.023	0.098	<0.01	<0.01	<0.01	0.026	<0 01	0.027	<0.01	0.01	<0.01	<0 01
Niobium	ICP	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.018	0.027	<0.007	0.0075
Phosphorous	ICP	<0.2	0.35	<0.2	<0 2	<0 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2
Potassium	ICP	2	1.8	1.9	2.9	1.7	2.1	1.8	1.3	2.4	2.3	1 6	1.7
Selenium	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	ICP	<0.006	<0.006	0.14	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Sodium	ICP	2.5	2.4	1.3	1.4	1.5	1.6	1.7	1.6	1.8	1.8	1 8	1.7
Strontium	ICP	0.0025	0.0088	<0.0004	0.0005	<0.0004	<0.0004	0.016	0.018	0.018	0.022	0.001	<0.0004
Thallium	AAS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	.	.
Thorium	ICP	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2	<0.2
Titanium	ICP	0.0074	0.11	<0.003	0.0036	<0.003	0.019	<0.003	0.0055	<0.003	0.0087	<0.003	0.012
Uranium	FL	0.01	0.015	0 002	0.001	0.002	0.003	0.002	0.002	<0.001	0.001	0.004	0.003
Vanadium	ICP	<0.005	0.0054	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	ICP	<0.001	0.069	<0.001	<0.001	<0.001	<0.001	<0.001	0.025	0.0082	0.037	0.015	0.022
Zirconium	ICP	0.0073	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0 005	<0 005

Water Quality Data for Monitor-Well GW-173

PARAMETER	DATE SAMPLED: 2/4/86	4/15/86	7/29/86	10/17/86	1/8/87	4/2/87
VOLATILE ORGANICS (ug/L)						
Acetone	N	N	N	N	5	N
Benzene	G	G	G	G	G	2
Bromodichloromethane	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	8
Carbon Disulfide	G	G	G	G	G	G
Carbon Tetrachloride	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N
2-Chloroethyl Vinyl Ether	N	N	N	N	N	N
Chloroform	G	G	5	3	2	G
Chloromethane	N	N	N	N	N	N
Dibromochloromethane	G	G	G	G	G	G
1,1-Dichloroethane	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G
Trans-1,2-Dichloroethene	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G
Cis-1,3-Dichloropropene	G	G	G	G	G	G
Trans-1,3-Dichloropropene	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N
Methylene Chloride	G	G	G	G	G	G
4-Methyl-2-Pentanone	N	N	N	N	N	N
Styrene	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	4	G	G	G
Toluene	G	G	13	1	1	2
1,1,1-Trichloroethane	G	G	5	3	2	5
1,1,2-Trichloroethane	G	G	G	G	G	G
Trichloroethene	G	G	G	2	1	G
Vinyl Acetate	N	N	N	N	N	N
Vinyl Chloride	N	N	N	N	N	N
Xylenes	G	G	G	1	G	2
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	73	<1	2	<2	<2	<1
Gross Be (pCi/L)	135	2.93	4	<2	4	11.5
Radium (pCi/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/4/86	4/15/86	7/29/86	10/17/86	1/8/87	4/2/87
MISCELLANEOUS ORGANICS (ug/L)						
Total Phenols	0.003	0.002	0.007	0.006	<0.001	<0.001
Total Organic Halogen (Rep. 1)	24	7	83	<10	.	.
Total Organic Halogen (Rep. 2)	26	10	119	<10	.	.
Total Organic Halogen (Rep. 3)	24	12	86	<10	.	.
Total Organic Halogen (Rep. 4)	26	<5	111	<10	.	.
ANIONS (mg/L)						
Chloride	<1	2.2	3.1	3.7	5.4	5.6
Fluoride	0.18	<0.1	0.2	0.1	<0.1	0.1
Nitrate (as N)	.	1.11	1.06	1	1.33	1.5
Sulfate	9.3	5.7	5.9	7.6	5.8	5.2
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	270	330	360	340	230	310
pH	8.3	7.5	8.2	8.4	8	7.8
Dissolved Oxygen (mg/L)	4	11.2	9.5	7.4	8	12
Redox (mV)	72	197	175	192	365	361
Temperature (°C)	15.3	19.7	22.8	20.2	15.9	12.4
Water Level (ft ± grade)	.	-144.9	-158	-155	-144.6	-138
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	G	24	111	74	.	.
pH - (Rep. 1)	7.8	7.7	7.8	8.3	7.5	8.1
pH - (Rep. 2)	7.7	7.7	7.8	8.2	.	8
pH - (Rep. 3)	7.7	7.7	7.8	8.2	.	7.9
pH - (Rep. 4)	.	7.9	7.8	8.2	.	8.6
Conductivity - (Rep. 1)	322	324	389	377	.	386
Conductivity - (Rep. 2)	316	332	386	375	.	391
Conductivity - (Rep. 3)	326	333	384	374	.	391
Conductivity - (Rep. 4)	325	334	385	379	.	389
Total Suspended Solids (mg/L	.	.	.	.	5	4
Total Coliform (cc/100 mls)	N	N	N	N	.	.
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.01	<0.02	<0.02	<0.02	.	.
2,4-D	<1	<2	<2	<1	.	.
Endrin	<0.05	<0.1	<0.1	<0.1	.	.
Methoxychlor	<0.04	<0.08	<0.08	<0.08	.	.
Silvex	<0.1	<0.2	<0.2	<0.1	.	.
Toxaphene	<1	<2	<2	<2	.	.

Water Quality Data for Monitor-Well GW-173

PARAMETER	DATE SAMPLED: 2/4/86	4/15/86	7/29/86	10/17/86	1/8/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	N	N	N	N	.	.
Acenaphthylene	N	N	N	N	.	.
Anthracene	N	N	N	N	.	.
Benzidine	X	X	X	X	.	.
Benzo(a)Anthracene	N	N	N	N	.	.
Benzo(a)Pyrene	N	N	N	N	.	.
Benzo(b)Fluoranthene	N	N	N	N	.	.
Benzo(g,h,i)Perylene	N	N	N	N	.	.
Benzo(k)Fluoranthene	N	N	N	N	.	.
Benzyl Alcohol	N	N	N	N	.	.
Benzyl Butyl Phthalate	N	N	N	N	.	.
Bis(2-Chloroethoxy)Methane	N	N	N	N	.	.
Bis(2-Chloroethyl)Ether	N	N	N	N	.	.
Bis(2-Chloroisopropyl)Ether	N	N	N	N	.	.
Bis(2-Ethylhexyl)Phthalate	N	277	N	36	.	.
4-Bromophenyl Phenyl Ether	N	N	N	N	.	.
4-Chloroaniline	N	N	N	N	.	.
2-Chloronaphthalene	N	N	N	N	.	.
4-Chlorophenyl Phenyl Ether	N	N	N	N	.	.
Chrysene	N	N	N	N	.	.
Di-n-Butyl Phthalate	N	2	N	N	.	.
Di-n-Octyl Phthalate	N	7	N	3	.	.
Dibenzo(a,h)Anthracene	N	N	N	N	.	.
Dibenzofuran	N	N	N	N	.	.
1,2-Dichlorobenzene	N	N	N	N	.	.
1,3-Dichlorobenzene	N	N	N	N	.	.
1,4-Dichlorobenzene	N	N	N	N	.	.
3,3'-Dichlorobenzidine	V	V	V	V	.	.
Diethyl Phthalate	N	1	N	N	.	.
Dimethyl Phthalate	N	N	N	N	.	.
2,4-Dinitrotoluene	N	N	N	N	.	.
2,6-Dinitrotoluene	N	N	N	N	.	.
Fluoranthene	N	N	N	N	.	.
Fluorene	N	N	N	N	.	.

PARAMETER	DATE SAMPLED: 2/4/86	4/15/86	7/29/86	10/17/86	1/8/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Hexachlorobenzene	N	N	N	N	.	.
Hexachlorobutadiene	N	N	N	N	.	.
Hexachlorocyclopentadiene	N	N	N	N	.	.
Hexachloroethane	N	N	N	N	.	.
Indeno(1,2,3-cd)Pyrene	N	N	N	N	.	.
Isophorone	N	N	N	N	.	.
2-Methylnaphthalene	N	N	N	N	.	.
N-Nitrosodi-N-Propylamine	N	N	N	N	.	.
N-Nitrosodimethylamine	N	N	N	N	.	.
N-Nitrosodiphenylamine	N	N	N	N	.	.
Naphthalene	N	N	N	N	.	.
2-Nitroaniline	M	M	M	M	.	.
3-Nitroaniline	M	M	M	M	.	.
4-Nitroaniline	M	M	M	M	.	.
Nitrobenzene	N	N	N	N	.	.
Phenanthrene	N	N	N	N	.	.
Pyrene	N	N	N	N	.	.
1,2,4-Trichlorobenzene	N	N	N	N	.	.
2,4,5-Trichlorophenol	M	M	M	M	.	.
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	M	M	M	M	.	.
4-Chloro-3-Methylphenol	N	N	N	N	.	.
2-Chlorophenol	N	N	N	N	.	.
2,4-Dichlorophenol	N	N	N	N	.	.
2,4-Dimethylphenol	N	N	N	N	.	.
2,4-Dinitrophenol	M	M	M	M	.	.
2-Methyl-4,6-Dinitrophenol	M	M	M	M	.	.
2-Methyl Phenol	N	N	N	N	.	.
3-Methyl Phenol	N	N	N	N	.	.
4-Methyl Phenol	N	N	N	N	.	.
2-Nitrophenol	N	N	N	N	.	.
4-Nitrophenol	M	M	M	M	.	.
Pentachlorophenol	M	M	M	M	.	.
Phenol	N	N	N	6	.	.
2,4,6-Trichlorophenol	N	N	N	N	.	.

Water Quality Data for Monitor-Well GW-174

DATE SAMPLED:		2/4/86 Dissolved	2/4/86 Total		1/8/87 Dissolved	1/8/87 Total	4/2/87 Dissolved	4/2/87 Total
PARAMETER								
METALS (mg/L)								
Aluminum	ICP	0.08	12	No Data Available from 4/15/86 to 10/17/86 See Text for Explanation	0.085	1.3	<0 02	5.7
Antimony	ICP	<0.05	<0.05		<0.05	<0.05	<0.05	<0.05
Arsenic	AAS	<0.005	0.021		<0.005	<0.005	<0.005	0.009
Barium	ICP	0.0098	0.14		0.011	0.016	0.37	0.66
Beryllium	ICP	<0.0003	0.0012		<0.0003	<0.0003	<0.0003	0 0014
Boron	ICP	0.021	0.093		0.037	0.036	0.017	0.044
Cadmium	ICP	<0.003	<0.003		<0.003	<0.003	<0.003	<0.003
Calcium	ICP	24	48		33	34	34	39
Chromium	ICP	<0.01	0.074		0.014	0.031	<0 01	0.026
Cobalt	ICP	<0.005	<0.005		<0.005	<0.005	<0.005	<0.005
Copper	ICP	<0.004	0.084		0.0078	0.11	<0.004	0.051
Iron	ICP	0.015	110		0.0064	3.2	0 038	7.3
Lead	AAS	<0.004	0.065		<0.004	0.023	<0.004	0.031
Lithium	ICP	<0.004	0.0076		<0.004	<0.004	<0.004	0.0097
Magnesium	ICP	19	36		21	20	24	26
Manganese	ICP	0.05	0.42		0.0059	0.069	0.0052	0.18
Mercury	ICP	<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01		<0.01	<0.01	<0.01	<0 01
Nickel	ICP	<0.01	0.032		<0.01	0.017	<0 01	0.022
Niobium	ICP	<0.007	<0.007		<0.007	0.024	<0.007	<0.007
Phosphorous	ICP	<0.2	1.1		<0.2	<0.2	<0.2	<0.2
Potassium	ICP	10	11		4.3	3.9	3 3	3 3
Selenium	AAS	<0.005	<0.005		<0.005	<0.005	<0 005	<0 005
Silver	ICP	<0.006	<0.006		<0.006	<0.006	<0 006	<0.006
Sodium	ICP	9.9	10		9.6	12	1.6	4 9
Strontium	ICP	0.039	0.1		0.026	0.037	0.01	0.019
Thallium	AAS	<0.01	<0.01		.	.	.	.
Thorium	ICP	<0.2	<0.2		<0 2	<0.2	<0 2	<0.2
Titanium	ICP	0.006	0.084		<0.003	<0.003	<0.003	0.12
Uranium	FL	0.004	0.008		<0.001	0.002	0.002	0.003
Vanadium	ICP	<0.005	0.0072		<0.005	<0.005	<0 005	0 011
Zinc	ICP	<0.001	0.15		0.022	0 054	0.0052	0.14
Zirconium	ICP	0.007	<0.005		<0.005	<0.005	<0 005	<0.005

Water Quality Data for Monitor-Well GW-174

PARAMETER	DATE SAMPLED: 2/4/86		1/8/87	4/2/87
VOLATILE ORGANICS (ug/L)				
Acetone	N	No Data Available from	N	N
Benzene	G	4/15/86 to 10/17/86	G	G
Bromodichloromethane	G	See Text for Explanation	G	G
Bromoform	G		G	G
Bromomethane	N		N	N
2-Butanone	N		N	4
Carbon Disulfide	G		1	G
Carbon Tetrachloride	G		G	2
Chlorobenzene	G		G	G
Chloroethane	N		N	N
2-Chloroethyl Vinyl Ether	N		N	N
Chloroform	G		2	G
Chloromethane	N		N	N
Dibromochloromethane	G		G	G
1,1-Dichloroethane	G		G	G
1,2-Dichloroethane	G		G	G
1,1-Dichloroethene	G		1	G
Trans-1,2-Dichloroethene	G		2	G
1,2-Dichloropropane	G		G	G
Cis-1,3-Dichloropropene	G		G	G
Trans-1,3-Dichloropropene	G		G	G
Ethylbenzene	G		G	G
2-Hexanone	N		N	N
Methylene Chloride	G		G	G
4-Methyl-2-Pentanone	N		N	N
Styrene	G		G	G
1,1,2,2-Tetrachloroethane	G		G	G
Toluene	G		1	G
1,1,1-Trichloroethane	G		8	19
1,1,2-Trichloroethane	G		G	G
Trichloroethene	G		2	2
Vinyl Acetate	N		N	N
Vinyl Chloride	N		N	N
Xylenes	G		G	G
RADIOCHEMICAL PARAMETERS				
Gross Alpha (pCi/L)	51		<2	6.9
Gross Beta (pCi/L)	108		2	10
Radium (Bq/L)	0.4		<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/4/86		1/8/87	4/2/87
MISCELLANEOUS ORGANICS (ug/L)				
Total Phenols	0.01	No Data Available from	<0.001	0.002
Total Organic Halogen (Rep. 1)	9	4/15/86 to 10/17/86	.	.
Total Organic Halogen (Rep. 2)	8	See Text for Explanation	.	.
Total Organic Halogen (Rep. 3)	9		.	.
Total Organic Halogen (Rep. 4)	11		.	.
ANIONS (mg/L)				
Chloride	<1		1.7	2
Fluoride	0.14		<0.1	<0.1
Nitrate (as N)	0.16		0.38	0.41
Sulfate	9.8		4.1	2.9
FIELD MEASUREMENTS				
Conductivity (umhos/cm)	270		310	400
pH	7.9		8.4	6.9
Dissolved Oxygen (mg/L)	3.2		9.4	8
Redox (mV)	110		268	200
Temperature (°C)	17		8.9	9.8
Water Level (ft ± grade)	- 3		-113.3	-109
MISCELLANEOUS PARAMETERS				
Turbidity (NTU)	G		.	.
pH - (Rep. 1)	7.9		8.2	8.3
pH - (Rep. 2)	7.8		.	8.2
pH - (Rep. 3)	7.9		.	8.2
pH - (Rep. 4)	7.8		.	8.2
Conductivity - (Rep. 1)	320		.	343
Conductivity - (Rep. 2)	325		.	342
Conductivity - (Rep. 3)	320		.	342
Conductivity - (Rep. 4)	334		.	349
Total Suspended Solids (mg/L	.		10	66
Total Coliform (cc/100 mls)	N		.	.
PESTICIDES (ug/L)				
gamma-BHC (Lindane)	<0.01		.	.
2,4-D	<1		.	.
Endrin	<0.05		.	.
Methoxychlor	<0.04		.	.
Silvex	<0.1		.	.
Toxaphene	<1		.	.

Water Quality Data for Monitor-Well GW-174

PARAMETER	DATE SAMPLED: 2/4/86		1/8/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)				
Acenaphthene	N	No Data Available from	.	.
Acenaphthylene	N	4/15/86 to 10/17/86	.	.
Anthracene	N	See Text for Explanation	.	.
Benzidine	X		.	.
Benzo(a)Anthracene	N		.	.
Benzo(a)Pyrene	N		.	.
Benzo(b)Fluoranthene	N		.	.
Benzo(g,h,i)Perylene	N		.	.
Benzo(k)Fluoranthene	N		.	.
Benzyl Alcohol	N		.	.
Benzyl Butyl Phthalate	N		.	.
Bis(2-Chloroethoxy)Methane	N		.	.
Bis(2-Chloroethyl)Ether	N		.	.
Bis(2-Chloroisopropyl)Ether	N		.	.
Bis(2-Ethylhexyl)Phthalate	N		.	.
4-Bromophenyl Phenyl Ether	N		.	.
4-Chloroaniline	N		.	.
2-Chloronaphthalene	N		.	.
4-Chlorophenyl Phenyl Ether	N		.	.
Chrysene	N		.	.
Di-n-Butyl Phthalate	N		.	.
Di-n-Octyl Phthalate	N		.	.
Dibenzo(a,h)Anthracene	N		.	.
Dibenzofuran	N		.	.
1,2-Dichlorobenzene	N		.	.
1,3-Dichlorobenzene	N		.	.
1,4-Dichlorobenzene	N		.	.
3,3'-Dichlorobenzidine	V		.	.
Diethyl Phthalate	N		.	.
Dimethyl Phthalate	N		.	.
2,4-Dinitrotoluene	N		.	.
2,6-Dinitrotoluene	N		.	.
Fluoranthene	N		.	.
Fluorene	N		.	.

PARAMETER	DATE SAMPLED: 2/4/86		1/8/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)				
Hexachlorobenzene	N	No Data Available from	.	.
Hexachlorobutadiene	N	4/15/86 to 10/17/86	.	.
Hexachlorocyclopentadiene	N	See Text for Explanation	.	.
Hexachloroethane	N		.	.
Indeno(1,2,3-cd)Pyrene	N		.	.
Isophorone	N		.	.
2-Methylnaphthalene	N		.	.
N-Nitrosodi-N-Propylamine	N		.	.
N-Nitrosodimethylamine	N		.	.
N-Nitrosodiphenylamine	N		.	.
Naphthalene	N		.	.
2-Nitroaniline	M		.	.
3-Nitroaniline	M		.	.
4-Nitroaniline	M		.	.
Nitrobenzene	N		.	.
Phenanthrene	N		.	.
Pyrene	N		.	.
1,2,4-Trichlorobenzene	N		.	.
2,4,5-Trichlorophenol	M		.	.
ACID EXTRACTABLES (ug/L)				
Benzoic Acid	M		.	.
4-Chloro-3-Methylphenol	N		.	.
2-Chlorophenol	N		.	.
2,4-Dichlorophenol	N		.	.
2,4-Dimethylphenol	N		.	.
2,4-Dinitrophenol	M		.	.
2-Methyl-4,6-Dinitrophenol	M		.	.
2-Methyl Phenol	.		.	.
3-Methyl Phenol	N		.	.
4-Methyl Phenol	N		.	.
2-Nitrophenol	N		.	.
4-Nitrophenol	M		.	.
Pentachlorophenol	M		.	.
Phenol	N		.	.
2,4,6-Trichlorophenol	N		.	.

Water Quality Data for Monitor-Well GW-176

DATE SAMPLED:		2/4/86 Dissolved	2/4/86 Total	4/14/86 Dissolved	4/14/86 Total	7/29/86 Dissolved	7/29/86 Total	10/15/86 Dissolved	10/15/86 Total	1/7/87 Dissolved	1/7/87 Total	4/6/87 Dissolved	4/6/87 Total
PARAMETER													
METALS (mg/L)													
Aluminum	ICP	0.051	38	<0.02	1	<0.02	1	0.059	0.095	0.059	0.2	<0.02	0.11
Antimony	ICP	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	AAS	<0.005	0.108	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	ICP	0.0084	0.11	0.01	0.013	0.0087	0.011	0 012	0.012	0 011	0.012	1.1	1
Beryllium	ICP	<0.0003	0.014	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	ICP	2.5	2.6	1.6	1.6	0.84	0.84	0.21	0.2	1.6	1.6	2.3	2.3
Cadmium	ICP	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Calcium	ICP	46	120	49	48	45	47	38	39	47	47	49	48
Chromium	ICP	<0.01	0.036	<0.01	<0.01	<0.01	<0.01	0.011	0.013	<0.01	0 011	<0.01	<0.01
Cobalt	ICP	<0.005	0.029	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	ICP	<0.004	0.14	<0.004	<0.004	0.013	0.03	<0.004	<0.004	0.017	0.024	<0.004	<0.004
Iron	ICP	0.014	97	0.01	1.6	<0.004	1.2	0.0096	0.064	0.0062	0.19	<0.004	0.097
Lead	AAS	0.004	0.219	0.004	0.013	<0.004	0.006	<0.004	0.005	<0.004	0.004	<0.004	0.005
Lithium	ICP	0.11	0.15	0.069	0.071	0.038	0.039	0.008	0.0069	0 074	0.072	0.12	0.12
Magnesium	ICP	32	69	30	30	29	30	23	23	30	31	34	34
Manganese	ICP	0.0041	2.7	0.016	0.074	0.013	0.055	<0.001	0.0049	0.0018	0.011	<0.001	0.0043
Mercury	ICP	<0.0002	0.0006	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01	<0 01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	ICP	<0.01	0.17	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Niobium	ICP	<0.007	<0.007	<0.007	<0.007	0.018	<0.007	0.019	<0.007	0.021	0.029	<0.007	<0.007
Phosphorous	ICP	<0.2	1.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2	<0.2
Potassium	ICP	1.3	5.1	0.87	1.4	1	1.2	<0.6	<0.6	1.3	0.9	<0 6	0.78
Selenium	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	ICP	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0 006
Sodium	ICP	0.59	0.65	0.65	0.5	0.71	0.62	0.76	0.75	0.72	0.67	0.63	0 63
Strontium	ICP	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.021	0.022	0.022	0.022	0.0081	0.0077
Thallium	AAS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.
Thorium	ICP	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2	<0 2
Titanium	ICP	0.0053	0.58	<0.003	0.024	<0.003	0.024	<0.003	<0.003	<0.003	<0.003	0.0043	0.011
Uranium	FL	0.002	0.01	0.002	0.003	<0.001	<0.001	<0.001	0.001	<0.001	0.001	0.003	0.002
Vanadium	ICP	<0.005	0.17	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0 005	<0.005
Zinc	ICP	<0.001	1.2	<0.001	0.0074	<0 001	<0.001	0.0058	0.0077	0.013	0.017	0.0077	0 0082
Zirconium	ICP	0.0051	0.017	<0 005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0 005

Water Quality Data for Monitor-Well GW-176

PARAMETER	DATE SAMPLED: 2/4/86	4/14/86	7/29/86	10/15/86	1/7/87	4/6/87
VOLATILE ORGANICS (ug/L)						
Acetone	N	N	N	N	N	N
Benzene	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N
2-Butanone	N	N	N	N	9	11
Carbon Disulfide	G	G	G	G	G	G
Carbon Tetrachloride	37	G	22	G	G	G
Chlorobenzene	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N
2-Chloroethyl Vinyl Ether	N	N	N	N	.	N
Chloroform	G	G	3	3	2	G
Chloromethane	N	N	N	N	N	N
Dibromochloromethane	G	G	G	G	G	G
1,1-Dichloroethane	22	26	16	8	8	50
1,2-Dichloroethane	G	G	G	G	G	3
1,1-Dichloroethene	G	11	10	6	5	21
Trans-1,2-Dichloroethene	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G
Cis-1,3-Dichloropropene	G	G	G	G	G	G
Trans-1,3-Dichloropropene	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N
Methylene Chloride	G	G	G	1	G	1
4-Methyl-2-Pentanone	N	N	N	N	N	N
Styrene	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G
Toluene	G	G	G	G	1	1
1,1,1-Trichloroethane	260	270	200	115	99	280
1,1,2-Trichloroethane	G	G	G	G	G	G
Trichloroethene	G	7	G	G	G	G
Vinyl Acetate	N	N	N	N	N	N
Vinyl Chloride	N	N	N	N	N	N
Xylenes	G	G	G	1	G	1
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	76	14.05	2	<3	<2	<3
Gross [illegible] (pCi/L)	83	22.52	3	5	3	4.2
Radium (ug/L)	0.24	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/4/86	4/14/86	7/29/86	10/15/86	1/7/87	4/6/87
MISCELLANEOUS ORGANICS (ug/L)						
Total Phenols	0.004	<0.001	0.005	0.016	0.002	<0.001
Total Organic Halogen (Rep. 1)	31	27	140	<10	.	
Total Organic Halogen (Rep. 2)	30	15	120	<10	.	.
Total Organic Halogen (Rep. 3)	29	19	110	<10	.	.
Total Organic Halogen (Rep. 4)	30	18	140	<10	.	.
ANIONS (mg/L)						
Chloride	<1	1.7	1.5	1.8	2.1	2 3
Fluoride	0.1	<0.1	0.1	<0.1	<0.1	<0.1
Nitrate (as N)	0.27	0.41	0.43	1.7	0.6	0 84
Sulfate	1	<1	1.3	<1	<1	1.3
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	400	440	390	330	350	760
pH	7.42	7.4	7.6	6.9	7.2	7.5
Dissolved Oxygen (mg/L)	5.8	8.6	8.9	7.2	8.2	8.4
Redox (mV)	153	155	230	256	352	357
Temperature (°C)	14	27.6	26.6	15.6	12.4	15.5
Water Level (ft ± grade)	-118.1	-113.2	-115.3	-116.2	-113.8	-112 7
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	G	45	27	1	.	.
pH - (Rep. 1)	7.1	7.6	7.2	6.9	7.7	7
pH - (Rep. 2)	7.1	7.2	7 2	6.9	7.6	7 2
pH - (Rep. 3)	7.1	7.2	7.2	6.9	7 4	6 9
pH - (Rep. 4)	7.3	7.6	7.2	6 9	7.8	7
Conductivity - (Rep. 1)	464	415	480	376	.	471
Conductivity - (Rep. 2)	458	415	482	374	.	471
Conductivity - (Rep. 3)	456	414	482	376	.	473
Conductivity - (Rep. 4)	457	413	479	375	.	476
Total Suspended Solids (mg/L	.	.	.	.	<1	5
Total Coliform (cc/100 mls)	N	N	N	!	.	.
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.01	<0.02	<0.02	<0.0:	.	.
2,4-D	<1	<2	<2	<1	.	.
Endrin	<0.05	<0 1	<0.1	<0.0!	.	
Methoxychlor	<0.04	<0.08	<0.08	<0.0-	.	.
Silvex	<0.1	<0.2	<0.2	<0.	.	.
Toxaphene	<1	<2	<2	<1	.	

Water Quality Data for Monitor-Well GW-176

PARAMETER	DATE SAMPLED: 2/4/86	4/14/86	7/29/86	10/15/86	1/7/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	N	N	N	N	.	.
Acenaphthylene	N	N	N	N	.	.
Anthracene	N	N	N	N	.	.
Benzidine	X	X	X	X	.	.
Benzo(a)Anthracene	N	N	N	N	.	.
Benzo(a)Pyrene	N	N	N	N	.	.
Benzo(b)Fluoranthene	N	N	N	N	.	.
Benzo(g,h,i)Perylene	N	N	N	N	.	.
Benzo(k)Fluoranthene	N	N	N	N	.	.
Benzyl Alcohol	N	N	N	N	.	.
Benzyl Butyl Phthalate	N	N	N	N	.	.
Bis(2-Chloroethoxy)Methane	N	N	N	N	.	.
Bis(2-Chloroethyl)Ether	N	N	N	N	.	.
Bis(2-Chloroisopropyl)Ether	N	N	N	N	.	.
Bis(2-Ethylhexyl)Phthalate	N	9	N	3	.	.
4-Bromophenyl Phenyl Ether	N	N	N	N	.	.
4-Chloroaniline	N	N	N	N	.	.
2-Chloronaphthalene	N	N	N	N	.	.
4-Chlorophenyl Phenyl Ether	N	N	N	N	.	.
Chrysene	N	N	N	N	.	.
Di-n-Butyl Phthalate	N	N	2	N	.	.
Di-n-Octyl Phthalate	N	N	0.1	N	.	.
Dibenzo(a,h)Anthracene	N	N	N	N	.	.
Dibenzofuran	N	N	N	N	.	.
1,2-Dichlorobenzene	N	N	N	N	.	.
1,3-Dichlorobenzene	N	N	N	N	.	.
1,4-Dichlorobenzene	N	N	N	N	.	.
3,3'-Dichlorobenzidine	V	V	V	V	.	.
Diethyl Phthalate	N	N	N	N	.	.
Dimethyl Phthalate	N	N	N	N	.	.
2,4-Dinitrotoluene	N	N	N	N	.	.
2,6-Dinitrotoluene	N	N	N	N	.	.
Fluoranthene	N	N	N	N	.	.
Fluorene	N	N	N	N	.	.

PARAMETER	DATE SAMPLED: 2/4/86	4/14/86	7/29/86	10/15/86	1/7/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Hexachlorobenzene	N	N	N	N	.	.
Hexachlorobutadiene	N	N	N	N	.	.
Hexachlorocyclopentadiene	N	N	N	N	.	.
Hexachloroethane	N	N	N	N	.	.
Indeno(1,2,3-cd)Pyrene	N	N	N	N	.	.
Isophorone	N	N	N	N	.	.
2-Methylnaphthalene	N	N	N	N	.	.
N-Nitrosodi-N-Propylamine	N	N	N	N	.	.
N-Nitrosodimethylamine	N	N	N	N	.	.
N-Nitrosodiphenylamine	N	N	N	N	.	.
Naphthalene	N	N	N	N	.	.
2-Nitroaniline	M	M	M	M	.	.
3-Nitroaniline	M	M	M	M	.	.
4-Nitroaniline	M	M	M	M	.	.
Nitrobenzene	N	N	N	N	.	.
Phenanthrene	N	N	N	N	.	.
Pyrene	N	N	N	N	.	.
1,2,4-Trichlorobenzene	N	N	N	N	.	.
2,4,5-Trichlorophenol	M	M	M	M	.	.
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	M	M	M	M	.	.
4-Chloro-3-Methylphenol	N	N	N	N	.	.
2-Chlorophenol	N	N	N	N	.	.
2,4-Dichlorophenol	N	N	N	N	.	.
2,4-Dimethylphenol	N	N	N	N	.	.
2,4-Dinitrophenol	M	M	M	M	.	.
2-Methyl-4,6-Dinitrophenol	M	M	M	M	.	.
2-Methyl Phenol	.	.	.	.	.	.
3-Methyl Phenol	N	N	N	N	.	.
4-Methyl Phenol	N	N	N	N	.	.
2-Nitrophenol	N	N	N	N	.	.
4-Nitrophenol	M	M	M	M	.	.
Pentachlorophenol	M	M	M	M	.	.
Phenol	N	9	N	N	.	.
2,4,6-Trichlorophenol	N	N	N	N	.	.

Water Quality Data for Monitor-Well GW-177

DATE SAMPLED:		2/4/86 Dissolved	2/4/86 Total	4/17/86 Dissolved	4/17/86 Total	7/29/86 Dissolved	7/29/86 Total	10/10/86 Dissolved	10/10/86 Total	1/7/87 Dissolved	1/7/87 Total	4/2/87 Dissolved	4/2/87 Total
PARAMETER													
METALS (mg/L)													
Aluminum	ICP	0.054	0.045	<0.02	<0.02	<0.02	0.27	0.064	0.072	0.075	0.12	0.042	0.031
Antimony	ICP	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	ICP	0.0049	0.0062	0.0029	0.0056	0.033	0.037	0.011	0.012	0.013	0.013	0.015	0 011
Beryllium	ICP	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0004
Boron	ICP	0.029	0.026	0.015	0.049	0.04	0.047	0.031	0.022	0.026	0.018	0.025	0.03
Cadmium	ICP	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0032	0.0058	<0.003	<0 003
Calcium	ICP	39	41	36	38	37	59	45	45	43	43	43	45
Chromium	ICP	<0.01	<0.01	<0 01	<0.01	<0.01	0.034	0.011	0.013	0 014	0.014	<0.01	<0.01
Cobalt	ICP	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	ICP	<0.004	0.057	<0 004	0.053	0.015	0.045	0 006	0.012	0.037	0 063	<0.004	<0 004
Iron	ICP	0.057	4.9	0.086	7.5	<0.004	4.3	0.021	0.19	0.009	0.16	0.0044	0.19
Lead	AAS	0.005	0.031	<0.004	0.039	0.005	0.016	0.004	0.014	<0.004	0.004	<0.004	<0.004
Lithium	ICP	0.0058	<0.004	<0.004	<0.004	<0.004	0.0042	<0.004	<0.004	<0.004	<0.004	0.0044	<0.004
Magnesium	ICP	27	28	27	28	25	30	27	27	28	28	31	33
Manganese	ICP	0.14	0.15	0.13	0.16	0.036	0.098	0.017	0.033	0.0071	0.018	0.049	0.042
Mercury	ICP	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01
Nickel	ICP	<0.01	<0.01	<0.01	<0.01	0.033	0.054	0.017	0.02	<0.01	<0.01	<0.01	<0 01
Niobium	ICP	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.0091	0.0073	<0.007	<0.007
Phosphorous	ICP	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2	<0.2
Potassium	ICP	21	15	10	11	5.8	5 8	2 2	2.3	1.9	1.3	7 6	7
Selenium	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	ICP	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Sodium	ICP	4.2	3.4	4	4.2	6.1	5.9	1.4	1.3	2	1	3 2	4.9
Strontium	ICP	0.034	0.031	0.03	0.033	0.029	0.077	0.04	0.041	0.031	0.022	0.026	0.024
Thallium	AAS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.
Thorium	ICP	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0 2	<0 2
Titanium	ICP	0.0067	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	0.0098
Uranium	FL	0.001	0.004	0.001	0.003	0.003	<0.001	0.007	0.007	<0.001	0.002	0 008	0 007
Vanadium	ICP	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	ICP	<0.001	<0.001	0.031	0.13	<0.001	<0.001	0.0086	0.0034	0.028	0.034	0.012	0.0095
Zirconium	ICP	0.0054	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Water Quality Data for Monitor-Well GW-177

PARAMETER	DATE SAMPLED: 2/4/86	4/17/86	7/29/86	10/10/86	1/7/87	4/2/87
VOLATILE ORGANICS (ug/L)						
Acetone	200	790	N	N	380	13
Benzene	G	G	G	G	1	1
Bromodichloromethane	G	G	G	G	G	G
Bromoform	G	G	G	2	G	G
Bromomethane	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N
Carbon Disulfide	G	G	G	G	G	G
Carbon Tetrachloride	G	G	G	G	G	3
Chlorobenzene	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N
2-Chloroethyl Vinyl Ether	N	N	N	N	.	N
Chloroform	G	G	3	3	2	G
Chloromethane	N	N	N	N	N	N
Dibromochloromethane	G	G	G	1	G	G
1,1-Dichloroethane	G	G	G	G	3	4
1,2-Dichloroethane	G	G	G	1	G	G
1,1-Dichloroethene	G	G	G	G	1	G
Trans-1,2-Dichloroethene	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G
Cis-1,3-Dichloropropene	G	G	G	G	G	G
Trans-1,3-Dichloropropene	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N
Methylene Chloride	G	G	G	1	G	G
4-Methyl-2-Pentanone	N	N	N	N	N	N
Styrene	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G
Toluene	G	G	3	1	1	G
1,1,1-Trichloroethane	G	6	12	17	38	38
1,1,2-Trichloroethane	G	G	G	G	G	G
Trichloroethene	G	G	G	2	G	1
Vinyl Acetate	N	N	N	N	N	N
Vinyl Chloride	N	N	N	N	N	N
Xylenes	G	G	G	1	G	G
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	2.37	1.6	4	2	<2	3
Gross Beta (pCi/L)	18.5	8.29	8	4	4	15
Radium (Bq/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/4/86	4/17/86	7/29/86	10/10/86	1/7/87	4/2/87
MISCELLANEOUS ORGANICS (ug/L)						
Total Phenols	0.013	0.008	0.011	0.003	0.009	<0.001
Total Organic Halogen (Rep. 1)	510	6	38	<10	.	.
Total Organic Halogen (Rep. 2)	480	195	40	<10	.	.
Total Organic Halogen (Rep. 3)	530	166	41	16	.	.
Total Organic Halogen (Rep. 4)	510	248	42	<10	.	.
ANIONS (mg/L)						
Chloride	1.8	8.4	6.4	3	1.8	3.2
Fluoride	0.15	0.2	0.2	<0.1	0.1	<0.1
Nitrate (as N)	<0.11	<0.11	<0.11	0.16	0.29	0.36
Sulfate	24	24	24	10.2	4.5	16
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	440	400	110	360	370	380
pH	7	7	6.3	7.1	6.9	7.7
Dissolved Oxygen (mg/L)	1.4	7	12.3	16.4	8.8	12
Redox (mV)	120	98	188	300	350	360
Temperature (°C)	15	12.4	21.9	24.3	13.3	11.4
Water Level (ft ± grade)	-118	-114.7	-115.2	-116	-114.6	-115.2
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	36	G	44	<1	.	.
pH - (Rep. 1)	7.5	7.4	7.8	7.6	8.4	8.3
pH - (Rep. 2)	7.4	7.5	7.8	7.6	8.2	8.1
pH - (Rep. 3)	7.4	7.5	7.8	7.6	8.5	8.1
pH - (Rep. 4)	7.4	7.5	7.8	7.8	8	8.2
Conductivity - (Rep. 1)	446	402	479	420	.	481
Conductivity - (Rep. 2)	478	425	478	424	.	485
Conductivity - (Rep. 3)	474	429	479	422	.	485
Conductivity - (Rep. 4)	486	427	478	423	.	483
Total Suspended Solids (mg/L	.	.	.	.	1	2
Total Coliform (cc/100 mls)	N	N	N	N	.	.
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.01	<0.02	<0.02	<0.01	.	.
2,4-D	<1	<2	<2	<1	.	.
Endrin	<0.05	<0.1	<0.1	<0.05	.	.
Methoxychlor	<0.04	<0.08	<0.08	<0.04	.	.
Silvex	<0.1	<0.2	<0.2	<0.1	.	.
Toxaphene	<1	<2	<2	<1	.	.

Water Quality Data for Monitor-Well GW-177

PARAMETER	DATE SAMPLED: 2/4/86	4/17/86	7/29/86	10/10/86	1/7/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	N	N	N	N	.	.
Acenaphthylene	N	N	N	N	.	.
Anthracene	N	N	N	N	.	.
Benzidine	X	X	X	X	.	.
Benzo(a)Anthracene	N	N	N	N	.	.
Benzo(a)Pyrene	N	N	N	N	.	.
Benzo(b)Fluoranthene	N	N	N	N	.	.
Benzo(g,h,i)Perylene	N	N	N	N	.	.
Benzo(k)Fluoranthene	N	N	N	N	.	.
Benzyl Alcohol	N	N	N	N	.	.
Benzyl Butyl Phthalate	N	1	N	N	.	.
Bis(2-Chloroethoxy)Methane	N	N	N	N	.	.
Bis(2-Chloroethyl)Ether	N	N	N	N	.	.
Bis(2-Chloroisopropyl)Ether	N	N	N	N	.	.
Bis(2-Ethylhexyl)Phthalate	N	2	N	9	.	.
4-Bromophenyl Phenyl Ether	N	N	N	N	.	.
4-Chloroaniline	N	N	N	N	.	.
2-Chloronaphthalene	N	N	N	N	.	.
4-Chlorophenyl Phenyl Ether	N	N	N	N	.	.
Chrysene	N	N	N	N	.	.
Di-n-Butyl Phthalate	N	2.2	N	N	.	.
Di-n-Octyl Phthalate	N	N	0.1	N	.	.
Dibenzo(a,h)Anthracene	N	N	N	N	.	.
Dibenzofuran	N	N	N	N	.	.
1,2-Dichlorobenzene	N	N	N	N	.	.
1,3-Dichlorobenzene	N	N	N	N	.	.
1,4-Dichlorobenzene	N	N	N	N	.	.
3,3'-Dichlorobenzidine	V	V	V	V	.	.
Diethyl Phthalate	N	0.9	N	N	.	.
Dimethyl Phthalate	N	N	N	N	.	.
2,4-Dinitrotoluene	N	N	N	N	.	.
2,6-Dinitrotoluene	N	N	N	N	.	.
Fluoranthene	N	N	N	N	.	.
Fluorene	N	N	N	N	.	.

PARAMETER	DATE SAMPLED: 2/4/86	4/17/86	7/29/86	10/10/86	1/7/87	4/2/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Hexachlorobenzene	N	N	N	N	.	.
Hexachlorobutadiene	N	N	N	N	.	.
Hexachlorocyclopentadiene	N	N	N	N	.	.
Hexachloroethane	N	N	N	N	.	.
Indeno(1,2,3-cd)Pyrene	N	N	N	N	.	.
Isophorone	N	N	N	N	.	.
2-Methylnaphthalene	N	N	N	N	.	.
N-Nitrosodi-N-Propylamine	N	N	N	N	.	.
N-Nitrosodimethylamine	N	N	N	N	.	.
N-Nitrosodiphenylamine	N	N	N	N	.	.
Naphthalene	N	N	N	N	.	.
2-Nitroaniline	M	M	M	M	.	.
3-Nitroaniline	M	M	M	M	.	.
4-Nitroaniline	M	M	M	M	.	.
Nitrobenzene	N	N	N	N	.	.
Phenanthrene	N	N	N	N	.	.
Pyrene	N	N	N	N	.	.
1,2,4-Trichlorobenzene	N	N	N	N	.	.
2,4,5-Trichlorophenol	M	M	M	M	.	.
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	M	M	M	M	.	.
4-Chloro-3-Methylphenol	N	N	N	N	.	.
2-Chlorophenol	N	N	N	N	.	.
2,4-Dichlorophenol	N	N	N	N	.	.
2,4-Dimethylphenol	N	N	N	N	.	.
2,4-Dinitrophenol	M	M	M	M	.	.
2-Methyl-4,6-Dinitrophenol	M	M	M	M	.	.
2-Methyl Phenol	.	.	.	.	.	.
3-Methyl Phenol	N	N	N	N	.	.
4-Methyl Phenol	N	N	N	N	.	.
2-Nitrophenol	N	N	N	N	.	.
4-Nitrophenol	M	M	M	M	.	.
Pentachlorophenol	M	M	M	M	.	.
Phenol	N	1	N	N	.	.
2,4,6-Trichlorophenol	N	N	N	N	.	.

Water Quality Data for Monitor-Well GW-179

DATE SAMPLED:		2/10/86 Dissolved	2/10/86 Total	4/23/86 Dissolved	4/23/86 Total	8/5/86 Dissolved	8/5/86 Total	10/20/86 Dissolved	10/20/86 Total	1/9/87 Dissolved	1/9/87 Total	4/6/87 Dissolved	4/6/87 Total
PARAMETER													
METALS (mg/L)													
Aluminum	ICP	0.042	14	<0.02	0.11	<0.02	0.22	0.052	0.29	0.07	0.087	0.021	5.7
Antimony	ICP	.	.	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	AAS	<0.005	0.013	<0.005	<0.005	<0 005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium	ICP	0.021	0.011	0.021	0.02	0.018	0.016	0.02	0.019	0.02	0.019	0.7	2.5
Beryllium	ICP	<0.0003	0.0013	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0013
Boron	ICP	0.034	0.19	0 0091	0.021	0.047	0.034	0.038	0.033	0.03	0.03	0.027	0.038
Cadmium	ICP	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Calcium	ICP	46	890	42	76	58	110	55	79	51	49	46	43
Chromium	ICP	0.014	0.22	<0 01	<0 01	0.011	0.012	<0.01	<0 01	0.011	0.013	<0.0[illegible]	0.022
Cobalt	ICP	<0.005	0.013	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	ICP	0.019	0.66	<0.004	0.12	<0 004	0.077	<0 004	0.041	0.014	0.036	<0.004	0.047
Iron	ICP	0.14	38	0.032	0.52	0.0043	1.1	0 021	1.1	0.012	0.13	<0.001	8.5
Lead	AAS	<0.004	0.069	0.022	0.022	<0 004	0.007	0.015	0.015	<0.004	<0.004	<0.00[illegible]	0.038
Lithium	ICP	0.0045	0.02	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.011
Magnesium	ICP	29	490	23	37	31	55	32	44	31	33	31	28
Manganese	ICP	0.026	0.99	0.011	0.042	0.016	0.072	0.0035	0.047	0.0041	0.011	0.017	0.28
Mercury	ICP	0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	<0.01	<0.01	<0.01
Nickel	ICP	<0.01	0.15	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.024
Niobium	ICP	<0.007	0.0074	<0.007	<0.007	<0.007	<0.007	<0.007	<0.007	0.02	0.026	<0.007	<0.007
Phosphorous	ICP	<0.2	0.75	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Potassium	ICP	7.2	9.9	<0 6	<0.6	1.5	1.4	1.3	1.7	1.2	1.4	1.9	3.1
Selenium	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	ICP	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Sodium	ICP	1.2	1.3	1.4	1.3	1.8	1.7	1.4	1.5	2.4	2.5	3 6	2 2
Strontium	ICP	0.049	0.0084	0.011	0.015	0.024	0.029	0.047	0.057	0.047	0.049	0.018	0.05
Thallium	AAS	<0.01	<0.01	<0.005	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.
Thorium	ICP	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	ICP	<0.003	0.33	<0.003	<0.003	<0.003	0.0049	<0.003	<0.003	<0.003	<0.003	0.0042	0.13
Uranium	FL	<0.001	0.008	0.008	0.009	0.001	0.002	0.004	0.004	<0.001	0.002	0.004	0.007
Vanadium	ICP	<0.005	0.045	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.0084
Zinc	ICP	0.014	0.72	0.028	0.049	0.015	0.076	0.0029	0.015	0.013	0.017	0.0087	0.17
Zirconium	ICP	<0.005	0.016	<0.005	<0.005	0.0061	0.003	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Water Quality Data for Monitor-Well GW-179

PARAMETER	DATE SAMPLED: 2/10/86	4/23/86	8/5/86	10/20/86	1/9/87	4/6/87
VOLATILE ORGANICS (ug/L)						
Acetone	N	N	N	N	24	6
Benzene	G	G	G	1	G	G
Bromodichloromethane	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G
Bromomethane	.	N	N	N	N	N
2-Butanone	N	N	N	N	N	10
Carbon Disulfide	G	G	G	G	G	G
Carbon Tetrachloride	110	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G
Chloroethane	N	N	6	6	N	N
2-Chloroethyl Vinyl Ether	N	N	N	N	N	N
Chloroform	G	G	3	10	G	1
Chloromethane	.	N	N	N	N	N
Dibromochloromethane	G	G	G	G	G	G
1,1-Dichloroethane	160	190	240	240	230	200
1,2-Dichloroethane	G	G	G	2	G	1
1,1-Dichloroethene	54	77	52	19	64	7
Trans-1,2-Dichloroethene	G	G	1	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G
Cis-1,3-Dichloropropene	G	G	G	G	G	G
Trans-1,3-Dichloropropene	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N
Methylene Chloride	G	G	1	G	G	1
4-Methyl-2-Pentanone	N	N	N	N	N	N
Styrene	G	G	G	1	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G
Toluene	15	G	G	2	2	1
1,1,1-Trichloroethane	790	1100	790	500	820	700
1,1,2-Trichloroethane	G	G	G	G	G	G
Trichloroethene	5	G	G	G	G	G
Vinyl Acetate	N	N	N	N	N	N
Vinyl Chloride	.	N	N	N	N	N
Xylenes	G	G	1	1	G	1
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	6.8	<3	4	<2	<2	<3
Gross B (pCi/L)	216	<7	4	<2	<2	4.6
Radium (pCi/L)	0.15	<0.1	<0.1	<0.1	<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/10/86	4/23/86	08/5/86	10/20/86	1/9/87	4/6/87
MISCELLANEOUS ORGANICS (ug/L)						
Total Phenols	0.003	0.002	0.004	0.005	<0.001	<0.001
Total Organic Halogen (Rep. 1)	131	70	160	<10	.	.
Total Organic Halogen (Rep. 2)	121	69	170	<10	.	.
Total Organic Halogen (Rep. 3)	126	69	180	<10	.	.
Total Organic Halogen (Rep. 4)	129	69	180	15	.	.
ANIONS (mg/L)						
Chloride	1.4	1.8	1.4	1.5	1.6	1.5
Fluoride	0.09	0.1	0.1	<0.1	<0.1	<0.1
Nitrate (as N)	<0.11	<0.11	0.14	<0.11	0.17	0.19
Sulfate	12	17	11	9.8	10.2	7.7
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	430	410	480	470	420	430
pH	8.6	8.1	7.2	7.8	7.5	5.3
Dissolved Oxygen (mg/L)	9.5	10.4	8.1	7.4	6.4	8.3
Redox (mV)	258	245	300	121	284	272
Temperature (°C)	8.2	14.8	19.6	20.7	14.3	13.8
Water Level (ft ± grade)	-109	-110	-109.9	-110	-109.2	-109
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	G	99	G	123	89	.
pH - (Rep. 1)	7.7	8	7.9	8	7.8	7.2
pH - (Rep. 2)	7.7	8	7.9	7.9	8	7.2
pH - (Rep. 3)	7.8	8	7.9	7.9	7.8	7.2
pH - (Rep. 4)	7.8	7.9	7.8	8.1	8	7.3
Conductivity - (Rep. 1)	380	476	452	492	.	527
Conductivity - (Rep. 2)	393	492	463	427	.	531
Conductivity - (Rep. 3)	433	492	464	491	.	531
Conductivity - (Rep. 4)	330	491	460	492	.	534
Total Suspended Solids (mg/L	.	.	.	.	75	34
Total Coliform (cc/100 mls)	N	N	N	N	.	.
PESTICIDES (ug/L)						
Gamma-BHC (Lindane)	<0.01	<0.02	<0.02	<0.01	.	.
2,4-D	<1	<2	<2	<1	.	.
Endrin	<0.05	<0.1	<0.1	<0.05	.	.
Methoxychlor	<0.04	<0.08	<0.08	<0.05	.	.
Silvex	<0.1	<0.2	<0.2	<0.1	.	.
Toxaphene	<1	<2	<2	<1	.	.

Water Quality Data for Monitor-Well GW-179

PARAMETER	DATE SAMPLED: 2/10/86	4/23/86	8/5/86	10/20/86	1/9/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene		N	N	N		
Acenaphthylene		N	N	N		
Anthracene		N	N	N		
Benzidine		X	X	X		
Benzo(a)Anthracene		N	N	N		
Benzo(a)Pyrene		N	N	N		
Benzo(b)Fluoranthene		N	N	N		
Benzo(g,h,i)Perylene		N	N	N		
Benzo(k)Fluoranthene		N	N	N		
Benzyl Alcohol		N	N	N		
Benzyl Butyl Phthalate		0.6	N	N		
Bis(2-Chloroethoxy)Methane		N	N	N		
Bis(2-Chloroethyl)Ether		N	N	N		
Bis(2-Chloroisopropyl)Ether		N	N	N		
Bis(2-Ethylhexyl)Phthalate		658	N	N		
4-Bromophenyl Phenyl Ether		N	N	N		
4-Chloroaniline		N	N	N		
2-Chloronaphthalene		N	N	N		
4-Chlorophenyl Phenyl Ether		N	N	N		
Chrysene		N	N	N		
Di-n-Butyl Phthalate		3	N	N		
Di-n-Octyl Phthalate		15	N	N		
Dibenzo(a,h)Anthracene		N	N	N		
Dibenzofuran		N	N	N		
1,2-Dichlorobenzene		N	N	N		
1,3-Dichlorobenzene		N	N	N		
1,4-Dichlorobenzene		N	N	N		
3,3'-Dichlorobenzidine		V	V	V		
Diethyl Phthalate		1	N	N		
Dimethyl Phthalate		N	N	N		
2,4-Dinitrotoluene		N	N	N		
2,6-Dinitrotoluene		N	N	N		
Fluoranthene		N	N	N		
Fluorene		N	N	N		

PARAMETER	DATE SAMPLED: 2/10/86	4/23/86	8/5/86	10/20/86	1/9/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Hexachlorobenzene		N	N	N		
Hexachlorobutadiene		N	N	N		
Hexachlorocyclopentadiene		N	N	N		
Hexachloroethane		N	N	N		
Indeno(1,2,3-cd)Pyrene		N	N	N		
Isophorone		N	N	N		
2-Methylnaphthalene		N	N	N		
N-Nitrosodi-N-Propylamine		N	N	N		
N-Nitrosodimethylamine		N	N	N		
N-Nitrosodiphenylamine		N	N	N		
Naphthalene		N	N	N		
2-Nitroaniline		M	M	M		
3-Nitroaniline		M	M	M		
4-Nitroaniline		M	M	M		
Nitrobenzene		N	N	N		
Phenanthrene		N	N	N		
Pyrene		N	N	N		
1,2,4-Trichlorobenzene		N	N	N		
2,4,5-Trichlorophenol		M	M	M		
ACID EXTRACTABLES (ug/L)						
Benzoic Acid		M	M	M		
4-Chloro-3-Methylphenol		N	N	N		
2-Chlorophenol		N	N	N		
2,4-Dichlorophenol		N	N	N		
2,4-Dimethylphenol		N	N	N		
2,4-Dinitrophenol		M	M	M		
2-Methyl-4,6-Dinitrophenol		M	M	M		
2-Methyl Phenol		.	.	.		
3-Methyl Phenol		N	N	N		
4-Methyl Phenol		N	N	N		
2-Nitrophenol		N	N	N		
4-Nitrophenol		M	M	M		
Pentachlorophenol		M	M	M		
Phenol		N	N	N		
2,4,6-Trichlorophenol		N	N	N		

Water Quality Data for Monitor-Well 1080

DATE SAMPLED:		2/19/86 Dissolved	2/19/86 Total	4/15/86 Dissolved	4/15/86 Total	7/29/86 Dissolved	7/29/86 Total	10/14/86 Dissolved	10/14/86 Total	1/9/87 Dissolved	1/9/87 Total	4/6/87 Dissolved	4/6/87 Total
PARAMETER													
METALS (mg/L)													
Aluminum	ICP	<0.02	4.1	<0.02	<0.02	0.03	0.044	0.064	3.8	0.066	0.085	<0.02	.
Antimony	ICP	.	.	.	.	<0.05	<0.05	0.055	<0.05	<0.05	<0.05	<0 05	.
Arsenic	AAS	<0.005	0.012	<0.005	<0.005	<0.005	<0.005	<0 005	0.013	<0.005	<0.005	<0.005	<0.005
Barium	ICP	0.0037	0.013	0.0013	0.0018	0.0036	0.0031	0.0035	0.017	0.0047	0.0057	0 013	.
Beryllium	ICP	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0012	<0 0003	<0.0003	<0.0003	.
Boron	ICP	0.77	0.85	0.21	0.23	0.14	0.14	0.14	0.16	0.56	0.64	0.9[illegible]	.
Cadmium	ICP	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0 003	.
Calcium	ICP	39	45	37	38	33	33	36	42	37	38	40	.
Chromium	ICP	<0.01	<0.01	<0 01	<0.01	<0.01	<0.01	0.01	0.019	0.011	<0.01	<0.01	.
Cobalt	ICP	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.
Copper	ICP	<0.004	<0.004	<0.004	<0.004	0.11	0.022	<0.004	0.0065	<0.004	0.0046	<0.004	.
Iron	ICP	0.012	6.7	<0.004	0.055	0.071	0.023	0.017	7	1	0.014	<0.004	.
Lead	AAS	0.008	0.019	0.005	0.005	0.004	<0.004	<0.004	0.019	0.007	<0.004	<0.004	<0.004
Lithium	ICP	0.028	0.032	<0.004	<0.004	<0.004	<0.004	<0.004	0.0041	0.014	0.015	0.029	.
Magnesium	ICP	23	28	22	23	22	21	21	25	24	24	27	.
Manganese	ICP	<0.001	0.32	<0.001	0.0037	0.0037	<0.001	<0.001	0.32	0.006	0.0013	<0.001	.
Mercury	ICP	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	ICP	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.016	<0.01	.
Nickel	ICP	<0.01	<0.01	<0.01	<0.01	0.019	<0.01	<0.01	0.024	<0.01	<0.01	<0.01	.
Niobium	ICP	<0.007	<0.007	<0.007	<0.007	0.012	<0.007	<0.007	<0.007	0.02	0.041	<0.007	.
Phosphorous	ICP	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0 2	<0.2	<0.2	<0.2	<0.2	.
Potassium	ICP	<0.6	1.5	<0 6	<0.6	<0 6	0.72	<0 6	1.9	0.96	0.66	0.78	.
Selenium	AAS	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0 005
Silver	ICP	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.
Sodium	ICP	2	2.1	0.8	0.91	1	0.82	0.91	0.87	1.2	1.3	1.4	.
Strontium	ICP	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	0.014	0.015	0.015	0.015	<0.0004	.
Thallium	AAS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.
Thorium	ICP	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.
Titanium	ICP	<0.003	0.065	<0.003	<0.003	<0.003	<0.003	<0.003	0.06	<0.003	<0.003	<0.003	.
Uranium	FL	0.001	<0.001	0.012	0.002	<0.001	0.004	<0.001	<0.001	0.001	<0.001	0.004	0.004
Vanadium	ICP	<0.005	0.0069	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.005	<0.005	<0.005	.
Zinc	ICP	0.0042	0.086	<0.001	<0.001	<0.001	<0.001	0.007	0.076	0.008	0.0085	0.0056	.
Zirconium	ICP	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.

Water Quality Data for Monitor-Well 1080

PARAMETER	DATE SAMPLED: 2/19/86	4/15/86	7/29/86	10/14/86	1/9/87	4/6/87
VOLATILE ORGANICS (ug/L)						
Acetone	N	67	N	14	N	N
Benzene	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G
Bromoform	G	G	G	3	G	G
Bromomethane	.	N	N	N	N	N
2-Butanone	N	N	N	N	N	10
Carbon Disulfide	G	G	G	G	1	G
Carbon Tetrachloride	92	G	26	G	G	G
Chlorobenzene	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	4
2-Chloroethyl Vinyl Ether	N	N	N	N	N	N
Chloroform	G	G	3	3	2	G
Chloromethane	.	N	N	N	N	N
Dibromochloromethane	G	G	G	1	G	G
1,1-Dichloroethane	100	41	22	20	100	220
1,2-Dichloroethane	G	G	G	2	1	1
1,1-Dichloroethene	22	6	7	5	7	10
Trans-1,2-Dichloroethene	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G
Cis-1,3-Dichloropropene	G	G	G	G	G	G
Trans-1,3-Dichloropropene	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N
Methylene Chloride	G	G	G	G	1	1
4-Methyl-2-Pentanone	N	N	N	9	N	N
Styrene	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	4	G	G
Toluene	G	G	G	1	1	1
1,1,1-Trichloroethane	680	370	240	190	280	280
1,1,2-Trichloroethane	G	G	G	2	G	G
Trichloroethene	G	G	G	2	G	G
Vinyl Acetate	N	N	N	N	N	N
Vinyl Chloride	.	N	N	N	N	N
Xylenes	G	G	1	1	G	G
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	15	3.55	1	<3	<2	<3
Gross Beta (pCi/L)	21	7.34	<2	9	<2	<3
Radium (Bq/L)	<0.1	0.09	<0.1	<0.1	<0.1	<0.1

PARAMETER	DATE SAMPLED: 2/19/86	4/15/86	7/29/86	10/14/86	1/9/87	4/6/87
MISCELLANEOUS ORGANICS (ug/L)						
Total Phenols	<0.001	<0.001	0.006	<0.001	<0.001	<0.001
Total Organic Halogen (Rep. 1)	490	441	480	<10	.	.
Total Organic Halogen (Rep. 2)	460	183	410	<10	.	.
Total Organic Halogen (Rep. 3)	520	329	380	<10	.	.
Total Organic Halogen (Rep. 4)	530	460	410	<10	.	.
ANIONS (mg/L)						
Chloride	2.4	1.8	1.6	1.6	2.3	2.6
Fluoride	0.09	<0.1	0.1	<0.1	<0.1	<0.1
Nitrate (as N)	0.47	0.32	0.29	0.2	0.38	0.34
Sulfate	2.2	<1	<1	<1	<1	1
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	320	330	320	310	340	350
pH	6	7.5	7.9	8.4	7.6	7.7
Dissolved Oxygen (mg/L)	6.2	12	8.2	7.1	8.2	7.5
Redox (mV)	.	179.8	176	315	346	364
Temperature (°C)	14	16.4	22	16.7	10.8	15.3
Water Level (ft ± grade)	-113.5	-117.5	-127.8	-131.7	-117.6	-115
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	135	<1	1.6	6	<1	.
pH - (Rep. 1)	7.1	7.9	7.5	7.7	7.9	7.6
pH - (Rep. 2)	7.2	7.6	7.5	7.7	7.9	7.5
pH - (Rep. 3)	7.3	7.8	7.5	7.7	7.9	7.5
pH - (Rep. 4)	7.9	7.9	7.5	7.7	8	7.6
Conductivity - (Rep. 1)	398	330	349	339	.	384
Conductivity - (Rep. 2)	398	327	346	340	.	383
Conductivity - (Rep. 3)	397	325	346	339	.	384
Conductivity - (Rep. 4)	399	326	349	340	.	386
Total Suspended Solids (mg/L	.	.	.	.	<1	2
Total Coliform (cc/100 mls)	N	N	N	N	.	.
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.01	<0.02	<0.02	<0.01	.	.
2,4-D	<1	<2	<2	<1	.	.
Endrin	<0.05	<0.1	<0.1	<0.05	.	.
Methoxychlor	<0.04	<0.08	<0.08	<0.04	.	.
Silvex	<0.1	<0.2	<0.2	<0.1	.	.
Toxaphene	<1	<2	<2	<1	.	.

Water Quality Data for Monitor-Well 1080

PARAMETER	DATE SAMPLED: 2/19/86	4/15/86	7/29/86	10/14/86	1/9/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	N	N	N	N	.	.
Acenaphthylene	N	N	N	N	.	.
Anthracene	N	N	N	N	.	.
Benzidine	X	X	X	X	.	.
Benzo(a)Anthracene	N	N	N	N	.	.
Benzo(a)Pyrene	N	N	N	N	.	.
Benzo(b)Fluoranthene	N	N	N	N	.	.
Benzo(g,h,i)Perylene	N	N	N	N	.	.
Benzo(k)Fluoranthene	N	N	N	N	.	.
Benzyl Alcohol	N	N	N	N	.	.
Benzyl Butyl Phthalate	N	N	N	N	.	.
Bis(2-Chloroethoxy)Methane	N	N	N	N	.	.
Bis(2-Chloroethyl)Ether	N	N	N	N	.	.
Bis(2-Chloroisopropyl)Ether	N	N	N	N	.	.
Bis(2-Ethylhexyl)Phthalate	N	3	N	160	.	.
4-Bromophenyl Phenyl Ether	N	N	N	N	.	.
4-Chloroaniline	N	N	N	N	.	.
2-Chloronaphthalene	N	N	N	N	.	.
4-Chlorophenyl Phenyl Ether	N	N	N	N	.	.
Chrysene	N	N	N	N	.	.
Di-n-Butyl Phthalate	N	N	2	2	.	.
Di-n-Octyl Phthalate	N	N	0.1	N	.	.
Dibenzo(a,h)Anthracene	N	N	N	N	.	.
Dibenzofuran	N	N	N	N	.	.
1,2-Dichlorobenzene	N	N	N	N	.	.
1,3-Dichlorobenzene	N	N	N	N	.	.
1,4-Dichlorobenzene	N	N	N	N	.	.
3,3'-Dichlorobenzidine	V	V	V	N	.	.
Diethyl Phthalate	N	N	N	N	.	.
Dimethyl Phthalate	N	N	N	N	.	.
2,4-Dinitrotoluene	N	N	N	N	.	.
2,6-Dinitrotoluene	N	N	N	N	.	.
Fluoranthene	N	N	N	N	.	.
Fluorene	N	N	N	N	.	.

PARAMETER	DATE SAMPLED: 2/19/86	4/15/86	7/29/86	10/14/86	1/9/87	4/6/87
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Hexachlorobenzene	N	N	N	N	.	.
Hexachlorobutadiene	N	N	N	N	.	.
Hexachlorocyclopentadiene	N	N	N	N	.	.
Hexachloroethane	N	N	N	N	.	.
Indeno(1,2,3-cd)Pyrene	N	N	N	N	.	.
Isophorone	N	N	N	N	.	.
2-Methylnaphthalene	N	N	N	N	.	.
N-Nitrosodi-N-Propylamine	N	N	N	N	.	.
N-Nitrosodimethylamine	N	N	N	N	.	.
N-Nitrosodiphenylamine	N	N	N	N	.	.
Naphthalene	N	N	N	N	.	.
2-Nitroaniline	M	M	M	N	.	.
3-Nitroaniline	M	M	M	N	.	.
4-Nitroaniline	M	M	M	N	.	.
Nitrobenzene	N	N	N	N	.	.
Phenanthrene	N	N	N	N	.	.
Pyrene	N	N	N	N	.	.
1,2,4-Trichlorobenzene	N	N	N	N	.	.
2,4,5-Trichlorophenol	M	M	M	N	.	.
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	M	M	M	N	.	.
4-Chloro-3-Methylphenol	N	N	N	N	.	.
2-Chlorophenol	N	N	N	N	.	.
2,4-Dichlorophenol	N	N	N	N	.	.
2,4-Dimethylphenol	N	N	N	N	.	.
2,4-Dinitrophenol	M	M	M	N	.	.
2-Methyl-4,6-Dinitrophenol	M	M	M	N	.	.
2-Methyl Phenol	.	.	.	.	.	.
3-Methyl Phenol	N	N	N	N	.	.
4-Methyl Phenol	N	N	N	N	.	.
2-Nitrophenol	N	N	N	N	.	.
4-Nitrophenol	M	M	M	N	.	.
Pentachlorophenol	M	M	M	N	.	.
Phenol	N	N	N	N	.	.
2,4,6-Trichlorophenol	N	N	N	N	.	.

Assessment Data for Monitor-Well GW-173

Quarter Sampled: / Date Sampled:	1st Quarter 3/12/88		2nd Quarter 6/7/88		3rd Quarter 8/8/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.24	0.28	<0.1	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)	0.003	<0.001	.	.	.	.	.	.
Cadmium (AAS)	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	0.047	<0.01	0.018	<0.01	0.015	0.01	<0.01	<0.01
Lead (AAS)	0.43	<0.004	<0.004	<0.004	0.051	0.0052	0.01	<0.004
Mercury (CVAA)	0.0004	<0.0002	<0.0002	<0.0002	0.0006	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.009	0.003	0.003	0.003	0.002	0.002	<0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	159		162		163		166	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	140	37	36	37	59	40	39	37
Chloride	5		4		4		3	
Fluoride	<0.1		0.11		<0.1		<0.1	
Magnesium (ICAP)	61	25	25	24	31	25	24	24
Nitrate (as N)	1.66		1.42		1.5		1.4	
Potassium	5	2.9	4.4	3.2	4.2	3.4	2.5	2.7
Sodium (ICAP)	2.4	2.3	2.2	2.9	2.5	2.4	2.2	2.4
Sulfate	11.4		12		12		11	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		G		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	G		G		0.5		0.4	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	G		G		G		<5	
1,2-Dichloroethane	G		G		G		<5	
1,1-Dichloroethene	G		G		G		<5	
trans-1,2-Dichloroethene	G		G		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		0.8		2	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	15		17		15		19	
Toluene	G		G		G		<5	
1,1,1-Trichloroethane	1		2		2		2	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	G		G		G		0.7	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	13		0.15		2		8	
Gross Beta, neg. (pCi/L)	2697		5		3		11	
MISCELLANEOUS PARAMETERS								
pH (average)	7.7		8.0		7.5		7.7	
Conductivity (average)	369		389		319		392	
Total Dissolved Solids (mg/L)	270		222		198		242	
Total Suspended Solids (mg/L)	26		13		222		4	
Water-Level Elevations (ft. msl)	975.9		962.0		962.0		958.5	

R02-09-89Ba

G - Detection Limit of 5 µg/L
N - Detection Limit of 10 µg/L

Assessment Data for Monitor-Well GW-174

Quarter Sampled: / Date Sampled:	1st Quarter 3/12/88		2nd Quarter 6/7/88		3rd Quarter 8/8/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.43	0.31	<0.1	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001
Beryllium (ICAP)	<0.001	<0.005	.	.	.	.	.	.
Cadmium (AAS)	0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	0.019	<0.01	0.025	<0.01	0.048	<0.01	0.015	0.016
Lead (AAS)	0.011	<0.004	0.015	<0.004	0.024	<0.004	0.0066	0.0048
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	0.003	0.005	0.001	0.002	0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	155		154		155		154	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	35	34	34	33	43	36	23	18
Chloride	5		6		6		6	
Fluoride	<0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	23	23	23	23	27	23	18	14
Nitrate (as N)	0.47		0.45		0.47		0.57	
Potassium	3.3	3	3.4	3	4.4	4.4	4 4	5.5
Sodium (ICAP)	3.8	4	5.3	3.9	3.3	3.4	22	32
Sulfate	3.4		3		4		5	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		0.7		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	G		G		0.4		<5	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	G		G		1		1	
1,2-Dichloroethane	G		G		G		<5	
1,1-Dichloroethene	G		G		1		0.9	
trans-1,2-Dichloroethene	3		3		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		2		<5	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	35		39		41		49	
Toluene	0.8		G		G		<5	
1,1,1-Trichloroethane	G		4		6		6	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	2		G		2		2	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	5		1		3		7	
Gross Beta, neg. (pCi/L)	28		28		7		23	
MISCELLANEOUS PARAMETERS								
pH (average)	7.9		8.1		7.8		8.6	
Conductivity (average)	334		386		295		355	
Total Dissolved Solids (mg/L)	228		220		212		218	
Total Suspended Solids (mg/L)	55		34		71		16	
Water-Level Elevations (ft. msl)	1002.0		989.7		990.7		984.2	

Assessment Data for Monitor-Well GW-175

Quarter Sampled: / Date Sampled:	1st Quarter	2nd Quarter	3rd Quarter 8/17/88		4th Quarter 10/24/88	
METALS (mg/L)	Installed in June, 1988		Total	Dissolved	Total	Dissolved
Arsenic (AAS)			<0.005	<0.005	<0.005	<0.005
Barium (AAS)			0.17	0.17	0.11	0.18
Beryllium (AAS)			<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)			.	.	.	.
Cadmium (AAS)			<0.002	<0.002	<0.002	<0.002
Chromium (AAS)			<0.01	<0.01	<0.01	<0.01
Lead (AAS)			<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)			<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)			<0.005	<0.005	<0.005	<0.005
Silver (AAS)			<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)			<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)			0.005	0.005	0.003	0.006
ANIONS & CATIONS (mg/L)						
Alkalinity, Bicarbonate			139		142	
Calcium (AAS)			.	.	.	.
Calcium (ICAP)			28	28	31	30
Chloride			2		1	
Fluoride			<0.1		<0.1	
Magnesium (ICAP)			20	20	19	19
Nitrate (as N)			0.29		0.35	
Potassium			1.1	1.1	0.71	1.1
Sodium (ICAP)			2.4	2.4	0.76	0.81
Sulfate			3		1	
VOLATILE ORGANICS (µg/L)						
Acrolein			.		.	
Acrylonitrile			.		.	
Benzene			G		<5	
Bromodichloromethane			G		<5	
Bromoform			G		<5	
Bromomethane			N		<10	
Carbon tetrachloride			G		<5	
Chlorobenzene			G		<5	
Chlorodibromomethane			G		<5	
Chloroethane			N		<10	
2-Chloroethyl vinyl ether			N		.	
Chloroform			G		<5	
Chloromethane			N		<10	
Dichlorodifluoromethane			.		.	
1,1-Dichloroethane			G		<5	
1,2-Dichloroethane			G		<5	
1,1-Dichloroethene			G		<5	
trans-1,2-Dichloroethene			G		.	
1,2-Dichloropropane			G		<5	
cis-1,3-Dichloropropene			G		<5	
trans-1,3-Dichloropropene			G		<5	
Ethylbenzene			G		<5	
Fluorotrichloromethane			.		.	
Methylene chloride			G		<5	
1,1,2,2-Tetrachloroethane			G		<5	
Tetrachloroethene			8		10	
Toluene			G		<5	
1,1,1-Trichloroethane			3		5	
1,1,2-Trichloroethane			G		<5	
Trichloroethene			G		<5	
Vinyl chloride			N		<10	
RADIOCHEMICAL PARAMETERS						
Gross Alpha, neg. (pCi/L)			0.5		3	
Gross Beta, neg. (pCi/L)			-0.82		7	
MISCELLANEOUS PARAMETERS						
pH (average)			7.8		7.9	
Conductivity (average)			275		310	
Total Dissolved Solids (mg/L)			178		184	
Total Suspended Solids (mg/L)			3		<1	
Water-Level Elevations (ft. msl)			965.5		958.4	

R02-09-89Ba

Assessment Data for Monitor-Well GW-176

Quarter Sampled: / Date Sampled:	1st Quarter 3/11/88		2nd Quarter 6/7/88		3rd Quarter 8/12/88		4th Quarter 10/26/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.22	0.19	<0.1	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)	<0.001	<0.001	.	.	.	.	.	.
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	<0.01	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.005	<0.004	<0.004	<0.004	<0.004	<0.004	0.0056	0.0088
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	0.006	<0.001	0.001	<0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	202		210		232		233	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	40	43	44	43	13	48	52	52
Chloride	3		3		2		2	
Fluoride	0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	26	29	31	31	8.7	31	33	33
Nitrate (as N)	1.24		0.44		0.5		0.51	
Potassium	2.1	2.5	2.3	2.4	3	1.8	1.8	2.7
Sodium (ICAP)	0.84	0.83	0.62	0.73	0.18	0.7	1.1	0.73
Sulfate	1.1		<1		1		<1	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		16		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	0.7		G		0.5		<5	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	83		26		16		12	
1,2-Dichloroethane	3		G		G		<5	
1,1-Dichloroethene	30		12		10		8	
trans-1,2-Dichloroethene	G		G		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		G		<5	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	14		10		10		8	
Toluene	G		G		G		<5	
1,1,1-Trichloroethane	390		130		130		100	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	G		G		G		<5	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	1		4		2		0.7	
Gross Beta, neg. (pCi/L)	1		26		1		2	
MISCELLANEOUS PARAMETERS								
pH (average)	6.7		7.2		7.0		6.6	
Conductivity (average)	417		464		455		477	
Total Dissolved Solids (mg/L)	274		292		312		308	
Total Suspended Solids (mg/L)	3		4		5		<1	
Water-Level Elevations (ft. msl)	1012.1		1009.1		1005.5		1008.6	

Assessment Data for Monitor-Well GW-177

Quarter Sampled: / Date Sampled:	1st Quarter 3/12/88		2nd Quarter 6/6/88		3rd Quarter 8/12/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.21	0.17	0.2	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)	<0.001	<0.001	.	.	.	.	.	.
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	0.013	<0.01	0.012	0.011	0.014	<0.01	<0.01	<0.01
Lead (AAS)	0.008	<0.004	<0.004	<0.004	0.0083	<0.004	0.0062	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	0.002	0.049	0.005	0.004	0.002	0.01	0.007
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	178		189		189		186	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	37	40	39	39	25	43	39	38
Chloride	6.8		5.2		6		5	
Fluoride	<0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	24	25	26	26	16	28	25	25
Nitrate (as N)	0.26		0.17		0.33		0.35	
Potassium	4.6	3.4	6	6.1	5	6.3	4.8	4.7
Sodium (ICAP)	2.4	2	3.1	2.9	1.1	2.2	2.2	1.9
Sulfate	12		14		9		8	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		9		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	G		G		G		0.4	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	14		19		19		27	
1,2-Dichloroethane	G		G		G		<5	
1,1-Dichloroethene	2		4		3		3	
trans-1,2-Dichloroethene	G		G		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		G		<5	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	G		3		1		1	
Toluene	G		G		G		<5	
1,1,1-Trichloroethane	57		79		79		82	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	G		G		G		<5	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	5		0.88		1		0.2	
Gross Beta, neg. (pCi/L)	48		96		8		8	
MISCELLANEOUS PARAMETERS								
pH (average)	7.7		7.9		7.6		7.9	
Conductivity (average)	400		429		390		423	
Total Dissolved Solids (mg/L)	258		246		280		278	
Total Suspended Solids (mg/L)	6		8		2		<1	
Water-Level Elevations (ft. msl)	1046.0		1045.3		1046.0		1042.9	

R02-09-89Ba

Assessment Data for Monitor-Well GW-178

Quarter Sampled: / Date Sampled:	1st Quarter 3/12/88		2nd Quarter 6/6/88		3rd Quarter 9/16/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.17	0.18	<0.1	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)	<0.001	<0.001	.	.	.	.	.	.
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	190		187		182		192	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	43	41	38	38	42	39	41	39
Chloride	1.8		2		2		2	
Fluoride	<0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	28	25	25	25	27	23	26	24
Nitrate (as N)	0.22		0.21		0.35		0.26	
Potassium	2.2	1.2	0.77	0.66	2.3	2.2	1.3	0.95
Sodium (ICAP)	1	0.91	1.7	1.9	1.3	2.3	1.3	1.6
Sulfate	1.7		2		2		2	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		4		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	G		G		G		<5	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	G		2		4		4	
1,2-Dichloroethane	G		G		G		<5	
1,1-Dichloroethene	G		G		G		2	
trans-1,2-Dichloroethene	G		G		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		G		<5	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	G		G		G		4	
Toluene	G		G		G		<5	
1,1,1-Trichloroethane	23		27		37		44	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	G		G		G		<5	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	3		8		-0.29		3	
Gross Beta, neg. (pCi/L)	106		26		0		4	
MISCELLANEOUS PARAMETERS								
pH (average)	7.9		7.8		7.4		8.0	
Conductivity (average)	386		388		417		409	
Total Dissolved Solids (mg/L)	266		226		258		242	
Total Suspended Solids (mg/L)	23		1		5		8	
Water-Level Elevations (ft. msl)	1054.9		1049.5		1044.7		1041.5	

Assessment Data for Monitor-Well GW-179

Quarter Sampled: / Date Sampled:	1st Quarter 3/14/88		2nd Quarter 6/10/88		3rd Quarter 8/12/88		4th Quarter
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.22	0.21	
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	
Beryllium (ICAP)	<0.001	<0.001	.	.	.	.	
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
Chromium (AAS)	0.022	<0.01	0.013	<0.01	<0.01	<0.01	
Lead (AAS)	0.27	<0.004	0.039	<0.004	0.017	<0.004	
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
Uranium (Fluor)	0.002	<0.001	0.003	0.001	0.001	0.003	
ANIONS & CATIONS (mg/L)							
Alkalinity, Bicarbonate	249		261		236		
Calcium (AAS)	.	.	.	.	.	.	
Calcium (ICAP)	150	61	87	66	42	60	
Chloride	1.4		.		1		
Fluoride	<0.1		<0.1		<0.1		
Magnesium (ICAP)	87	31	55	38	27	34	
Nitrate (as N)	0.2		0.23		0.2		
Potassium	3.3	1.6	3	2.7	4 4	3.5	
Sodium (ICAP)	3.8	4	3.9	3.7	1.9	3.3	
Sulfate	8		7		6		
VOLATILE ORGANICS (µg/L)							
Acrolein	.		.		.		
Acrylonitrile	.		.		.		
Benzene	G		G		G		
Bromodichloromethane	G		G		G		
Bromoform	G		G		G		
Bromomethane	N		N		N		
Carbon tetrachloride	G		G		100		
Chlorobenzene	G		G		G		
Chlorodibromomethane	G		G		G		
Chloroethane	N		N		3		
2-Chloroethyl vinyl ether	N		N		N		
Chloroform	3		G		2		
Chloromethane	N		N		N		
Dichlorodifluoromethane	.		.		.		
1,1-Dichloroethane	300		250		240		
1,2-Dichloroethane	2		G		1		
1,1-Dichloroethene	71		62		62		
trans-1,2-Dichloroethene	G		G		G		
1,2-Dichloropropane	G		G		G		
cis-1,3-Dichloropropene	G		G		G		
trans-1,3-Dichloropropene	G		G		G		
Ethylbenzene	0.6		G		G		
Fluorotrichloromethane	.		.		.		
Methylene chloride	G		G		G		
1,1,2,2-Tetrachloroethane	G		G		G		
Tetrachloroethene	12		11		10		
Toluene	G		G		G		
1,1,1-Trichloroethane	990		700		880		
1,1,2-Trichloroethane	G		G		G		
Trichloroethene	G		G		G		
Vinyl chloride	N		N		N		
RADIOCHEMICAL PARAMETERS							
Gross Alpha, neg. (pCi/L)	2		2		14		
Gross Beta, neg. (pCi/L)	18		7		30		
MISCELLANEOUS PARAMETERS							
pH (average)	7.2		7.4		7.4		
Conductivity (average)	517		528		464		
Total Dissolved Solids (mg/L)	342		380		312		
Total Suspended Solids (mg/L)	331		149		33		
Water-Level Elevations (ft. msl)	1019.1		1018.5		1019.9		

R02-09-89Ba

Assessment Data for Monitor-Well GW-180

Quarter Sampled: / Date Sampled:	1st Quarter 3/11/88		2nd Quarter 6/7/88		3rd Quarter 9/16/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.19	0.18	<0.1	<0.1
Beryllium (AAS)	.	.	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)	<0.001	<0.001	.	.	.	.	.	.
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	0.018	0.016	0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	<0.004	<0.004	0.0047	0.0042	<0.004	<0.004	0.0049	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	236		234		226		216	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	45	52	54	54	52	52	44	44
Chloride	2		2		2		2	
Fluoride	0.8		<0.1		<0.1		<0.1	
Magnesium (ICAP)	30	34	34	34	32	32	29	29
Nitrate (as N)	0.12		<0.11		<0.11		<0.11	
Potassium	2.3	2.7	5.7	5.7	0.69	0.82	1.9	1.2
Sodium (ICAP)	1.3	1.4	1.1	1	0.75	0.93	0.59	0.51
Sulfate	9.4		3		1		<1	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		G		<5	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	0.6		G		G		<5	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	20		16		15		8	
1,2-Dichloroethane	G		G		G		<5	
1,1-Dichloroethene	G		G		G		1	
trans-1,2-Dichloroethene	21		25		27		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		G		3	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	160		160		150		180	
Toluene	G		1		G		<5	
1,1,1-Trichloroethane	8		7		11		10	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	6		7		6		6	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	0.6		-0.85		0.23		0.07	
Gross Beta, neg. (pCi/L)	4.5		11		0		2	
MISCELLANEOUS PARAMETERS								
pH (average)	7.4		7.5		7.4		7.4	
Conductivity (average)	484		492		505		452	
Total Dissolved Solids (mg/L)	304		274		284		284	
Total Suspended Solids (mg/L)	1		1		<1		<1	
Water-Level Elevations (ft. msl)	989.2		980.9		973.4		969.2	

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Assessment Data for Monitor-Well GW-181

Quarter Sampled: / Date Sampled:	1st Quarter	2nd Quarter	3rd Quarter 8/17/88		4th Quarter 10/26/88	
METALS (mg/L)	Installed in April, 1988		Total	Dissolved	Total	Dissolved
Arsenic (AAS)			<0.005	<0.005	<0.005	<0.005
Barium (AAS)			0.19	0.2	<0.1	<0.1
Beryllium (AAS)			<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)			.	.	.	.
Cadmium (AAS)			<0.002	<0.002	<0.002	<0.002
Chromium (AAS)			<0.001	<0.01	<0.01	<0.01
Lead (AAS)			<0.004	0.0041	<0.004	0.0047
Mercury (CVAA)			<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)			<0.005	<0.005	<0.005	<0.005
Silver (AAS)			<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)			<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)			0.002	0.003	<0.001	<0.001
ANIONS & CATIONS (mg/L)						
Alkalinity, Bicarbonate			120		126	
Calcium (AAS)			.	.	.	.
Calcium (ICAP)			26	27	29	28
Chloride			5		3	
Fluoride			<0.1		<0.1	
Magnesium (ICAP)			16	16	17	17
Nitrate (as N)			<0.11		<0.11	
Potassium			3	3	3.3	3
Sodium (ICAP)			1.3	1.3	2.4	2.2
Sulfate			2		1	
VOLATILE ORGANICS (µg/L)						
Acrolein			.		.	
Acrylonitrile			.		.	
Benzene			G		<5	
Bromodichloromethane			G		<5	
Bromoform			G		<5	
Bromomethane			N		<10	
Carbon tetrachloride			G		<5	
Chlorobenzene			G		<5	
Chlorodibromomethane			G		<5	
Chloroethane			N		<10	
2-Chloroethyl vinyl ether			N		.	
Chloroform			G		<5	
Chloromethane			N		<10	
Dichlorodifluoromethane			.		.	
1,1-Dichloroethane			1		2	
1,2-Dichloroethane			G		<5	
1,1-Dichloroethene			G		<5	
trans-1,2-Dichloroethene			G		.	
1,2-Dichloropropane			G		<5	
cis-1,3-Dichloropropene			G		<5	
trans-1,3-Dichloropropene			G		<5	
Ethylbenzene			G		<5	
Fluorotrichloromethane			.		.	
Methylene chloride			G		<5	
1,1,2,2-Tetrachloroethane			G		<5	
Tetrachloroethene			G		<5	
Toluene			G		<5	
1,1,1-Trichloroethane			3		4	
1,1,2-Trichloroethane			G		<5	
Trichloroethene			G		<5	
Vinyl chloride			N		<10	
RADIOCHEMICAL PARAMETERS						
Gross Alpha, neg. (pCi/L)			0.93		1.5	
Gross Beta, neg. (pCi/L)			4		6	
MISCELLANEOUS PARAMETERS						
pH (average)			8.2		8.3	
Conductivity (average)			258		286	
Total Dissolved Solids (mg/L)			202		170	
Total Suspended Solids (mg/L)			2		<1	
Water-Level Elevations (ft. msl)			976.7		976.0	

Assessment Data for Monitor-Well GW-322

Quarter Sampled: / Date Sampled:	1st Quarter 3/12/88		2nd Quarter 6/7/88		3rd Quarter 8/8/88		4th Quarter 10/24/88	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.005	<0.005	0.012	<0.005	0.0075	<0.005	<0.005	<0.005
Barium (AAS)	<0.1	<0.1	<0.1	<0.1	0.45	0.19	<0.1	<0.1
Beryllium (AAS)	.	.	0.0012	<0.001	0.0021	<0.001	<0.001	<0.001
Beryllium (ICAP)	<0.002	<0.001	.	.	.	.	.	.
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (AAS)	<0.01	<0.01	0.01	<0.01	0.014	<0.01	<0.01	<0.01
Lead (AAS)	0.006	0.005	0.049	<0.004	0.04	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	0.001	0.003	<0.001	0.003	0.002	<0.001	<0.001
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	127		130		134		132	
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	28	28	100	29	58	30	29	28
Chloride	1.8		2		2		2	
Fluoride	0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	18	17	68	19	36	19	18	18
Nitrate (as N)	0.27		0.21		0.2		0.24	
Potassium	2.1	0.75	2.8	1.2	3.2	2.8	1.2	1.4
Sodium (ICAP)	0.62	0.45	0.62	0.65	0.6	0.46	0.46	0.47
Sulfate	1		<1		<1		<1	
VOLATILE ORGANICS (µg/L)								
Acrolein	.		.		.		.	
Acrylonitrile	.		.		.		.	
Benzene	G		G		G		<5	
Bromodichloromethane	G		G		G		<5	
Bromoform	G		G		G		<5	
Bromomethane	N		N		N		<10	
Carbon tetrachloride	G		G		94		72	
Chlorobenzene	G		G		G		<5	
Chlorodibromomethane	G		G		G		<5	
Chloroethane	N		N		N		<10	
2-Chloroethyl vinyl ether	N		N		N		.	
Chloroform	0.3		G		1		0.9	
Chloromethane	N		N		N		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	30		34		37		34	
1,2-Dichloroethane	2		2		3		<5	
1,1-Dichloroethene	87		95		93		94	
trans-1,2-Dichloroethene	G		G		G		.	
1,2-Dichloropropane	G		G		G		<5	
cis-1,3-Dichloropropene	G		G		G		<5	
trans-1,3-Dichloropropene	G		G		G		<5	
Ethylbenzene	G		G		G		<5	
Fluorotrichloromethane	.		.		.		.	
Methylene chloride	G		G		G		<5	
1,1,2,2-Tetrachloroethane	G		G		G		<5	
Tetrachloroethene	4		6		7		6	
Toluene	G		G		G		<5	
1,1,1-Trichloroethane	670		620		790		670	
1,1,2-Trichloroethane	G		G		G		<5	
Trichloroethene	G		2		G		<5	
Vinyl chloride	N		N		N		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	1		-0.55		22.96		2	
Gross Beta, neg. (pCi/L)	6		13		78.98		5	
MISCELLANEOUS PARAMETERS								
pH (average)	7.7		7.8		7.6		7.9	
Conductivity (average)	265		295		238		302	
Total Dissolved Solids (mg/L)	200		172		156		184	
Total Suspended Solids (mg/L)	17		20		206		4	
Water-Level Elevations (ft. msl)	980.5				988.3		973.5	

Assessment Data for Monitor-Well GW-511

Quarter Sampled: / Date Sampled:	1st Quarter	2nd Quarter	3rd Quarter 8/17/88		4th Quarter 10/26/88	
METALS (mg/L)	Installed in April, 1988		Total	Dissolved	Total	Dissolved
Arsenic (AAS)			0.01	0.008	0.0082	<0.005
Barium (AAS)			0.18	0.16	<0.1	<0.1
Beryllium (AAS)			<0.001	<0.001	<0.001	<0.001
Beryllium (ICAP)			.	.	.	.
Cadmium (AAS)			<0.002	<0.002	<0.002	<0.002
Chromium (AAS)			0.015	0.012	<0.01	<0.01
Lead (AAS)			<0.004	<0.004	0.055	0.0045
Mercury (CVAA)			<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)			<0.005	<0.005	<0.005	<0.005
Silver (AAS)			<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)			<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)			0.002	0.001	<0.001	<0.001
ANIONS & CATIONS (mg/L)						
Alkalinity, Bicarbonate			55		44	
Calcium (AAS)			.	.	.	.
Calcium (ICAP)			24	6.4	25	6.1
Chloride			18		19	
Fluoride			<0.1		<0.1	
Magnesium (ICAP)			7.2	6.9	4.6	4.3
Nitrate (as N)			<0.11		<0.11	
Potassium			16	16	18	17
Sodium (ICAP)			4.2	4.5	5.9	5.7
Sulfate			3		2	
VOLATILE ORGANICS (µg/L)						
Acrolein			.		.	
Acrylonitrile			.		.	
Benzene			G		<5	
Bromodichloromethane			G		<5	
Bromoform			G		<5	
Bromomethane			N		<10	
Carbon tetrachloride			G		<5	
Chlorobenzene			G		3	
Chlorodibromomethane			G		<5	
Chloroethane			N		<10	
2-Chloroethyl vinyl ether			N		.	
Chloroform			0.6		0.4	
Chloromethane			N		<10	
Dichlorodifluoromethane			.		.	
1,1-Dichloroethane			G		1	
1,2-Dichloroethane			G		<5	
1,1-Dichloroethene			G		<5	
trans-1,2-Dichloroethene			G		.	
1,2-Dichloropropane			G		<5	
cis-1,3-Dichloropropene			G		<5	
trans-1,3-Dichloropropene			G		<5	
Ethylbenzene			G		<5	
Fluorotrichloromethane			.		.	
Methylene chloride			G		<5	
1,1,2,2-Tetrachloroethane			G		<5	
Tetrachloroethene			G		<5	
Toluene			G		<5	
1,1,1-Trichloroethane			3		3	
1,1,2-Trichloroethane			G		<5	
Trichloroethene			G		<5	
Vinyl chloride			N		<10	
RADIOCHEMICAL PARAMETERS						
Gross Alpha, neg. (pCi/L)			1		2	
Gross Beta, neg. (pCi/L)			12		16	
MISCELLANEOUS PARAMETERS						
pH (average)			9.2		9.4	
Conductivity (average)			158		165	
Total Dissolved Solids (mg/L)			128		98	
Total Suspended Solids (mg/L)			1		<1	
Water-Level Elevations (ft. msl)			978.1		975.4	

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Appendix IX Data for Monitor-Wells at Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit, 1988

Well Number:	GW-173		GW-174		GW-176		GW-177	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.01	<0.01	<0.01	<0.01	<0.001	<0.001	<0.001	<0.001
Barium (AAS)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Beryllium (AAS)	.	.	.	.	.	.	.	.
Beryllium (ICAP)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium (AAS)	0.116	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium (AAS)	0.114	<0.01	0.0766	<0.01	<0.01	<0.01	0.0271	<0.01
Lead (AAS)	0.0226	<0.01	0.0238	0.0322	<0.005	<0.005	0.0286	0.0486
Mercury (CVAA)	0.0005	<0.0002	0.00067	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	.	.	.	.	.	.	.	.
Uranium (Fluor)	.	.	.	.	.	.	.	.
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	.		.	.	.	.	.	.
Calcium (AAS)	.	.	.	.	.	.	.	.
Calcium (ICAP)	161		172	77.2	46.9	47.6	49.1	44.1
Chloride	.		.	.	.	.	.	.
Fluoride	0.1		.	.	<0.1	.	<0.1	.
Magnesium (ICAP)	58.3		90.7	33	28.9	29	28.3	25.6
Nitrate (as N)	.		.	.	.	.	.	
Potassium	<5.0		5	<5	<5	<5	<5	<5
Sodium (ICAP)	<5.0		5.34	6.09	<5	<5	<5	<5
Sulfate	.		.	.	.	.	.	.
VOLATILE ORGANICS (µg/L)								
Acrolein	<10		<10		<10		<10	
Acrylonitrile	<10		<10		<10		<10	
Benzene	<5		<5		<5		2	
Bromodichloromethane	<5		<5		<5		<5	
Bromoform	<5		<5		<5		<5	
Bromomethane	<10		<10		<10		<10	
Carbon tetrachloride	<5		<5		<5		<5	
Chlorobenzene	<5		<5		<5		<5	
Chlorodibromomethane	<5		<5		<5		<5	
Chloroethane	<10		<10		<10		<10	
2-Chloroethyl vinyl ether	<10		<10		<10		<10	
Chloroform	<5		<5		<5		<5	
Chloromethane	<10		<10		<10		<10	
Dichlorodifluoromethane	.		.		.		.	
1,1-Dichloroethane	<5		2		14		13	
1,2-Dichloroethane	<5		<5		<5		<5	
1,1-Dichloroethene	<5		2		9		2	
trans-1,2-Dichloroethene	<5		8		<5		<5	
1,2-Dichloropropane	<5		<5		<5		<5	
cis-1,3-Dichloropropene	<5		<5		<5		<5	
trans-1,3-Dichloropropene	<5		<5		<5		<5	
Ethylbenzene	<5		<5		<5		<5	
Fluorotrichloromethane	14		44		6		2	
Methylene chloride	4		4		4		4	
1,1,2,2-Tetrachloroethane	<5		<5		<5		<5	
Tetrachloroethene	12		42		5		12	
Toluene	<5		<5		2		<5	
1,1,1-Trichloroethane	1		5		96		41	
1,1,2-Trichloroethane	<5		<5		<5		<5	
Trichloroethene	<5		4		<5		<5	
Vinyl chloride	<10		<10		<10		<10	
RADIOCHEMICAL PARAMETERS								
Gross Alpha, neg. (pCi/L)	.		.		.		.	
Gross Beta, neg. (pCi/L)	.		.		.		.	
MISCELLANEOUS PARAMETERS								
pH (average)	.		.		.		.	
Conductivity (average)	.		.		.		.	
Total Dissolved Solids (mg/L)	.		.		.		.	
Total Suspended Solids (mg/L)	.		.		.		.	
Water-Level Elevations (ft, msl)	.		.		.		.	

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Appendix IX Data for Monitor-Wells at Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit, 1988

Well Number:	GW-178		GW-180		GW-322	
METALS (mg/L)	Total	Dissolved	Total	Dissolved	Total	Dissolved
Arsenic (AAS)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium (AAS)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Beryllium (AAS)	.	.	.	.	.	.
Beryllium (ICAP)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium (AAS)	<0.005	<0.005	0.0612	<0.005	<0.005	<0.005
Chromium (AAS)	0.023	<0.01	<0.01	<0.01	0.047	<0.01
Lead (AAS)	0.024	<0.005	<0.005	<0.005	0.017	<0.005
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium (AAS)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thorium (ICAP)	.	.	.	.	.	.
Uranium (Fluor)	.	.	.	.	.	.
ANIONS & CATIONS (mg/L)						
Alkalinity, Bicarbonate	.	.	.	.	.	.
Calcium (AAS)	.	.	.	.	.	.
Calcium (ICAP)	48.3	41	47	46.5	150	30.6
Chloride	.	.	.	.	.	.
Fluoride	<0.1	.	<0.1	.	<0.1	.
Magnesium (ICAP)	26.9	24.7	28.2	28.1	90.2	18
Nitrate (as N)	.	.	.	.	.	.
Potassium	<5	<5	<5	<5	<5	<5
Sodium (ICAP)	<5	<5	<5	<5	<5	<5
Sulfate	.	.	.	.	.	.
VOLATILE ORGANICS (µg/L)						
Acrolein	<10		<10		<10	
Acrylonitrile	<10		<10		<10	
Benzene	<5		<5		<5	
Bromodichloromethane	<5		<5		<5	
Bromoform	<5		<5		<5	
Bromomethane	<10		<10		<10	
Carbon tetrachloride	<5		<5		<5	
Chlorobenzene	<5		<5		<5	
Chlorodibromomethane	<5		<5		<5	
Chloroethane	<10		<10		<10	
2-Chloroethyl vinyl ether	<10		<10		<10	
Chloroform	<5		<5		<5	
Chloromethane	<10		<10		<10	
Dichlorodifluoromethane	.		.		.	
1,1-Dichloroethane	<10		7		27	
1,2-Dichloroethane	<5		<5		3	
1,1-Dichloroethene	<5		2		68	
trans-1,2-Dichloroethene	<5		25		<5	
1,2-Dichloropropane	<5		<5		<5	
cis-1,3-Dichloropropene	<5		<5		<5	
trans-1,3-Dichloropropene	<5		<5		<5	
Ethylbenzene	<5		<5		<5	
Fluorotrichloromethane	2		39		18	
Methylene chloride	3		5		6	
1,1,2,2-Tetrachloroethane	<5		4		<5	
Tetrachloroethene	<5		170		4	
Toluene	<5		<5		1	
1,1,1-Trichloroethane	15		8		550	
1,1,2-Trichloroethane	<5		<5		<5	
Trichloroethene	<5		7		<5	
Vinyl chloride	<10		<10		<10	
RADIOCHEMICAL PARAMETERS						
Gross Alpha, neg. (pCi/L)	.		.		.	
Gross Beta, neg. (pCi/L)	.		.		.	
MISCELLANEOUS PARAMETERS						
pH (average)	.		.		.	
Conductivity (average)	.		.		.	
Total Dissolved Solids (mg/L)	.		.		.	
Total Suspended Solids (mg/L)	.		.		.	
Water-Level Elevations (ft. msl)	.		.		.	

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1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name **GW-173**

Date Sampled	1/5/89	1/5/89	4/4/89	4/4/89	8/10/89	8/10/89	10/4/89	10/4/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	14:45:00	14:45:00	10:55:00	10:55:00	12:38:00	12:38:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.003	<0.003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0064	<0.004	0.014	<0.004	<0.004	0.0041	0.011	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0004
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	165		160		166		201	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	36	36	43	40	36	38	43	43
Chloride	3		3		3		3	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	24	24	26	25	23	23	26	26
Nitrate (as N)	1.1		1.4		1		1.5	
Potassium	4.1	4.3	2.1	2.3	1.9	0.83	<6	<6
Sodium (ICAP)	2.4		2.3	2.3	2.1	2.1	3.7	2.9
Sulfate	11		9		9		9	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	395		387		347		351	
Conductivity, 2 (µmhos/cm)	398		397		351		354	
Conductivity, 3 (µmhos/cm)	395		397		351		347	
Conductivity, 4 (µmhos/cm)	398		397		354		354	
Conductivity Average (µmhos/cm)	397		395		351		352	
pH, 1 (pH units)	6.7		6.4		6.2		7.8	
pH, 2 (pH units)	6.8		6.4		6.3		7.7	
pH, 3 (pH units)	6.7		6.4		6.3		7.7	
pH, 4 (pH units)	6.8		6.5		6.3		7.7	
pH Average (pH units)	6.8		6.4		6.3		7.7	
Total Dissolved Solids (mg/L)	208		188		204		190	
Total Suspended Solids (mg/L)	<1		3		8		<1	
Turbidity (NTU)	.		5.1		15		1.5	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-174

Date Sampled	1/5/89	1/5/89	4/3/89	4/3/89	8/11/89	8/11/89	10/10/89	10/10/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	12:50:00	12:50:00	17:32:00	17:32:00	14:15:00	14:15:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	0.0015	<0.0003	<0.0003	0.00035	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	0.18	<0.01	0.024	<0.01	0.013	<0.01
Lead (AAS)	0.0047	<0.004	0.14	<0.004	0.007	<0.004	0.0056	<0.004
Mercury (CVAA)	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	0.17	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	<0.001	0.005	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (ICAP)	.	.	0.018	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	158		156		148		204	
Alkalinity, Carbonate	<1		<1		13		<1	
Calcium (ICAP)	33	32	93	35	9.2	9.8	39	36
Chloride	6		7		6		9	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	23	22	55	24	11	12	25	23
Nitrate (as N)	0.42		0.5		0.6		0.5	
Potassium	3.8	4.3	5.5	4.3	7.2	7.8	1	4
Sodium (ICAP)	4.7		2.7	2.9	39	41	1.8	1.5
Sulfate	4		3		4		4	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	364		307		305		337	
Conductivity, 2 (µmhos/cm)	367		311		308		344	
Conductivity, 3 (µmhos/cm)	364		309		311		344	
Conductivity, 4 (µmhos/cm)	367		307		308		344	
Conductivity Average (µmhos/cm)	366		309		308		342	
pH, 1 (pH units)	6.8		6.5		6.7		7.9	
pH, 2 (pH units)	6.7		6.5		7		7.9	
pH, 3 (pH units)	6.8		6.5		7.2		8.3	
pH, 4 (pH units)	6.8		6.5		7.1		7.6	
pH Average (pH units)	6.8		6.5		7.0		7.9	
Total Dissolved Solids (mg/L)	186		178		180		188	
Total Suspended Solids (mg/L)	4		194		<1		46	
Turbidity (NTU)	.		125		11		37	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name **GW-175**

Date Sampled	1/6/89	1/6/89	4/6/89	4/6/89	8/14/89	8/14/89	10/21/89	10/21/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	10:50:00	10:50:00	12:50:00	12:50:00	12:15:00	12:15:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.01	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	0.00045	0.00044
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0054	0.0048	<0.004	<0.004	<0.004	<0.004	0.041	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	136		136		168		180	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	29	29	31	31	35	36	33	32
Chloride	1		1		2		2	
Fluoride	<0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	19	19	20	20	21	22	21	20
Nitrate (as N)	0.36		0.4		0.4		0.4	
Potassium	0.73	1.7	4.6	4.4	0.63	<0.6	<0.6	<0.6
Sodium (ICAP)	0.69		1	1	0.71	0.6	0.83	0.77
Sulfate	1		1		1		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	309		323		295		288	
Conductivity, 2 (µmhos/cm)	306		323		298		295	
Conductivity, 3 (µmhos/cm)	309		323		292		292	
Conductivity, 4 (µmhos/cm)	309		323		298		292	
Conductivity Average (µmhos/cm)	308		323		296		292	
pH, 1 (pH units)	6.7		6.5		6.7		8	
pH, 2 (pH units)	6.7		6.6		6.7		8	
pH, 3 (pH units)	6.7		6.6		6.7		8	
pH, 4 (pH units)	6.7		6.6		6.7		8.1	
pH Average (pH units)	6.7		6.6		6.7		8.0	
Total Dissolved Solids (mg/L)	156		160		174		170	
Total Suspended Solids (mg/L)	1		<1		4		14	
Turbidity (NTU)	.		0.7		5.2		4.9	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-176

Date Sampled	1/6/89	1/6/89	4/3/89	4/3/89	8/11/89	8/11/89	10/13/89	10/13/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	12:35:00	12:35:00	19:20:00	19:20:00	11:20:00	11:20:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	0.011	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0049	0.022	<0.004	<0.004	0.0059	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	0.016	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	<0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	236		241		274		305	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	56	56	56	55	51	51	57	57
Chloride	.		4		2		3	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	34	34	35	34	31	31	34	34
Nitrate (as N)	0.5		0.7		0.5		0.5	
Potassium	2	2	4.4	4	<0.6	<0.6	0.96	1.1
Sodium (ICAP)	0.35		0.78	0.77	0.8	0.75	0.66	0.94
Sulfate	1		1		1		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	517		409		469		475	
Conductivity, 2 (µmhos/cm)	520		412		469		475	
Conductivity, 3 (µmhos/cm)	517		414		469		482	
Conductivity, 4 (µmhos/cm)	517		412		472		482	
Conductivity Average (µmhos/cm)	518		412		470		479	
pH, 1 (pH units)	6.7		6.3		6.8		7	
pH, 2 (pH units)	6.7		6.4		6.8		7	
pH, 3 (pH units)	6.7		6.3		6.8		7.1	
pH, 4 (pH units)	6.7		6.3		6.7		7	
pH Average (pH units)	6.7		6.3		6.8		7.0	
Total Dissolved Solids (mg/L)	282		256		240		276	
Total Suspended Solids (mg/L)	1		<1		<1		<1	
Turbidity (NTU)	.		0.6		0.95		1.8	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-177

Date Sampled	1/4/89	1/4/89	4/4/89	4/4/89	8/31/89	8/31/89	10/12/89	10/12/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	14:30:00	14:30:00	15:00:00	15:00:00	14:15:00	14:15:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	0.00032	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	0.028	<0.01	<0.01	<0.01	0.22	<0.01
Lead (AAS)	0.013	0.0045	0.04	<0.004	<0.004	<0.004	0.31	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	0.013	<0.01	<0.01	<0.01	0.057	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	0.018	<0.01
Uranium (Fluor)	0.001	0.001	0.001	0.003	<0.001	<0.001	0.004	0.002
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	183		215		206		221	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	30	38	66	42	41	42	210	35
Chloride	4		4		3		3	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	27	28	35	26	25	27	83	26
Nitrate (as N)	0.34		0.2		0.2		0.2	
Potassium	5.6	9.4	7.2	4.9	4.3	5.6	4.8	9
Sodium (ICAP)	2.5		2.1	1.8	1.3	2	1.3	2
Sulfate	8		9		8		8	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	419		418		452		364	
Conductivity, 2 (µmhos/cm)	422		421		387		367	
Conductivity, 3 (µmhos/cm)	419		424		390		370	
Conductivity, 4 (µmhos/cm)	422		421		462		370	
Conductivity Average (µmhos/cm)	421		421		423		368	
pH, 1 (pH units)	6.8		6.6		6.8		7.8	
pH, 2 (pH units)	6.7		6.4		6.8		7.8	
pH, 3 (pH units)	6.7		6.4		6.7		7.8	
pH, 4 (pH units)	6.7		6.6		6.8		7.9	
pH Average (pH units)	6.7		6.5		6.8		7.8	
Total Dissolved Solids (mg/L)	216		206		240		292	
Total Suspended Solids (mg/L)	1		66		<1		2	
Turbidity (NTU)	.		6.5		1.4		1.5	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-178

Date Sampled	1/6/89	1/6/89	4/4/89	4/4/89	8/11/89	8/11/89	10/10/89	10/10/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	11:45:00	11:45:00	13:00:00	13:00:00	10:07:00	10:07:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0093	<0.004	0.0086	<0.004	0.018	<0.004	0.0069	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	0.001	<0.001	<0.001	<0.001	0.001	<0.001	0.003
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	185		188		230		243	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	40	39	43	43	49	43	64	41
Chloride	2		2		2		2	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	27	26	27	27	26	26	33	26
Nitrate (as N)	0.24		0.3		0.3		0.3	
Potassium	3.2	3.2	<0.6	<0.6	<0.6	<0.6	2.6	0.61
Sodium (ICAP)	1.4		2.2	1.8	1.7	2.2	1.7	1.8
Sulfate	2		2		1		2	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	413		415		383		377	
Conductivity, 2 (µmhos/cm)	410		415		383		380	
Conductivity, 3 (µmhos/cm)	404		412		416		383	
Conductivity, 4 (µmhos/cm)	410		412		380		383	
Conductivity Average (µmhos/cm)	409		414		391		381	
pH, 1 (pH units)	6.9		6.6		6.5		7.9	
pH, 2 (pH units)	6.9		6.5		6.5		8.2	
pH, 3 (pH units)	6.9		6.5		6.6		7.9	
pH, 4 (pH units)	6.9		6.6		6.5		7.9	
pH Average (pH units)	6.9		6.6		6.5		8.0	
Total Dissolved Solids (mg/L)	210		200		194		226	
Total Suspended Solids (mg/L)	14		<1		33		11	
Turbidity (NTU)	.		0.7		24		48	

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1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name **GW-179**

Date Sampled	Not Sampled	4/20/89	4/20/89	Not Sampled	Not Sampled
Sample Preparation		Total	Dissolved		
Sample Type		.	.		
Time Sampled		12:15:00	12:15:00		
Sampler/Analyst		K-25	K-25		
METALS (mg/L)					
Arsenic (AAS)					
Barium (AAS)		.	.		
Beryllium (AAS)		.	.		
Beryllium (ICAP)		<0.0003	<0.0003		
Cadmium (AAS)		.	.		
Chromium (AAS)		0.012	0.011		
Lead (AAS)		0.0058	<0.004		
Mercury (CVAA)		<0.0002	<0.0002		
Nickel (ICAP)		<0.01	<0.01		
Selenium (AAS)		.	.		
Silver (AAS)		.	.		
Thorium (ICAP)		.	.		
Tin (AAS)		<0.01	<0.01		
Uranium (Fluor)		<0.001	<0.001		
Vanadium (ICAP)		<0.005	<0.005		
ANIONS & CATIONS (mg/L)					
Alkalinity, Bicarbonate		255			
Alkalinity, Carbonate		<1			
Calcium (ICAP)		88	61		
Chloride		1			
Fluoride		<0.1			
Magnesium (ICAP)		50	33		
Nitrate (as N)		0.2			
Potassium		<0.6	3.1		
Sodium (ICAP)		4.3	4.2		
Sulfate		6			
MISCELLANEOUS PARAMETERS					
Conductivity, 1 (µmhos/cm)		558			
Conductivity, 2 (µmhos/cm)		564			
Conductivity, 3 (µmhos/cm)		570			
Conductivity, 4 (µmhos/cm)		549			
Conductivity Average (µmhos/cm)		560			
pH, 1 (pH units)		6.7			
pH, 2 (pH units)		6.7			
pH, 3 (pH units)		6.7			
pH, 4 (pH units)		6.6			
pH Average (pH units)		6.7			
Total Dissolved Solids (mg/L)		296			
Total Suspended Solids (mg/L)		122			
Turbidity (NTU)		18			

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-180

Date Sampled	1/5/89	1/5/89	4/4/89	4/4/89	8/10/89	8/10/89	10/12/89	10/12/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	11:00:00	11:00:00	13:05:00	13:05:00	14:47:00	14:47:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0059	<0.004	<0.004	<0.004	<0.004	0.0066	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	0.001	<0.001	0.001	<0.001	<0.001	0.004	<0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	284		268		286		344	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	54	55	62	62	60	60	61	62
Chloride	2		2		2		2	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	35	35	40	40	38	38	38	38
Nitrate (as N)	0.14		<0.2		<0.2		<0.2	
Potassium	4.7	4.8	3.6	3.6	2.5	2.1	1.4	1.4
Sodium (ICAP)	0.9		1	0.97	0.81	0.9	0.68	0.73
Sulfate	2		2		1		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	514		451		544		541	
Conductivity, 2 (µmhos/cm)	517		449		544		547	
Conductivity, 3 (µmhos/cm)	514		449		550		554	
Conductivity, 4 (µmhos/cm)	514		454		550		547	
Conductivity Average (µmhos/cm)	515		451		547		547	
pH, 1 (pH units)	6.8		6.5		6.5		7.5	
pH, 2 (pH units)	6.9		6.5		6.5		7.5	
pH, 3 (pH units)	6.9		6.5		6.5		7.5	
pH, 4 (pH units)	6.9		6.5		6.5		7.5	
pH Average (pH units)	6.9		6.5		6.5		7.5	
Total Dissolved Solids (mg/L)	272		286		296		312	
Total Suspended Solids (mg/L)	1		2		<1		<1	
Turbidity (NTU)	.		0.6		1.4		0.6	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name **GW-181**

Date Sampled	1/6/89	1/6/89	4/4/89	4/4/89	8/9/89	8/9/89	10/6/89	10/6/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	13:50:00	13:50:00	16:50:00	16:50:00	16:30:00	16:30:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.01	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.003	<0.003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0057	0.006	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	125		147		141		171	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	27	27	34	35	31	29	33	34
Chloride	2		1		2		2	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	17	17	21	22	20	19	20	20
Nitrate (as N)	<0.11		<0.2		<0.2		<0.2	
Potassium	4.1	2.9	4.1	3.4	1.7	2.4	<6	<6
Sodium (ICAP)	1.2		0.6	0.61	0.99	0.95	1.4	1.6
Sulfate	1		1		1		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	294		279		275		275	
Conductivity, 2 (µmhos/cm)	288		281		275		278	
Conductivity, 3 (µmhos/cm)	297		281		278		272	
Conductivity, 4 (µmhos/cm)	297		283		278		278	
Conductivity Average (µmhos/cm)	294		281		277		276	
pH, 1 (pH units)	6.7		6.3		6.1		7.9	
pH, 2 (pH units)	6.6		6.4		6.1		7.9	
pH, 3 (pH units)	6.7		6.4		6.2		7.9	
pH, 4 (pH units)	6.7		6.4		6.1		7.9	
pH Average (pH units)	6.7		6.4		6.1		7.9	
Total Dissolved Solids (mg/L)	146		162		170		156	
Total Suspended Solids (mg/L)	2		1		<1		2	
Turbidity (NTU)	.		1.8		1.5		1.6	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-322

Date Sampled	1/5/89	1/5/89	4/3/89	4/3/89	8/11/89	8/11/89	10/12/89	10/12/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	14:15:00	14:15:00	14:44:00	14:44:00	15:50:00	15:50:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	0.0058	0.0066	0.004	<0.004	0.0063	<0.004	0.0084	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	0.013	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	<0.001	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	134		133		162		180	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	29	29	32	32	31	31	31	31
Chloride	2		2		2		2	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	19	20	20	20	18	19	19	19
Nitrate (as N)	0.22		0.3		0.2		0.3	
Potassium	2.5	3.1	2.7	2.9	0.82	0.82	<0.6	<0.6
Sodium (ICAP)	0.47		0.52	0.52	0.75	0.68	0.37	0.46
Sulfate	<1		1		1		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	306		321		278		275	
Conductivity, 2 (µmhos/cm)	309		327		282		278	
Conductivity, 3 (µmhos/cm)	306		321		278		285	
Conductivity, 4 (µmhos/cm)	309		321		278		282	
Conductivity Average (µmhos/cm)	308		323		279		280	
pH, 1 (pH units)	6.7		6.3		6.7		7.5	
pH, 2 (pH units)	6.7		6.4		6.7		7.5	
pH, 3 (pH units)	6.7		6.4		6.7		7.6	
pH, 4 (pH units)	6.7		6.3		6.5		7.6	
pH Average (pH units)	6.7		6.4		6.7		7.6	
Total Dissolved Solids (mg/L)	152		134		144		142	
Total Suspended Solids (mg/L)	8		<1		4		<1	
Turbidity (NTU)	.		2.6		3		3.6	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name GW-511

Date Sampled	1/9/89	1/9/89	4/4/89	4/4/89	8/10/89	8/10/89	10/10/89	10/10/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	.	.	.	.	.	.	.	.
Time Sampled	10:58:00	10:58:00	16:15:00	16:15:00	10:55:00	10:55:00	.	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	0.0077	0.008	.	.	.	.	.	.
Barium (AAS)	<0.1	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (ICAP)	.	.	<0.005	0.0057	<0.005	0.0052	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	78		86		93		103	
Alkalinity, Carbonate	6		15		11		18	
Calcium (ICAP)	20	17	19	14	19	19	21	21
Chloride	13		8		7		6	
Fluoride	<0.1		<0.1		<0.1		<0.1	
Magnesium (ICAP)	9.8	10	11	11	10	10	11	12
Nitrate (as N)	<0.11		<0.2		<0.2		<0.2	
Potassium	10	9.2	9.9	8.9	9	9	7.6	5.4
Sodium (ICAP)	3.3		3.1	3	2.9	2.9	2.5	2.6
Sulfate	2		2		2		2	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	214		204		190		190	
Conductivity, 2 (µmhos/cm)	208		204		193		193	
Conductivity, 3 (µmhos/cm)	211		204		197		200	
Conductivity, 4 (µmhos/cm)	208		206		193		203	
Conductivity Average (µmhos/cm)	210		205		193		197	
pH, 1 (pH units)	6.8		7.1		6.7		8.4	
pH, 2 (pH units)	6.9		7.3		6.9		8.4	
pH, 3 (pH units)	6.6		7.2		6.9		8.5	
pH, 4 (pH units)	6.9		7.2		6.9		8.5	
pH Average (pH units)	6.8		7.2		6.9		8.5	
Total Dissolved Solids (mg/L)	116		106		106		138	
Total Suspended Solids (mg/L)	<1		<1		1		<1	
Turbidity (NTU)	.		1		0.41		0.75	

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name	GW-181						GW-322	
Date Sampled	1/6/89	1/6/89	6/9/89	6/9/89	10/10/89	10/10/89	4/3/89	4/3/89
Sample Preparation	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Sample Type	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate	Duplicate
Time Sampled	13:50:00	13:50:00	16:30:00	16:30:00	.	.	14:44:00	14:44:00
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
METALS (mg/L)								
Arsenic (AAS)	<0.005	<0.005	.	.	.	.	.	.
Barium (AAS)	<0.01	<0.1	.	.	.	.	.	.
Beryllium (AAS)	<0.001	<0.001	.	.	.	.	.	.
Beryllium (ICAP)	.	.	<0.0003	<0.0003	<0.003	<0.003	<0.0003	<0.0003
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	.	.
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Lead (AAS)	<0.004	0.0046	<0.004	<0.004	0.0096	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel (ICAP)	.	.	<0.01	<0.01	<0.1	<0.1	<0.01	<0.01
Selenium (AAS)	<0.005	<0.005	.	.	.	.	.	.
Silver (AAS)	<0.01	<0.01	.	.	.	.	.	.
Thorium (ICAP)	<0.2	<0.2	.	.	.	.	.	.
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Uranium (Fluor)	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (ICAP)	.	.	<0.005	<0.005	<0.05	<0.05	<0.005	<0.005
ANIONS & CATIONS (mg/L)								
Alkalinity, Bicarbonate	125		142		171		133	
Alkalinity, Carbonate	<1		<1		<1		<1	
Calcium (ICAP)	27	28	30	30	34	34	31	31
Chloride	.		2		2		2	
Fluoride	<0.2		<0.1		<0.1		<0.1	
Magnesium (ICAP)	17	17	19	19	20	20	20	20
Nitrate (as N)	<0.11		<0.2		<0.2		0.3	
Potassium	2.6	4.7	2.4	3.1	<6	<6	3.4	2.7
Sodium (ICAP)	0.9		1.1	1	1.7	1.7	0.51	0.52
Sulfate	1		1		2		1	
MISCELLANEOUS PARAMETERS								
Conductivity, 1 (µmhos/cm)	300		275		265		262	
Conductivity, 2 (µmhos/cm)	297		331		275		262	
Conductivity, 3 (µmhos/cm)	294		275		275		262	
Conductivity, 4 (µmhos/cm)	294		278		272		260	
Conductivity Average (µmhos/cm)	296		290		272		262	
pH, 1 (pH units)	6.7		6.2		8		6.3	
pH, 2 (pH units)	6.7		6.2		7.8		6.4	
pH, 3 (pH units)	6.7		6.2		7.9		6.3	
pH, 4 (pH units)	6.7		6.2		8.2		6.3	
pH Average (pH units)	6.7		6.2		8.0		6.3	
Total Dissolved Solids (mg/L)	150		172		152		130	
Total Suspended Solids (mg/L)	<1		<1		<1		<1	
Turbidity (NTU)	.		1.2		1.4		2.4	

f 3-90Ba	GW-181		GW-322 Duplicates

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name	GW-173				GW-174				GW-175			
Date Sampled	1/5/89	4/4/89	8/10/89	10/4/89	1/5/89	4/3/89	8/11/89	10/10/89	1/6/89	4/6/89	8/14/89	10/21/89
Sample Preparation	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
Sample Type	.	.	.	.	.	.	.	.	.	.	.	.
Time Sampled	14:45:00	10:55:00	12:38:00	.	12:50:00	17:32:00	14:15:00	.	10:50:00	12:50:00	12:15:00	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
VOLATILE ORGANICS (µg/L)												
Acetone	N	N	N	5	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	2	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G	G	2	G	1
Chlorobenzene	G	G	G	G	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	1	G	1	1	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	1	G	G	G	G
1,2-Dichloroethene	G	G	G	G	4	3	G	4	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G	G	G	G	G
Fluorotrichloromethane	.	56	9	.	.	18	26	.	.	16	9	.
Freon		46	11	.		5	48	.		.	.	.
2-Hexanone	N	N	N	N	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	1	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	G	G	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G	G	G	G	G
Tetrachloroethene	20	15	14	16	42	33	37	40	6	69	16	17
Toluene	G	G	G	G	0.3	G	G	G	2	G	G	G
1,1,1-Trichloroethane	2	1	G	G	7	4	4	4	2	4	5	5
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	2	1	1	2	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N	N	N	N	N
Xylenes, total	G	G	G	G	G	G	G	G	G	G	G	G
RADIOCHEMICAL PARAMETERS												
Gross Alpha, neg. (pCi/L)	4	1	2	5.9	4	1	2	1.8	7	-1	1	1.9
Gross Alpha (CE ±)			2	.			1	.			1	.
Gross Beta, neg. (pCi/L)	21	-2	-1	11.2	9	28	11	9.3	16	6	21	2.7
Gross Beta (CE ±)			4	.			3	.			4	.
Radium (Bq/L)	0.015	.	.	.	0.033	.	.	.	0.025	.	.	.
FIELD MEASUREMENTS												
Conductivity, field 1 (µmhos/cm)	399	342	403	399	354	293	335	398	266	269	330	293
pH, field 1 (pH units)	7	7.3	7.5	7.4	7.8	7.6	8.7	7.7	7.6	7.5	7.9	7.8
Dissolved Oxygen, field (ppm)	9.2	6.8	7.6	7.2	12	9.5	3.4	6.6	9.6	9.2	9	10.6
Redox, field 1 (mV)	401	331	167	264	350	184	164	229	261	316	222	224
Temperature, field 1 (°C)	13.1	16.9	16.2	16.2	6.5	22.9	16.7	16.4	12.9	16.9	15.4	9.6
Water Level (ft ± grade)	-147	-123	-133.98	-119.3	-121	-104.6	-108.62	-104.75	-126.2	-108	-116.67	-119
Water-Level Elevation (ft, msl)	966.0	990.0	979.0	993.7	993.1	1009.5	1005.4	1009.3	953.7	973.9	965.2	962.9

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name	GW-176				GW-177				GW-178			
Date Sampled	1/6/89	4/3/89	8/11/89	10/13/89	1/4/89	4/4/89	8/31/89	10/12/89	1/6/89	4/4/89	8/11/89	10/10/89
Sample Preparation	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
Sample Type	.	.	.	.	.	.	.	.	.	.	.	.
Time Sampled	12:35:00	10:20:00	11:20:00	.	14:30:00	15:00:00	14:15:00	.	11:45:00	13:00:00	10:07:00	.
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
VOLATILE ORGANICS (µg/L)												
Acetone	N	N	N	4	N	N	N	12	N	N	N	N
Benzene	G	G	G	G	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N	N	N	N	N
1,1-Dichloroethane	64	170	25	32	32	21	8	7	5	6	5	6
1,2-Dichloroethane	4	9	G	1	G	G	G	G	G	G	G	G
1,1-Dichloroethene	14	39	10	11	5	2	G	1	2	2	2	2
1,2-Dichloroethene	G	G	G	G	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G	G	G	G	G
Fluorotrichloromethane	.	G	.	.	.	.	.	.	.	.	.	.
Freon		.	.	.		.	.	.		.	.	.
2-Hexanone	N	N	N	N	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	G	G	G	G	4	G	G	G
Styrene	G	G	G	G	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G	G	G	G	G
Tetrachloroethene	11	15	8	8	1	0.8	5	G	G	0.8	G	0.9
Toluene	1	G	G	G	G	G	G	G	G	G	G	G
1,1,1-Trichloroethane	150	350	110	110	96	49	25	14	39	38	33	32
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N	N	N	N	N
Xylenes, total	G	G	G	G	G	G	G	G	G	G	G	G
RADIOCHEMICAL PARAMETERS												
Gross Alpha, neg. (pCi/L)	3	0	2	1	7	1	2	4.4	5	-1	1	3.4
Gross Alpha (CE ±)			1	.			1	.			1	.
Gross Beta, neg. (pCi/L)	6	3	6	3.4	15	8	3	59.9	5	1	65	17.1
Gross Beta (CE ±)			3	.			3	.			5	.
Radium (Bq/L)	0	.	.	.	0.033	.	.	.	0	.	.	.
FIELD MEASUREMENTS												
Conductivity, field 1 (µmhos/cm)	477	417	510	540	397	328	387	428	345	373	383	383
pH, field 1 (pH units)	6.8	6.6	7.1	6.5	7	7.8	7.4	7.9	6	7.6	7.4	7.6
Dissolved Oxygen, field (ppm)	6	6.2	7.2	5.2	7.9	10	4.2	8	12.3	9.8	8.3	8.6
Redox, field 1 (mV)	318	344	237	249	400	323	12	188	364	320	280	267
Temperature, field 1 (°C)	15.5	18.7	17.1	15.6	13.1	16.9	21.5	18.4	11.1	19.3	16.1	14.1
Water Level (ft ± grade)	-118	-113.2	-113.7	-113.43	-112.5	-109.6	-115.66	-114.66	-93	-86.2	-86.39	-86.43
Water-Level Elevation (ft, msl)	1008.1	1008.9	1008.4	1008.7	1043.0	1045.9	1039.9	1040.9	1046.1	1054.9	1052.7	1054.6

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name	GW-179				GW-180				GW-181			
Date Sampled	Not Sampled	4/20/89	Not Sampled	Not Sampled	1/5/89	4/4/89	8/10/89	10/12/89	1/6/89	4/4/89	8/9/89	10/6/89
Sample Preparation		Total			Total	Total	Total	Total	Total	Total	Total	Total
Sample Type		.			.	.	.	.	.	.	.	.
Time Sampled		12:15:00			11:00:00	13:05:00	14:47:00	.	13:50:00	16:50:00	16:30:00	.
Sampler/Analyst		K-25			K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
VOLATILE ORGANICS (µg/L)												
Acetone		N			N	N	N	N	N	N	9	11
Benzene		G			G	G	G	G	G	G	G	G
Bromodichloromethane		G			G	G	G	G	G	G	G	G
Bromoform		G			G	G	G	G	G	G	G	G
Bromomethane		N			N	N	N	N	N	N	N	N
2-Butanone		1			N	N	N	N	N	N	N	N
Carbon disulfide		G			G	G	G	G	G	G	G	G
Carbon tetrachloride		G			G	G	G	G	1	G	G	G
Chlorobenzene		G			G	G	G	G	G	G	G	G
Chlorodibromomethane		G			G	G	G	G	G	G	G	G
Chloroethane		N			N	N	N	N	N	N	N	N
Chloroform		G			G	G	G	G	G	G	G	G
Chloromethane		N			N	N	N	N	N	N	N	N
1,1-Dichloroethane		200			19	13	7	6	2	G	G	G
1,2-Dichloroethane		G			G	G	G	G	G	G	G	G
1,1-Dichloroethene		75			G	1	G	G	G	G	G	G
1,2-Dichloroethene		G			G	15	13	11	G	G	G	G
1,2-Dichloropropane		G			G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene		G			G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene		G			G	G	G	G	G	G	G	G
Ethylbenzene		G			G	G	G	G	G	G	G	G
Fluorotrichloromethane		.			.	220	21	.	.	.	.	.
Freon		.				230	36	.		.	.	.
2-Hexanone		N			N	N	N	N	N	N	N	N
4-Methyl-2-pentanone		N			N	N	N	N	N	N	N	N
Methylene chloride		G			G	G	G	G	2	G	G	G
Styrene		G			G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane		G			G	G	G	G	G	G	G	G
Tetrachloroethene		12			96	140	120	110	G	G	G	G
Toluene		G			G	G	G	G	G	G	G	G
1,1,1-Trichloroethane		550			6	7	5	6	5	G	G	G
1,1,2-Trichloroethane		G			G	G	G	G	G	G	G	G
Trichloroethene		G			3	5	4	4	G	G	G	G
Vinyl acetate		N			N	N	N	N	N	N	N	N
Vinyl chloride		N			N	N	N	N	N	N	N	N
Xylenes, total		G			G	G	G	G	G	G	G	G
RADIOCHEMICAL PARAMETERS												
Gross Alpha, neg. (pCi/L)		6			6	0	-0.2	3	3	0	-0.1	-2.6
Gross Alpha (CE ±)							1	.			1	.
Gross Beta, neg. (pCi/L)		15			10	6	40	137	6	3	3	-23.5
Gross Beta (CE ±)							5	.			4	.
Radium (Bq/L)		.			0.011	.	.	.	0	.	.	.
FIELD MEASUREMENTS												
Conductivity, field 1 (µmhos/cm)		521			548	575	580	615	256	313	284	279
pH, field 1 (pH units)		7.8			6.3	7.3	7.1	7.2	7.2	7.6	7.8	7.9
Dissolved Oxygen, field (ppm)		10.8			7.5	9.1	6.7	6.5	7.4	7.9	6.9	6
Redox, field 1 (mV)		252			400	209	249	291	367	320	139	257
Temperature, field 1 (°C)		17.1			12.9	14.4	16.3	13.7	13.6	14.6	14.6	13.7
Water Level (ft ± grade)		-111.3			-116	-43	-103.89	-101.23	-114.5	-94.5	-99.25	-101.21
Water-Level Elevation (ft, msl)		1013.0			985.4	1058.4	997.5	1000.2	976.1	996.1	991.3	989.3

1989 Assessment Data for Monitor Wells at the Chestnut Ridge Security Pits Hazardous-Waste Disposal Unit

Well Name	GW-322				GW-511				GW-181			GW-322
Date Sampled	1/5/89	4/3/89	8/11/89	10/12/89	1/9/89	4/4/89	8/10/89	10/10/89	1/6/89	8/9/89	10/10/89	4/3/89
Sample Preparation	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total	Total
Sample Type	.	.	.	.	.	.	.	.	Duplicate	Duplicate	Duplicate	Duplicate
Time Sampled	14:15:00	14:44:00	15:50:00	.	10:56:00	16:15:00	10:55:00	.	13:50:00	16:30:00	.	14:44:00
Sampler/Analyst	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25	K-25
VOLATILE ORGANICS (µg/L)												
Acetone	N	N	N	20	7	N	N	6	N	N	7	N
Benzene	G	G	G	Z	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	Z	G	G	G	G	G	G	G	G
Bromoform	G	G	G	Z	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	M	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	M	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	Z	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	Z	G	G	G	G	2	G	G	G
Chlorobenzene	G	G	G	Z	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	Z	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	M	N	N	N	N	N	N	N	N
Chloroform	1	G	1	Z	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	M	N	N	N	N	N	N	N	N
1,1-Dichloroethane	41	40	35	45	1	G	G	G	2	G	G	39
1,2-Dichloroethane	3	G	2	Z	G	G	G	G	G	G	G	G
1,1-Dichloroethene	95	98	80	90	G	G	G	G	G	G	G	100
1,2-Dichloroethene	G	G	G	Z	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	Z	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	Z	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	Z	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	Z	G	G	G	G	G	G	G	G
Fluorotrichloromethane	.	14	33	.	.	.	.	.	.	.	.	14
Freon		3	.	.		.	.	.		.	.	5
2-Hexanone	N	N	N	M	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	M	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	Z	G	G	G	G	5	G	G	0.8
Styrene	G	G	G	Z	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	Z	G	G	G	G	G	G	G	G
Tetrachloroethene	5	5	5	Z	G	G	G	G	G	G	G	6
Toluene	G	G	G	Z	2	G	G	G	G	G	G	G
1,1,1-Trichloroethane	630	630	630	660	4	1	G	G	4	G	G	660
1,1,2-Trichloroethane	G	G	G	Z	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	Z	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	M	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	M	N	N	N	N	N	N	N	N
Xylenes, total	G	G	G	Z	G	G	G	G	G	G	G	G
RADIOCHEMICAL PARAMETERS												
Gross Alpha, neg. (pCi/L)	4	1	0.3	2.1	2	-1	4	1.3	3	0.1	4.5	-1
Gross Alpha (CE ±)			1	.			2	.		1	.	
Gross Beta, neg. (pCi/L)	12	4	88	59.5	13	10	56	45.9	8	4	-26.8	2
Gross Beta (CE ±)			6	.			5	.		4	.	
Radium (Bq/L)	0.037	.	.	.	0	.	.	.	0	.	.	.
FIELD MEASUREMENTS												
Conductivity, field 1 (µmhos/cm)	292	269	280	305	198	208	208	239	259	279	279	274
pH, field 1 (pH units)	7.2	7.8	7.7	7.8	10.1	9.3	9.2	8.9	7.2	7.8	7.8	7.6
Dissolved Oxygen, field (ppm)	7.1	8.4	8.1	7.7	6.8	8.5	6.4	5.8	7.4	6.8	6.1	8.4
Redox, field 1 (mV)	324	315	240	254	159	98	101	209	359	142	.	317
Temperature, field 1 (°C)	12.2	15.6	16.3	15.7	14.6	13.8	14.8	14	13.8	14.6	13.6	16
Water Level (ft ± grade)	-157.7	-142.1	-144.63	-147.92	-113	-97.6	-99.63	-101.37	-114.5	-99.25	.	-142.1
Water-Level Elevation (ft, msl)	974.1	989.7	987.2	983.9	977.7	993.1	991.1	989.3	976.1	991.3		989.7

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GW-181/GW- ?/GW-511

TER QUALITY 1990
.ESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-173								GW-174			
	02/03/90		05/22/90		07/25/90		10/27/90		01/27/90		05/23/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	.	.	0.18	<0.02	0.17	0.034	0.58	1.3	.	.	0.45	<0.02
Antimony	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Barium	.	.	0.0096	0.0099	0.011	0.01	0.016	0.017	.	.	0.018	0.016
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00043	0.00033	<0.0003	<0.0003	<0.0003	<0.0003
Boron	.	.	0.0086	0.023	0.0094	0.022	0.015	<0.004	.	.	0.015	0.0063
Cadmium (AAS)	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002
Cadmium	.	.	<0.003	0.0039	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.013	0.012	<0.01	<0.01	<0.01	<0.01
Chromium	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	0.011	<0.01
Cobalt	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005
Copper	.	.	0.021	<0.004	0.019	<0.004	0.057	0.049	.	.	0.0047	0.011
Iron	.	.	0.72	0.0065	0.57	0.008	2	3.7	.	.	0.57	0.0061
Lead (AAS)	<0.004	<0.004	0.004	<0.004	-0.0051	<0.004	0.024	0.027	<0.004	<0.004	0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	.	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Silicon	.	.	4	4.1	3.9	4.2	6.2	8.6	.	.	5.3	4.5
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006
Strontium	.	.	0.016	0.014	0.017	0.016	0.022	0.023	.	.	0.027	0.028
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2
Tin (AAS)	<0.01	<0.01	.	.	.	.	.	.	<0.01	<0.01	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	0.003	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	.	.	0.015	0.011	0.019	0.01	0.026	0.038	.	.	0.016	0.0025
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	182	.	188	.	185	.	188	.	185	.	187	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	<1	.	<1	.
Calcium	39	38	35	37	39	37	44	44	36	36	33	33
Chloride	3	.	3	.	3	.	3	.	10	.	10	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	24	24	23	23	23	22	25	25	25	24	23	23
Manganese	.	.	0.0077	<0.001	0.013	<0.001	0.044	0.066	.	.	0.017	<0.001
Nitrate-N	2	.	1	.	1.5	.	1	.	0.5	.	0.5	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	1.2	1.3	1.2	1.2	1.4	1.3	1.6	1.7	2	2	1.7	1.7
Sodium	2.3	2.3	2	2.4	2.5	2.5	2.9	2.8	4.1	4.2	3.9	4.2
Sulfate	8	.	8	.	7	.	8	.	3	.	4	.

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-174				GW-175							
	07/25/90		10/27/90		03/05/90		05/22/90		07/24/90		10/26/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	0.047	0.034	0.19	0.036	.	.	<0.02	<0.02	0.029	0.031	0.075	0.039
Antimony	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	0.057
Barium	0.064	0.056	0.063	0.059	.	.	0.027	0.034	0.036	0.037	0.037	0.038
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.015	0.015	0.02	0.014	.	.	0.0098	0.014	<0.004	<0.004	0.019	0.018
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003	0.0041	0.0053	<0.003	<0.003
Chromium (AAS)	0.012	<0.01	0.042	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.04
Chromium	0.012	<0.01	0.028	<0.01	.	.	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.0057	0.021	0.0047	.	.	<0.004	<0.004	0.0099	0.0085	0.0042	0.0056
Iron	0.12	0.023	0.7	0.0099	.	.	0.077	<0.004	0.082	0.014	0.093	0.011
Lead (AAS)	<0.004	<0.004	0.011	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	0.034	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	0.014	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	5	4.8	6.4	6.3	.	.	3.2	3.7	3.2	3.2	1.9	4.8
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.12	0.13	0.16	0.15	.	.	0.013	0.012	0.014	0.017	0.014	0.014
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	.	.	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	<0.001	0.001	0.001	0.001	<0.001	<0.001	0.001	0.001	0.001	0.002	0.001	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.013	0.028	0.014	<0.001	.	.	0.0041	0.0074	0.022	<0.001	0.0083	0.013
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	189	.	189	.	173	.	184	.	171	.	169	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	<1	.	<1	.
Calcium	30	20	17	14	32	32	32	33	33	34	34	35
Chloride	10	.	8	.	2	.	2	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	21	17	16	15	21	21	22	21	21	25	21	21
Manganese	0.004	<0.001	0.015	<0.001	.	.	<0.001	<0.001	<0.001	<0.001	0.0016	<0.001
Nitrate-N	0.5	.	0.6	.	0.3	.	0.3	.	0.2	.	0.3	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	3.7	5.6	7.2	7	<0.6	<0.6	<0.6	<0.6	0.6	0.61	0.69	<0.6
Sodium	12	23	35	34	1	0.94	0.38	1.2	1.2	0.75	1.3	1.1
Sulfate	4	.	5	.	1	.	1	.	1	.	1	.

(CONTINUED)

TER QUALITY 1990
.ESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-176								GW-177			
	01/27/90		05/24/90		07/28/90		10/29/90		02/27/90		05/23/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	.	.	0.069	0.023	<0.02	<0.02	0.024	<0.02	.	.	<0.02	<0.02
Antimony	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Barium	.	.	0.017	0.017	0.019	0.016	0.016	0.017	.	.	0.017	0.015
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	.	.	0.71	0.84	0.55	0.54	0.36	0.37	.	.	0.033	0.023
Cadmium (AAS)	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002
Cadmium	.	.	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Cobalt	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005
Copper	.	.	0.0053	<0.004	<0.004	<0.004	<0.004	<0.004	.	.	<0.004	<0.004
Iron	.	.	0.037	0.0054	0.013	<0.004	0.0088	<0.004	.	.	0.047	<0.004
Lead (AAS)	<0.004	<0.004	0.0042	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00023	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Nickel	<0.01	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Silicon	.	.	4.1	5.6	5.1	4.8	6.8	6.8	.	.	4.1	4.1
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006
Strontium	.	.	0.022	0.021	0.025	0.021	0.021	0.021	.	.	0.018	0.018
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2
Tin (AAS)	<0.01	<0.01	.	.	.	.	.	.	<0.01	<0.01	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.002	0.002	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	.	.	0.007	0.0058	0.0032	0.016	0.0089	0.012	.	.	0.0016	<0.001
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	244	.	263	.	272	.	278	.	203	.	204	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	<1	.	<1	.
Calcium	50	49	60	59	51	51	55	55	40	40	37	37
Chloride	3	.	2	.	2	.	2	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	0.1	.	<0.1	.
Magnesium	31	30	37	36	33	33	35	35	26	26	24	24
Manganese	.	.	0.0044	0.0013	0.0012	<0.001	<0.001	<0.001	.	.	0.0069	0.0069
Nitrate-N	0.6	.	0.5	.	0.5	.	0.6	.	<0.2	.	<0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	1.1	1.1	1.2	1.3	0.99	0.99	1	1	3.7	3.3	3	3.2
Sodium	0.93	0.92	0.63	1.3	0.72	0.64	0.85	0.76	1.1	1.1	0.7	0.87
Sulfate	2	.	1	.	1	.	1	.	11	.	8	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-177				GW-178							
	07/26/90		10/27/90		01/28/90		05/17/90		07/21/90		10/22/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	<0.02	<0.02	0.033	0.039	.	.	0.91	0.055	2.5	<0.2	0.69	<0.2
Antimony	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5
Barium	0.02	0.02	0.023	0.035	.	.	0.017	0.011	0.12	0.027	0.029	0.026
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.003	<0.003	<0.003	<0.003
Boron	0.021	0.022	0.02	0.019	.	.	0.016	0.024	0.061	0.1	<0.04	0.2
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002	0.0028	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	.	.	0.0071	<0.003	<0.03	<0.03	<0.03	<0.03
Chromium (AAS)	0.085	0.102	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.082	<0.01	<0.04	<0.04
Chromium	0.073	0.11	<0.01	<0.01	.	.	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1
Cobalt	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05
Copper	0.2	0.1	0.0051	0.0088	.	.	0.01	0.0043	0.29	<0.04	<0.04	<0.04
Iron	0.021	0.08	0.029	0.015	.	.	1.3	0.0081	18	0.063	1.4	<0.04
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.011	<0.004	0.38	<0.004	0.032	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	0.00038	0.00038	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1
Nickel	<0.01	0.016	<0.01	<0.01	<0.01	.	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5
Silicon	4.4	4.9	5.2	5.6	.	.	6.1	4.5	6.8	4.4	6.2	6.4
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006	<0.06	<0.06	<0.06	<0.06
Strontium	0.019	0.02	0.018	0.03	.	.	0.032	0.018	0.15	0.076	0.048	0.046
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2	<2	<2	<2	<2
Tin (AAS)	.	.	.	.	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	0.002	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05	<0.05	<0.05
Zinc	0.016	0.0044	0.0088	0.0088	.	.	0.15	0.089	3.1	0.15	0.24	0.084
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	208	.	207	.	218	.	219	.	167	.	211	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	<1	.	<1	.
Calcium	39	39	41	41	42	42	77	42	79	43	51	50
Chloride	2	.	3	.	2	.	3	.	26	.	15	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	0.6	.	0.1	.
Magnesium	25	25	25	24	27	27	41	28	27	17	25	26
Manganese	0.013	<0.001	<0.001	<0.001	.	.	0.08	<0.001	0.44	0.011	0.056	0.034
Nitrate-N	0.2	.	0.3	.	0.3	.	0.4	.	0.5	.	0.5	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	7	8.6	4	8.5	<0.6	<0.6	0.63	0.62	<6	<6	<6	<6
Sodium	1.6	1.9	1.5	1.7	1.5	1.6	1.8	1.8	48	29	22	23
Sulfate	7	.	6	.	2	.	1	.	34	.	18	.

(CONTINUED)

TER QUALITY 1990
ESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-179								GW-180			
	03/21/90		06/09/90		09/24/90		12/11/90		03/05/90		05/24/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	.	.	0.26	0.034	0.035	<0.02	0.11	0.05	.	.	0.048	0.026
Antimony	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	.	.	<0.05	<0.05	<0.05	<0.05	0.051	0.051	.	.	<0.05	0.083
Barium	.	.	0.034	0.031	0.027	0.027	0.029	0.028	.	.	0.029	0.029
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	.	.	0.019	0.045	0.017	0.014	0.024	0.023	.	.	0.015	<0.004
Cadmium (AAS)	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002
Cadmium	.	.	0.0037	<0.003	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003
Chromium (AAS)	0.031	<0.01	0.027	<0.01	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	.	.	0.017	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Cobalt	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005
Copper	.	.	0.15	0.028	0.03	0.015	0.038	0.016	.	.	0.0043	0.004
Iron	.	.	0.72	<0.004	0.19	<0.004	0.26	0.044	.	.	<0.004	<0.004
Lead (AAS)	0.11	<0.004	0.029	<0.004	0.005	<0.004	0.0061	<0.004	0.013	<0.004	<0.004	0.013
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Nickel	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Silicon	.	.	3.6	3.7	2.9	4.1	5.1	5.4	.	.	6.1	6.1
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006
Strontium	.	.	0.039	0.029	0.027	0.027	0.027	0.027	.	.	0.022	0.022
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2
Tin (AAS)	<0.01	<0.01	.	.	.	.	.	.	<0.01	<0.01	.	.
Uranium (Fluor)	0.001	<0.001	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	.	.	0.017	0.002	<0.001	<0.001	0.025	0.019	.	.	0.0099	0.017
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	310	.	286	.	271	.	288	.	313	.	308	.
Alkalinity-CO3	<1	.	<2	.	<1	.	<1	.	<1	.	<1	.
Calcium	130	60	90	57	61	53	66	57	58	58	66	65
Chloride	2	.	2	.	2	.	2	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	0.1	.	<0.1	.
Magnesium	79	37	52	34	39	34	40	34	33	33	43	42
Manganese	.	.	0.039	0.0042	0.0084	0.0086	0.0097	0.0056	.	.	<0.001	0.001
Nitrate-N	0.3	.	0.3	.	0.3	.	0.3	.	0.2	.	<0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	4.1	5.4	4.4	4.2	4	4	3.9	4	1.2	1.2	1.2	1.3
Sodium	2.9	3.4	3.2	3.6	3	4.3	2.4	2.3	0.74	0.72	0.63	0.85
Sulfate	5	.	5	.	5	.	3	.	1	.	<1	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-180				GW-181							
	07/26/90		10/29/90		03/02/90		05/21/90				07/23/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT		DIS		TOT	DIS
								FD		FD		
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	<0.02	<0.02	0.033	0.03	.	.	<0.02	<0.02	<0.02	<0.02	<0.02	0.026
Antimony	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.028	0.027	0.026	0.026	.	.	0.0078	0.008	0.046	0.007	0.0074	0.0086
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	0.0013	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.01	0.016	<0.004	<0.004	.	.	<0.004	<0.004	0.068	0.021	<0.004	0.0099
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003	<0.003	0.0032	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.074	0.06	<0.004	<0.004	.	.	<0.004	<0.004	<0.004	<0.004	0.0049	<0.004
Iron	0.0062	<0.004	0.044	<0.004	.	.	0.09	0.098	<0.004	<0.004	0.22	0.021
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.015	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	5.5	5.6	6.5	6.6	.	.	4.3	4.3	3.5	4.3	4	4
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.021	0.021	0.018	0.018	.	.	0.019	0.019	0.39	0.018	0.021	0.021
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	.	.	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.01	0.0088	0.011	0.011	.	.	0.0087	0.0042	0.0078	0.0036	0.0022	0.0073
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	297	.	266	.	158	.	163	163	.	.	156	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	<1	.	.	<1	.
Calcium	55	55	52	52	30	29	31	31	170	30	30	30
Chloride	2	.	2	.	2	.	1	1	.	.	2	.
Fluoride	<0.1	.	<0.1	.	0.1	.	<0.1	<0.1	.	.	<0.1	.
Magnesium	38	38	34	34	20	19	20	20	22	19	19	17
Manganese	<0.001	<0.001	<0.001	<0.001	.	.	<0.001	0.0022	3.2	<0.001	0.0032	0.0029
Nitrate-N	0.2	.	0.2	.	<0.2	.	<0.2	<0.2	.	.	<0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	1.1	1.1	0.82	0.8	1.7	1.7	1.6	1.6	3.7	1.5	2	2
Sodium	0.45	0.7	0.73	0.76	0.82	0.79	0.94	0.74	11	0.74	0.64	1
Sulfate	1	.	<1	.	2	.	1	1	.	.	1	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-181		GW-322									
	10/25/90		01/28/90				05/23/90		07/26/90		10/29/90	
	TOT	DIS	TOT		DIS		TOT	DIS	TOT	DIS	TOT	DIS
				FD		FD						
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	<0.02	0.034	.	.	.	.	0.37	0.023	0.56	<0.02	5.8	<0.02
Antimony	<0.05	<0.05	.	.	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	.	.	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0079	0.0078	.	.	.	.	0.009	0.0077	0.0093	0.0083	0.031	0.0085
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0015	<0.0003
Boron	<0.004	0.012	.	.	.	.	0.019	0.018	0.017	0.02	<0.004	<0.004
Cadmium (AAS)	<0.002	<0.002	.	.	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	.	.	.	.	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	.	.	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	.	.	.	.	<0.005	<0.005	<0.005	<0.005	0.0085	<0.005
Copper	<0.004	0.0042	.	.	.	.	0.017	<0.004	0.052	0.04	0.018	<0.004
Iron	0.071	0.012	.	.	.	.	0.45	0.017	0.51	<0.004	11	0.0088
Lead (AAS)	<0.004	<0.004	0.0053	0.0073	<0.004	<0.004	<0.004	0.011	<0.004	<0.004	0.04	0.0047
Mercury (CVAA)	<0.0002	<0.0002	0.0004	0.00042	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	.	.	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	0.011	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	.	.	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	4.9	4.9	.	.	.	.	4.8	4.3	4.4	3.9	11	5.6
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	.	.	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.021	0.021	.	.	.	.	0.013	0.012	0.012	0.011	0.034	0.013
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	.	.	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	<0.01	<0.01	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.022	<0.005
Zinc	<0.001	0.014	.	.	.	.	0.028	<0.001	0.0087	0.0018	0.17	0.0056
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	141	.	154	156	.	.	158	.	158	.	165	.
Alkalinity-CO3	<1	.	<1	<1	.	.	<1	.	<1	.	<1	.
Calcium	30	30	40	43	31	32	35	32	33	31	100	32
Chloride	1	.	2	2	.	.	2	.	2	.	2	.
Fluoride	<0.1	.	<0.1	<0.1	.	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	19	19	26	28	20	20	22	21	20	19	63	19
Manganese	<0.001	0.0035	.	.	.	.	0.017	<0.001	0.01	<0.001	0.49	0.0012
Nitrate-N	<0.2	.	0.2	0.2	.	.	<0.2	.	0.4	.	0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	1.9	1.8	0.71	0.81	<0.6	<0.6	0.71	<0.6	0.76	0.69	1.7	<0.6
Sodium	0.57	0.75	0.5	0.53	0.58	0.46	0.47	0.64	0.54	0.44	0.67	0.57
Sulfate	1	.	1	1	.	.	<1	.	2	.	1	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-511								GW-607			
	02/28/90		05/18/90		07/21/90		10/24/90		02/09/90		05/18/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	.	.	<0.02	<0.02	0.023	<0.02	0.067	0.04	.	.	0.031	<0.02
Antimony	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	.	.	<0.05	<0.05	<0.05	<0.05	0.057	0.05	.	.	<0.05	<0.05
Barium	.	.	0.0084	0.0078	0.011	0.0098	0.0082	0.0086	.	.	0.011	0.0096
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	0.001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	.	.	0.014	0.015	<0.004	<0.004	0.013	0.017	.	.	0.02	0.011
Cadmium (AAS)	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002
Cadmium	.	.	<0.003	0.0043	0.013	0.0033	<0.003	<0.003	.	.	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.04	<0.01	<0.01	0.041	<0.01
Chromium	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Cobalt	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005
Copper	.	.	<0.004	<0.004	0.011	0.015	0.004	0.0042	.	.	<0.004	<0.004
Iron	.	.	0.0095	<0.004	0.02	0.009	0.014	0.011	.	.	0.052	<0.004
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.0073	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	0.00039	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Silicon	.	.	4.3	4.4	4.2	4	4.7	4.5	.	.	4.1	4.1
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006
Strontium	.	.	0.052	0.052	0.049	0.05	0.047	0.049	.	.	0.034	0.034
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2
Tin (AAS)	<0.01	<0.01	.	.	.	.	.	.	<0.01	<0.01	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	.	.	0.0012	0.0061	0.0017	0.055	0.0066	0.0091	.	.	0.005	0.01
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	127	.	120	.	130	.	144	.	112	.	134	.
Alkalinity-CO3	10	.	10	.	<1	.	4	.	<1	.	<1	.
Calcium	25	24	21	21	24	24	22	24	25	25	27	26
Chloride	4	.	4	.	4	.	4	.	1.5	.	1	.
Fluoride	0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	15	15	13	14	15	15	14	15	13	13	14	15
Manganese	.	.	<0.001	<0.001	0.0016	<0.001	0.0016	0.0016	.	.	0.0041	<0.001
Nitrate-N	<0.2	.	<0.2	.	<0.2	.	<0.2	.	<0.2	.	<0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	6.8	6.6	6.9	6.8	5.9	6.2	5.4	5.9	2.1	2.1	3.4	3.4
Sodium	2.3	2.3	2.2	2.1	1.7	2	1.7	1.8	0.71	0.79	0.96	0.85
Sulfate	2	.	2	.	2	.	2	.	2.4	.	2	.

(CONTINUED)

ER QUALITY 1990
STNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-607				GW-608							
	07/21/90		10/24/90		02/10/90		05/18/90		07/23/90		10/24/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	
												FD
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	0.034	<0.02	0.063	0.061	.	.	<0.02	<0.02	<0.02	<0.02	0.033	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0093	0.0086	0.01	0.011	.	.	0.013	0.012	0.012	0.013	0.014	0.013
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0011	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.0061	0.015	.	.	0.039	0.036	<0.004	<0.004	0.019	0.0051
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	0.0037	0.0038	<0.003	0.0033	.	.	<0.003	<0.003	0.0092	0.0054	<0.003	0.0034
Chromium (AAS)	<0.01	<0.01	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.04
Chromium	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.007	0.0053	<0.004	0.0062	.	.	<0.004	<0.004	0.023	0.027	0.0058	<0.004
Iron	0.031	0.0072	0.0074	0.0099	.	.	0.12	<0.004	0.39	0.025	0.096	0.098
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.8	3.7	5.2	4.7	.	.	4.2	4.2	3.6	2.5	4.8	4.6
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.032	0.031	0.036	0.036	.	.	0.015	0.014	0.015	0.016	0.014	0.014
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	.	.	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.014	0.0033	<0.001	0.0069	.	.	0.01	0.0094	0.0087	0.0093	0.0039	0.0048
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	141	.	131	.	130	.	147	.	150	.	139	141
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	<1	.	<1	<1
Calcium	27	27	28	27	25	25	29	29	30	31	28	28
Chloride	1	.	1	.	2.1	.	2	.	2	.	2	2
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	<0.1
Magnesium	16	16	15	15	16	16	18	18	18	19	18	18
Manganese	0.0022	<0.001	<0.001	<0.001	.	.	0.018	<0.001	0.026	0.023	0.0048	0.0034
Nitrate-N	<0.2	.	<0.2	.	0.7	.	0.5	.	0.3	.	0.3	0.3
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	4	4	4.1	4.2	2.1	2.3	0.8	0.84	1.6	1.3	1.7	1.6
Sodium	0.86	0.89	0.75	1.1	0.77	0.74	0.63	0.7	1	0.75	0.54	0.44
Sulfate	1	.	2	.	2.3	.	2	.	2	.	3	3

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-608		GW-609									
	10/24/90		02/14/90		05/17/90		07/21/90				10/23/90	
	DIS		TOT	DIS	TOT	DIS	TOT		DIS		TOT	DIS
		FD						FD		FD		
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	0.052	<0.02	.	.	0.051	0.023	<0.02	<0.02	0.021	<0.02	0.039	0.037
Antimony	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	.	.	0.062	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.068
Barium	0.013	0.013	.	.	0.012	0.011	0.015	0.015	0.015	0.015	0.012	0.011
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.023	0.0082	.	.	0.031	0.0088	<0.004	<0.004	<0.004	<0.004	<0.004	0.017
Cadmium (AAS)	<0.002	<0.002	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	0.004	<0.003	.	.	0.0052	<0.003	<0.003	<0.003	0.0063	<0.003	<0.003	<0.003
Chromium (AAS)	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.04
Chromium	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.0064	0.0073	.	.	0.011	0.0049	<0.004	<0.004	0.013	0.0042	0.0067	0.0091
Iron	0.015	0.027	.	.	0.022	0.029	0.042	0.0065	0.034	<0.004	<0.004	0.012
Lead (AAS)	<0.004	<0.004	0.018	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	4.1	4.4	.	.	4.3	4.4	4	4.2	4.5	4.2	1.4	5.3
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.014	0.014	.	.	0.015	0.013	0.013	0.014	0.013	0.013	0.015	0.014
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	<0.01	<0.01	.	.	.	.	.	.	.	.
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0078	0.0029	.	.	0.025	0.038	0.0082	0.0072	0.0097	<0.001	0.031	0.0046
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	.	178	.	183	.	187	186	.	.	162	.
Alkalinity-CO3	.	.	<1	.	<1	.	<1	<1	.	.	<1	.
Calcium	27	28	35	35	35	35	33	35	35	35	35	34
Chloride	.	.	2	.	2	.	1.6	1.6	.	.	2	.
Fluoride	.	.	0.2	.	<0.1	.	<0.1	<0.1	.	.	<0.1	.
Magnesium	17	17	23	22	22	22	21	23	23	23	22	21
Manganese	0.005	0.0026	.	.	<0.001	<0.001	<0.001	<0.001	0.0056	<0.001	<0.001	0.0019
Nitrate-N	.	.	0.9	.	0.9	.	1	0.9	.	.	1	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	1.7	1.7	1.1	1.2	1.7	1.5	0.79	0.83	0.76	0.82	1.1	1
Sodium	0.65	0.77	0.57	0.54	1.1	0.79	0.37	0.38	0.41	0.41	0.66	0.69
Sulfate	.	.	2	.	2	.	2	2	.	.	2	.

(CONTINUED)

TER QUALITY 1990
ITNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-610								GW-611			
	02/09/90		05/22/90		07/24/90		10/26/90		02/09/90		05/22/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	.	.	0.64	<0.02	0.63	<0.02	0.36	0.045	.	.	0.069	<0.02
Antimony	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	.	.	<0.05	0.061	<0.05	<0.05	<0.05	<0.05	.	.	0.061	<0.05
Barium	.	.	0.082	0.072	0.081	0.069	0.092	0.095	.	.	0.02	0.018
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00053	<0.0003	<0.0003	<0.0003	<0.0003
Boron	.	.	0.016	0.012	<0.004	<0.004	0.072	0.0079	.	.	0.018	0.013
Cadmium (AAS)	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002
Cadmium	.	.	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	.	.	0.003	<0.003
Chromium (AAS)	0.033	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	<0.04	0.018	0.015	<0.01	<0.01
Chromium	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Cobalt	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005
Copper	.	.	0.011	<0.004	0.0099	0.0044	0.0053	<0.004	.	.	0.0055	<0.004
Iron	.	.	0.88	0.0078	0.74	0.012	0.35	0.011	.	.	0.099	<0.004
Lead (AAS)	0.016	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00024	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01
Nickel	0.068	<0.01	0.012	<0.01	<0.01	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05
Silicon	.	.	5.6	4.1	5.1	4.1	6.5	4.8	.	.	4.3	4.3
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006
Strontium	.	.	0.021	0.016	0.023	0.016	0.02	0.018	.	.	0.021	0.018
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2
Tin (AAS)	<0.01	<0.01	.	.	.	.	.	.	<0.01	<0.01	.	.
Uranium (Fluor)	<0.001	<0.001	0.001	<0.001	0.001	0.001	0.001	0.001	<0.001	<0.001	0.002	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	.	.	0.018	0.0062	0.0042	<0.001	0.0062	<0.001	.	.	0.0096	0.0059
	.	.	.	.	.	.	.	.	.	.	.	.
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	170	.	170	.	166	.	162	.	149	.	216	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.	12	.	<1	.
Calcium	69	33	37	33	39	33	37	34	26	18	42	43
Chloride	2.1	.	2	.	2	.	2	.	2	.	1	.
Fluoride	7.1	.	<0.1	.	<0.1	.	<0.1	.	0.1	.	<0.1	.
Magnesium	26	22	21	20	22	20	20	20	23	20	29	28
Manganese	.	.	0.03	0.0068	0.035	0.0062	0.019	0.0059	.	.	0.008	0.0033
Nitrate-N	0.5	.	0.6	.	0.5	.	0.5	.	2.6	.	3	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	2.7	1.5	1.1	1	0.84	0.77	0.6	0.65	23	23	1.3	0.99
Sodium	1.9	1.3	1.1	1.1	0.71	0.74	1.1	0.86	3.3	3.2	1.2	1.3
Sulfate	1.8	.	2	.	1	.	<1	.	17	.	2	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

METALS AND MAJOR IONS (mg/L)	GW-611				GW-612							
	07/24/90		10/26/90		02/10/90		05/25/90		07/31/90		10/30/90	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS	.	.	.	.	.	.	.	.	.	.	.	.
Aluminum	0.15	<0.02	0.12	0.039	.	.	<0.02	<0.02	<0.02	<0.02	0.036	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Arsenic	<0.05	<0.05	<0.05	<0.05	.	.	0.072	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.021	0.024	0.029	0.028	.	.	0.013	0.013	0.014	0.014	0.014	0.014
Beryllium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Beryllium	<0.0003	<0.0003	0.00033	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.011	0.0091	.	.	0.24	0.19	0.13	0.14	0.14	0.14
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	.	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	.	.	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.04	<0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	.	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.014	0.0071	0.013	0.0053	.	.	<0.004	<0.004	<0.004	0.023	0.017	0.012
Iron	0.35	0.01	0.16	0.012	.	.	0.029	0.026	0.3	0.013	0.2	0.021
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.0074	<0.004	0.011	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	.	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	0.019	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Selenium	<0.05	<0.05	<0.05	<0.05	.	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	4.3	4.4	3.2	5.6	.	.	4.5	4.4	3.6	3.9	4.7	4.6
Silver (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	.	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.02	0.02	0.023	0.021	.	.	0.014	0.014	0.018	0.018	0.015	0.015
Thallium (AAS)	.	.	.	.	.	.	.	.	.	.	.	.
Thorium	<0.2	<0.2	<0.2	<0.2	.	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Tin (AAS)	.	.	.	.	<0.01	<0.01	.	.	.	.	.	.
Uranium (Fluor)	0.001	0.003	0.002	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.008	<0.001	0.016	0.0072	.	.	0.012	0.0088	0.0082	0.35	0.018	0.011
MAJOR IONS	.	.	.	.	.	.	.	.	.	.	.	.
Alkalinity-HCO3	218	.	217	.	198	.	197	.	197	.	204	.
Alkalinity-CO3	<1	.	<1	.	2	.	<1	.	<1	.	<1	.
Calcium	50	43	51	47	34	32	39	38	34	34	37	38
Chloride	1	.	2	.	2.3	.	2	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	29	29	31	29	24	23	28	28	27	27	26	26
Manganese	0.01	<0.001	0.0041	<0.001	.	.	<0.001	<0.001	0.017	0.015	0.004	0.0034
Nitrate-N	4	.	3	.	0.2	.	0.3	.	0.2	.	0.2	.
Nitrite-N	.	.	.	.	.	.	.	.	.	.	.	.
Potassium	0.69	0.83	0.85	0.72	4.6	5.4	1.4	1.5	1.4	1.5	1.2	1.1
Sodium	1.4	1.1	1.7	1.7	0.84	0.92	0.82	0.83	0.62	0.7	0.7	0.74
Sulfate	3	.	4	.	2.4	.	3	.	3	.	3	.

TER QUALITY 1990
ESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-173				GW-174				GW-175	
	02/03/90	05/22/90	07/25/90	10/27/90	01/27/90	05/23/90	07/25/90	10/27/90	03/05/90	05/22/90
Acetone	<10	<10	<10	<10	3	<10	12	<10	<10	<10
Benzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Butanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Carbon disulfide	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Carbon tetrachloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chloroform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	<5	<5	<5	<5	2	<5	1	<5	<5	<5
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<5	<5	<5	<5	1	<5	<5	<5	<5	2
1,2-Dichloroethene	<5	<5	<5	<5	4	3	<5	6	<5	<5
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-Hexanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Methylene chloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Styrene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Tetrachloroethene	13	11	13	14	45	32	34	44	32	35
Toluene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	0.9	0.9	<5	1	6	3	3	4	10	12
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	2	1	1	2	<5	<5
Vinyl acetate	<10	<10	<10	<10	<10	<10	2	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Xylenes	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-175		GW-176				GW-177			
	07/24/90	10/26/90	01/27/90	05/24/90	07/28/90	10/29/90	02/27/90	05/23/90	07/26/90	10/27/90
Acetone	<10	11	43	<20	<20	<10	<10	<10	6	<10
Benzene	<5	0.9	<5	<10	<10	0.8	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
2-Butanone	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
Carbon disulfide	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Carbon tetrachloride	<5	<5	<5	<10	14	<5	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
Chloroform	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Chloromethane	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
1,1-Dichloroethane	<5	<5	93	57	27	45	5	4	4	8
1,2-Dichloroethane	<5	<5	3	<10	<10	2	<5	<5	<5	<5
1,1-Dichloroethene	<5	<5	32	19	16	15	<5	<5	<5	1
1,2-Dichloroethene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
1,2-Dichloropropane	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
2-Hexanone	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
Methylene chloride	<5	2	<5	<10	<10	2	<5	<5	<5	<5
Styrene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Tetrachloroethene	27	12	12	6	10	5	2	<5	<5	<5
Toluene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	8	4	220	150	100	120	13	6	12	20
1,1,2-Trichloroethane	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5
Vinyl acetate	<10	<10	<10	<20	<20	<10	<10	<10	2	<10
Vinyl chloride	<10	<10	<10	<20	<20	<10	<10	<10	<10	<10
Xylenes	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5

(CONTINUED)

TER QUALITY 1990
STNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-178				GW-179				GW-180	
	01/28/90	05/17/90	07/21/90	10/22/90	03/21/90	06/09/90	09/24/90	12/11/90	03/05/90	05/24/90
Acetone	<10	<10	<10	<10	<50	4	11	<10	<10	<10
Benzene	<5	<5	<5	<5	<25	<10	<10	1	<5	<5
Bromodichloromethane	<5	<5	2	<5	<25	<10	<10	<5	<5	<5
Bromoform	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
2-Butanone	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
Carbon disulfide	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Carbon tetrachloride	<5	<5	<5	<5	40	<10	<10	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
Chloroform	<5	<5	20	10	<25	<10	<10	<5	<5	<5
Chloromethane	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
1,1-Dichloroethane	6	<5	<5	3	120	120	110	110	5	4
1,2-Dichloroethane	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
1,1-Dichloroethene	<5	<5	<5	<5	59	51	40	52	<5	<5
1,2-Dichloroethene	<5	<5	<5	<5	<25	<10	<10	<5	10	8
1,2-Dichloropropane	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
cis-1,3-Dichloropropene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
trans-1,3-Dichloropropene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
2-Hexanone	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
Methylene chloride	<5	<5	<5	<5	<25	<10	<10	2	<5	<5
Styrene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<25	<10	13	<5	<5	<5
Tetrachloroethene	0.8	<5	<5	<5	<25	5	4	6	100	67
Toluene	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
1,1,1-Trichloroethane	33	27	6	16	290	280	210	310	4	3
1,1,2-Trichloroethane	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	<25	<10	<10	<5	3	2
Vinyl acetate	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10	<50	<20	<20	<10	<10	<10
Xylenes	<5	<5	<5	<5	<25	<10	<10	<5	<5	<5

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-180		GW-181					GW-322		
	07/26/90	10/29/90	03/02/90	05/21/90		07/23/90	10/25/90	01/28/90		05/23/90
					FD				FD	
Acetone	6	<10	17	<10	<10	8	<10	38	<50	<50
Benzene	<5	0.9	<5	<5	<5	<5	<5	<25	<25	<25
Bromodichloromethane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Bromoform	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Bromomethane	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
2-Butanone	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
Carbon disulfide	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Carbon tetrachloride	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Chlorobenzene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Chlorodibromomethane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Chloroethane	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
Chloroform	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Chloromethane	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
1,1-Dichloroethane	3	2	<5	<5	<5	<5	<5	54	53	54
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
1,1-Dichloroethene	<5	<5	<5	<5	<5	<5	<5	100	98	110
1,2-Dichloroethene	8	5	<5	<5	<5	<5	<5	<25	<25	<25
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Ethylbenzene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
2-Hexanone	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
Methylene chloride	<5	2	<5	<5	<5	<5	<5	<25	<25	<25
Styrene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Tetrachloroethene	89	73	<5	<5	<5	<5	<5	6	6	6
Toluene	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
1,1,1-Trichloroethane	4	3	<5	<5	<5	<5	<5	580	590	560
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25
Trichloroethene	3	2	<5	<5	<5	<5	<5	<25	<25	<25
Vinyl acetate	2	<10	<10	<10	<10	2	<10	<50	<50	<50
Vinyl chloride	<10	<10	<10	<10	<10	<10	<10	<50	<50	<50
Xylenes	<5	<5	<5	<5	<5	<5	<5	<25	<25	<25

(CONTINUED)

WATER QUALITY 1990
STINUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-322		GW-511				GW-607			
	07/26/90	10/29/90	02/28/90	05/18/90	07/21/90	10/24/90	02/09/90	05/18/90	07/21/90	10/24/90
Acetone	<50	<50	<10	<10	<10	<10	<10	<10	<10	16
Benzene	<25	4	<5	<5	<5	0.9	<5	<5	<5	0.9
Bromodichloromethane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Bromoform	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Bromomethane	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
2-Butanone	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
Carbon disulfide	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Carbon tetrachloride	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Chlorobenzene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Chlorodibromomethane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Chloroethane	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
Chloroform	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Chloromethane	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	63	59	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichloroethane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	110	95	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichloroethene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichloropropane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
2-Hexanone	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
Methylene chloride	<25	11	<5	<5	<5	3	<5	<5	<5	2
Styrene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Tetrachloroethene	7	<25	<5	<5	<5	<5	<5	<5	<5	<5
Toluene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	590	520	<5	<5	<5	<5	<5	<5	<5	<5
1,1,2-Trichloroethane	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Trichloroethene	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5
Vinyl acetate	9	<50	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl chloride	<50	<50	<10	<10	<10	<10	<10	<10	<10	<10
Xylenes	<25	<25	<5	<5	<5	<5	<5	<5	<5	<5

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-608					GW-609				
	02/10/90	05/18/90	07/23/90	10/24/90		02/14/90	05/17/90	07/21/90		10/23/90
					FD				FD	
Acetone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Benzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
2-Butanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Carbon disulfide	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Carbon tetrachloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Chloroform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
1,1-Dichloroethane	5	<5	<5	2	2	2	<5	<5	<5	2
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	2	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,2-Dichloroethene	<5	<5	<5	<5	<5	25	47	39	39	28
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
2-Hexanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Methylene chloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Styrene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Tetrachloroethene	1	<5	6	2	2	27	54	51	43	22
Toluene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
1,1,1-Trichloroethane	16	12	13	<5	<5	2	<5	<5	<5	2
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5	<5	3	5	<5	<5	3
Vinyl acetate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Vinyl chloride	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Xylenes	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-610				GW-611				GW-612	
	02/09/90	05/22/90	07/24/90	10/26/90	02/09/90	05/22/90	07/24/90	10/26/90	02/10/90	05/25/90
Acetone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Benzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Bromodichloromethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Bromoform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Bromomethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
2-Butanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Carbon disulfide	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Carbon tetrachloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Chlorobenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Chlorodibromomethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Chloroethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Chloroform	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Chloromethane	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
1,1-Dichloroethane	<5	<5	<5	<5	<5	2	<5	1	170	150
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	6	<25
1,1-Dichloroethene	<5	<5	<5	<5	<5	2	<5	2	61	61
1,2-Dichloroethene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Ethylbenzene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
2-Hexanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
4-Methyl-2-pentanone	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Methylene chloride	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Styrene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Tetrachloroethene	1	<5	<5	1	<5	<5	<5	<5	10	8
Toluene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
1,1,1-Trichloroethane	<5	<5	<5	<5	13	17	12	15	410	370
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Trichloroethene	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25
Vinyl acetate	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Vinyl chloride	<10	<10	<10	<10	<10	<10	<10	<10	<10	<50
Xylenes	<5	<5	<5	<5	<5	<5	<5	<5	<5	<25

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

VOLATILE ORGANICS (ug/L)	GW-612	
	07/31/90	10/30/90
Acetone	11	<20
Benzene	<10	2
Bromodichloromethane	<10	<10
Bromoform	<10	<10
Bromomethane	<20	<20
2-Butanone	<20	<20
Carbon disulfide	<10	<10
Carbon tetrachloride	<10	<10
Chlorobenzene	<10	<10
Chlorodibromomethane	<10	<10
Chloroethane	<20	<20
Chloroform	<10	<10
Chloromethane	<20	<20
1,1-Dichloroethane	160	160
1,2-Dichloroethane	4	<10
1,1-Dichloroethene	46	38
1,2-Dichloroethene	<10	4
1,2-Dichloropropane	<10	<10
cis-1,3-Dichloropropene	<10	<10
trans-1,3-Dichloropropene	<10	<10
Ethylbenzene	<10	<10
2-Hexanone	<20	<20
4-Methyl-2-pentanone	<20	<20
Methylene chloride	<10	5
Styrene	<10	<10
1,1,2,2-Tetrachloroethane	<10	<10
Tetrachloroethene	7	8
Toluene	<10	<10
1,1,1-Trichloroethane	230	120
1,1,2-Trichloroethane	<10	<10
Trichloroethene	<10	<10
Vinyl acetate	3	<20
Vinyl chloride	<20	<20
Xylenes	<10	<10

WATER QUALITY 1990
STINUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-173				GW-174				GW-175	
	02/03/90	05/22/90	07/25/90	10/27/90	01/27/90	05/23/90	07/25/90	10/27/90	03/05/90	05/22/90
MISCELLANEOUS										
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	351	309	376	352	390	313	404	348	240	271
Conductivity, 1 (umhos/cm)	385	327	343	332	348	300	354	315	309	307
Conductivity, 2 (umhos/cm)	354	.	.	.	348	.	.	.	315	.
Conductivity, 3 (umhos/cm)	392	.	.	.	354	.	.	.	315	.
Conductivity, 4 (umhos/cm)	354	.	.	.	354	.	.	.	319	.
Dissolved Oxygen, Field (ppm)	3.9	6.6	7.5	7.1	7.7	5.2	5.7	4.5	11	9
Dissolved Solids (mg/L)	186	200	174	240	176	224	194	258	130	162
pH, Field (pH units)	7.8	7.6	7.8	7.7	8	8	8.2	8.3	7.3	8
pH, 1 (pH units)	7.1	6.8	7.4	7	7.2	7	7.6	7	7.8	6.8
pH, 2 (pH units)	7.1	.	.	.	7.2	.	.	.	7.8	.
pH, 3 (pH units)	7.1	.	.	.	7.2	.	.	.	7.8	.
pH, 4 (pH units)	7.1	.	.	.	7.2	.	.	.	7.9	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	219	270	300.9	285	306	248	271.2	266	189	270
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	23	16	7	10	32	89	6	8	12	2
Turbidity (NTU)	14	17	5.6	8	13	130	2.2	19	2.8	3
Depth to Water (ft +/- grade)	-122.08	.	.	.	-103.16	.	.	.	<109	.
Water Temp, Field (degrees C)	14.7	14.5	15.6	13.5	12.9	16.3	16.5	14.2	12.3	13.7
RADIOCHEMICAL										
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	0.32	<0.72	-0.082	1.4	2.32	1.84	0.78	2.79	1.23	<0.05
Gross Alpha (CE+/-)	1.1	1.1	0.98	1.3	1.5	1.4	1.2	1.5	1.1	1
Gross Beta (pCi/L)	1.79	2.33	4.54	0.8	54.4	0.47	2.79	8.58	3.8	1.63
Gross Beta (CE+/-)	3.3	3	3.2	3.3	5.6	3.4	3.1	3.7	2.9	2.9
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-175		GW-176				GW-177			
	07/24/90	10/26/90	01/27/90	05/24/90	07/28/90	10/29/90	02/27/90	05/23/90	07/26/90	10/27/90
MISCELLANEOUS	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	335	256	491	451	437	508	391	338	387	391
Conductivity, 1 (umhos/cm)	298	273	423	445	557	451	376	338	351	346
Conductivity, 2 (umhos/cm)	.	.	420	.	.	.	383	.	.	.
Conductivity, 3 (umhos/cm)	.	.	436	.	.	.	383	.	.	.
Conductivity, 4 (umhos/cm)	.	.	426	.	.	.	386	.	.	.
Dissolved Oxygen, Field (ppm)	9.1	9.1	6.1	5.9	6.2	5.9	6.2	3.3	6.3	6.5
Dissolved Solids (mg/L)	170	186	212	280	284	300	196	214	198	200
pH, Field (pH units)	8.2	8.5	6.9	7	7	6.7	7.7	7.8	7.9	7.8
pH, 1 (pH units)	7.6	6.9	6.8	6.9	7.7	6.8	7.7	7	7.8	7
pH, 2 (pH units)	.	.	6.8	.	.	.	7.7	.	.	.
pH, 3 (pH units)	.	.	6.8	.	.	.	7.6	.	.	.
pH, 4 (pH units)	.	.	6.8	.	.	.	7.8	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	172.3	309	491	267	224	321	186	242	174.7	275
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	2	1	5	2	<1	<1	3	1	<1	<1
Turbidity (NTU)	3	1.9	2.2	4.8	1.3	1	0.75	1.1	2	0.3
Depth to Water (ft +/- grade)	.	.	-113.25	.	.	.	-114.16	.	.	.
Water Temp, Field (degrees C)	15.8	12.1	13.7	17.2	16.1	14.7	20	16.7	16.7	15.6
	.	.	.	.	.	.	.	.	.	.
RADIOCHEMICAL	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.63	1.23	0.63	3.09	0.86	1.33	2.49	2.69	1.53	1.45
Gross Alpha (CE+/-)	1.3	1.3	1.2	1.5	1.6	1.3	1.3	1.5	1.7	1.3
Gross Beta (pCi/L)	3.26	0.29	0	4.07	1.9	0.83	6.48	1.86	8.94	6.68
Gross Beta (CE+/-)	3.1	3.3	3.3	3.5	3.4	3.3	3.1	3.5	3.8	3.6
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

WATER QUALITY 1990
MOUNT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-178				GW-179				GW-180	
	01/28/90	05/17/90	07/21/90	10/22/90	03/21/90	06/09/90	09/24/90	12/11/90	03/05/90	05/24/90
MISCELLANEOUS	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	401	422	367	446	577	542	455	428	456	487
Conductivity, 1 (umhos/cm)	379	362	420	412	518	546	447	468	545	514
Conductivity, 2 (umhos/cm)	389	.	.	.	521	.	.	.	548	.
Conductivity, 3 (umhos/cm)	432	.	.	.	524	.	.	.	548	.
Conductivity, 4 (umhos/cm)	385	.	.	.	521	.	.	.	548	.
Dissolved Oxygen, Field (ppm)	8.7	10.2	5.8	7.3	7.1	6.7	7.3	7	10.9	5.3
Dissolved Solids (mg/L)	194	222	358	354	268	294	256	282	272	310
pH, Field (pH units)	7.7	7.7	7.6	7.4	8.4	7.7	8.6	6.5	6.8	7.1
pH, 1 (pH units)	7.3	6.9	7.4	7.1	7	7.4	7	7	7.5	7
pH, 2 (pH units)	7.3	.	.	.	7	.	.	.	7.5	.
pH, 3 (pH units)	7.3	.	.	.	7	.	.	.	7.5	.
pH, 4 (pH units)	7.3	.	.	.	7	.	.	.	7.5	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	401	319	234.4	308	175	156	76	306	204	234
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	2	7	134	15	598	90	413	68	2	<1
Turbidity (NTU)	1.6	2.3	4000	2000	380	120	32	38	1.1	1.2
Depth to Water (ft +/- grade)	-86.25	.	.	.	<109	.	.	.	-91.5	.
Water Temp, Field (degrees C)	14.4	15.7	16.8	14.6	16.9	16.2	17	14.6	14.6	14.5
	.	.	.	.	.	.	.	.	.	.
RADIOCHEMICAL	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.3	<0.51	3.39	0.38	4.2	2.84	2.56	2.18	0.8	0.82
Gross Alpha (CE+/-)	1.3	1.2	1.6	2.6	1.9	1.5	1.5	1.4	0.97	1.1
Gross Beta (pCi/L)	0.67	<0.09	6.17	-3.72	20.81	10.48	9.57	4.22	5.81	2.44
Gross Beta (CE+/-)	3.4	3.2	3.5	6.2	4.3	3.5	3.4	3.4	3.1	3.4
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	0	0	0	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	0.86	32.8	1.5	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	0.43	0	0.44	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	32.8	0.9	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	<0.43	0	0.44	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	32.8	0.9	.	.	.	.	.	.

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WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-180		GW-181					GW-322		
	07/26/90	10/29/90	03/02/90	05/21/90		07/23/90	10/25/90	01/28/90		05/23/90
					FD				FD	
MISCELLANEOUS	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	517	490	284	260	254	322	256	290	305	271
Conductivity, 1 (umhos/cm)	490	433	268	258	262	274	241	282	295	262
Conductivity, 2 (umhos/cm)	.	.	285	.	.	.	.	316	282	.
Conductivity, 3 (umhos/cm)	.	.	288	.	.	.	.	285	285	.
Conductivity, 4 (umhos/cm)	.	.	285	.	.	.	.	285	282	.
Dissolved Oxygen, Field (ppm)	5.6	4.8	6.5	6.4	6.4	6.7	6.4	7	7.2	7.1
Dissolved Solids (mg/L)	300	300	128	152	154	162	194	154	130	174
pH, Field (pH units)	7.3	7	7.7	7.8	7.7	8.2	7.6	7.8	7.8	8
pH, 1 (pH units)	7.8	7	7.5	6.7	6.7	7.5	6.4	7.1	7.1	6.8
pH, 2 (pH units)	.	.	7.5	.	.	.	.	7.1	7.1	.
pH, 3 (pH units)	.	.	7.5	.	.	.	.	7.1	7.1	.
pH, 4 (pH units)	.	.	7.5	.	.	.	.	7.1	7.1	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	219.4	283	185	287	293	184	320	340	292	244
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	<1	3	1	<1	2	1	<1	75	83	12
Turbidity (NTU)	1	3	2.7	1.1	1.1	2	1.9	45	45	23
Depth to Water (ft +/- grade)	.	.	-78.9	.	.	.	.	-143.5	.	.
Water Temp, Field (degrees C)	16	13.5	12.6	15.4	15.8	16	13.3	13.8	13.8	16.1
	.	.	.	.	.	.	.	.	.	.
RADIOCHEMICAL	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	0.77	2.62	1.18	<0.75	0.11	1.26	0.24	<0.06	0.19	1.77
Gross Alpha (CE+/-)	1.4	1.5	1.58	1.1	1.2	1.2	1.1	1	1.1	1.3
Gross Beta (pCi/L)	<0.56	0.63	<1.01	4.77	5	3.72	2.27	0.78	1.34	3.03
Gross Beta (CE+/-)	3.3	3.3	3.69	3.1	3.2	3.2	3.4	3.4	3.4	3.4
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

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TER QUALITY 1990
-ESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-322		GW-511				GW-607			
	07/26/90	10/29/90	02/28/90	05/18/90	07/21/90	10/24/90	02/09/90	05/18/90	07/21/90	10/24/90
MISCELLANEOUS										
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	296	310	205	228	248	243	227	248	198	247
Conductivity, 1 (umhos/cm)	252	255	231	213	228	196	207	227	239	213
Conductivity, 2 (umhos/cm)	.	.	241	.	.	.	232	.	.	.
Conductivity, 3 (umhos/cm)	.	.	238	.	.	.	235	.	.	.
Conductivity, 4 (umhos/cm)	.	.	238	.	.	.	210	.	.	.
Dissolved Oxygen, Field (ppm)	7.4	7	3.6	4.7	6.3	6	8.5	6.6	6.5	6.6
Dissolved Solids (mg/L)	172	220	176	132	96	130	94	132	142	128
pH, Field (pH units)	8	7.6	8.6	8.8	8.7	8.6	7.9	7.9	8.4	8.4
pH, 1 (pH units)	7.8	6.9	8.2	6.6	8.1	6.8	6.8	6.6	7.9	6.8
pH, 2 (pH units)	.	.	8.3	.	.	.	6.9	.	.	.
pH, 3 (pH units)	.	.	8.4	.	.	.	6.9	.	.	.
pH, 4 (pH units)	.	.	8.3	.	.	.	6.9	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	255.1	289	160	201	187	249	304	265	223.8	260
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	9	600	<1	<1	<1	<1	6	3	2	<1
Turbidity (NTU)	15	360	1.5	1	0.9	0.4	11	5.9	1.6	2
Depth to Water (ft +/- grade)	.	.	-78.5	.	.	.	-72.91	.	.	.
Water Temp, Field (degrees C)	17	15	13.2	15.1	15.1	14.8	13.7	15	17.5	14.7
RADIOCHEMICAL										
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	0.19	3.12	<0.12	1.13	1.07	0.65	0.42	<0.41	0.75	0.51
Gross Alpha (CE+/-)	1.5	1.6	0.7	1.4	1.2	1.2	1.1	0.1	1.2	1.2
Gross Beta (pCi/L)	<0.22	<0.02	8.27	11.64	8.26	5.82	3.24	4.89	4.42	2.75
Gross Beta (CE+/-)	3.3	3.3	3.2	3.5	3.6	3.6	3.2	3.2	3.2	3.4
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-608					GW-609				
	02/10/90	05/18/90	07/23/90	10/24/90		02/14/90	05/17/90	07/21/90		10/23/90
					FD				FD	
MISCELLANEOUS	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	261	282	299	266	265	275	362	345	348	322
Conductivity, 1 (umhos/cm)	260	210	267	231	231	345	310	322	322	297
Conductivity, 2 (umhos/cm)	269	.	.	.	.	326	.	.	.	.
Conductivity, 3 (umhos/cm)	273	.	.	.	.	326	.	.	.	.
Conductivity, 4 (umhos/cm)	254	.	.	.	.	357	.	.	.	.
Dissolved Oxygen, Field (ppm)	8	7.8	6.7	7.6	7.5	6.4	5.9	6.8	6.9	7
Dissolved Solids (mg/L)	100	166	140	160	160	178	202	176	160	158
pH, Field (pH units)	7.3	7.4	8	7.7	7.7	7.4	7.6	7.7	7.7	7.5
pH, 1 (pH units)	7	6.6	7.5	6.1	6.1	7.1	6.8	7.5	7.5	6.9
pH, 2 (pH units)	7	.	.	.	.	7.2	.	.	.	.
pH, 3 (pH units)	7	.	.	.	.	7.2	.	.	.	.
pH, 4 (pH units)	7	.	.	.	.	7.2	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	355	287	199	303	298	249	296	222	223	292
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	16	8	2	<1	<1	<1	1	<1	2	<1
Turbidity (NTU)	22	18	3.5	1	1	0.9	1	1	1	0.3
Depth to Water (ft +/- grade)	<92	.	.	.	.	-147.75	.	.	.	.
Water Temp, Field (degrees C)	15.2	16.6	15.6	14.5	14.5	16.4	15.8	15.3	15.1	14.4
	.	.	.	.	.	.	.	.	.	.
RADIOCHEMICAL	.	.	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	0.09	0.28	7.75	<0.04	1.21	0.98	<0.03	9.26	1.95	0.11
Gross Alpha (CE+/-)	1	1.3	1.1	1.1	1.3	1.3	1.2	1.1	1.3	1.1
Gross Beta (pCi/L)	0.22	4.19	2.68	0.09	0.28	2.09	1.56	2.1	1.28	<0.8
Gross Beta (CE+/-)	3	3.1	3.1	3.3	3.3	3.2	3.1	3.2	3.2	3.2
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

WATER QUALITY 1990
ESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-610				GW-611				GW-612	
	02/09/90	05/22/90	07/24/90	10/26/90	02/09/90	05/22/90	07/24/90	10/26/90	02/10/90	05/25/90
MISCELLANEOUS										
Ammonia-N (mg/L)	.	.	.	.	.	.	.	.	.	.
Coliform (cc/100 mL)	.	.	.	.	.	.	.	.	.	.
Conductivity, Field (umhos/cm)	265	256	332	256	266	339	454	363	274	353
Conductivity, 1 (umhos/cm)	320	289	298	276	348	383	399	388	335	324
Conductivity, 2 (umhos/cm)	307	.	.	.	335	.	.	.	360	.
Conductivity, 3 (umhos/cm)	335	.	.	.	345	.	.	.	367	.
Conductivity, 4 (umhos/cm)	323	.	.	.	323	.	.	.	335	.
Dissolved Oxygen, Field (ppm)	6.3	6.4	7.1	7.3	8.2	8.7	8.8	8.8	6.5	6.4
Dissolved Solids (mg/L)	134	176	154	182	156	216	220	276	162	212
pH, Field (pH units)	8.5	7.6	8	8.3	9.4	7.7	7.8	8.3	8.8	7.8
pH, 1 (pH units)	7.1	6.7	7.5	6.9	7.8	6.8	7.6	7.1	7.3	6.9
pH, 2 (pH units)	7.1	.	.	.	7.7	.	.	.	7.3	.
pH, 3 (pH units)	7.1	.	.	.	7.7	.	.	.	7.3	.
pH, 4 (pH units)	7.1	.	.	.	7.7	.	.	.	7.4	.
Phenols (mg/L)	.	.	.	.	.	.	.	.	.	.
Redox, Field (mV)	233	212	238.3	289	194	263	230.8	293	230	270
Total Organic Carbon, 1 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 2 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 3 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Carbon, 4 (mg/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 1 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 2 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 3 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Organic Halide, 4 (ug/L)	.	.	.	.	.	.	.	.	.	.
Total Suspended Solids (mg/L)	43	30	51	24	20	14	22	18	2	1
Turbidity (NTU)	18	16	18	14	17	7	18	22	1	1
Depth to Water (ft +/- grade)	-76.63	.	.	.	-94.87	.	.	.	-112.2	.
Water Temp, Field (degrees C)	14.3	14	15.5	13.5	13.6	14.3	17.6	14.4	12.2	16.1
RADIOCHEMICAL										
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Cesium-137 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.22	2.13	-0.0876	2.54	0.69	4.29	0.99	1.6	2.02	2.49
Gross Alpha (CE+/-)	1.2	1.4	0.95	1.5	1.1	1.7	1.2	1.3	1.4	1.4
Gross Beta (pCi/L)	6.59	0.81	2.56	<0.89	21.91	0.23	2.33	0.73	6.59	1.75
Gross Beta (CE+/-)	3.4	3.4	3.1	3.2	4.1	3.4	3.1	3.3	3.4	3.3
Iodine-125+129 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Iodine-125+129 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Protactinium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Radium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Radium-228 (Bq/L)	.	.	.	.	.	.	.	.	.	.
Radium-228 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Strontium (pCi/L)	.	.	.	.	.	.	.	.	.	.
Strontium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Technetium-99 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Thorium-231+234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Tritium (Bq/L)	.	.	.	.	.	.	.	.	.	.
Tritium (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-234 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-235 (CE+/-)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (pCi/L)	.	.	.	.	.	.	.	.	.	.
Uranium-238 (CE+/-)	.	.	.	.	.	.	.	.	.	.

(CONTINUED)

WATER QUALITY 1990
CHESTNUT RIDGE SECURITY PITS

MISCELLANEOUS AND RADIOCHEMICAL PARAMETERS	GW-612	
	07/31/90	10/30/90
MISCELLANEOUS	.	.
	.	.
Ammonia-N (mg/L)	.	.
Coliform (cc/100 mL)	.	.
Conductivity, Field (umhos/cm)	369	373
Conductivity, 1 (umhos/cm)	369	364
Conductivity, 2 (umhos/cm)	.	.
Conductivity, 3 (umhos/cm)	.	.
Conductivity, 4 (umhos/cm)	.	.
Dissolved Oxygen, Field (ppm)	6.6	6.4
Dissolved Solids (mg/L)	196	260
pH, Field (pH units)	7.9	7.6
pH, 1 (pH units)	8.1	7
pH, 2 (pH units)	.	.
pH, 3 (pH units)	.	.
pH, 4 (pH units)	.	.
Phenols (mg/L)	.	.
Redox, Field (mV)	150	286
Total Organic Carbon, 1 (mg/L)	.	.
Total Organic Carbon, 2 (mg/L)	.	.
Total Organic Carbon, 3 (mg/L)	.	.
Total Organic Carbon, 4 (mg/L)	.	.
Total Organic Halide, 1 (ug/L)	.	.
Total Organic Halide, 2 (ug/L)	.	.
Total Organic Halide, 3 (ug/L)	.	.
Total Organic Halide, 4 (ug/L)	.	.
Total Suspended Solids (mg/L)	1	7
Turbidity (NTU)	3	2
Depth to Water (ft +/- grade)	.	.
Water Temp, Field (degrees C)	17.3	14.7
	.	.
RADIOCHEMICAL	.	.
	.	.
Cesium-137 (pCi/L)	.	.
Cesium-137 (pCi/L)	.	.
Cesium-137 (CE+/-)	.	.
Gross Alpha (pCi/L)	0.23	2.25
Gross Alpha (CE+/-)	1.6	1.6
Gross Beta (pCi/L)	0.45	2.84
Gross Beta (CE+/-)	3.2	3.2
Iodine-125+129 (Bq/L)	.	.
Iodine-125+129 (CE+/-)	.	.
Protactinium (pCi/L)	.	.
Radium (Bq/L)	.	.
Radium (CE+/-)	.	.
Radium-228 (Bq/L)	.	.
Radium-228 (CE+/-)	.	.
Strontium (pCi/L)	.	.
Strontium (CE+/-)	.	.
Technetium-99 (pCi/L)	.	.
Technetium-99 (CE+/-)	.	.
Thorium-231+234 (pCi/L)	.	.
Thorium-231+234 (CE+/-)	.	.
Tritium (Bq/L)	.	.
Tritium (CE+/-)	.	.
Uranium-234 (pCi/L)	.	.
Uranium-234 (CE+/-)	.	.
Uranium-235 (pCi/L)	.	.
Uranium-235 (CE+/-)	.	.
Uranium-238 (pCi/L)	.	.
Uranium-238 (CE+/-)	.	.

Groundwater Quality Data, 1991

Well No.	GW-166	GW-173						
Location	CRDT	CRSP						
Date Sampled	06/08/91	02/01/91		05/03/91		08/06/91		10/10/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	0.063	0.048	0.055	0.12	<0.02	0.11	<0.02	0.11
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0098	0.013	0.012	0.01	0.014	0.013	0.016	0.016
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.02	0.031	0.014	<0.004	<0.004	<0.004	<0.004	0.029
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	0.043	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.014	0.0062	0.0069	0.006	<0.004	<0.004	<0.004
Iron	0.057	0.051	<0.004	0.34	<0.005	0.2	<0.005	0.22
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.039	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.4	3.8	3.7	3.8	3.9	3.7	3.6	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.059	0.017	0.016	0.015	0.014	0.015	0.015	0.016
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0033	0.019	0.0018	0.0068	<0.002	<0.002	<0.002	0.018
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	188	.	191	.	184	.	192
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	31	38	37	32	32	37	38	42
Chloride	.	3	.	3	.	2	.	2
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	17	23	23	24	24	22	22	25
Manganese	0.012	0.0048	0.001	0.0041	<0.001	0.0032	<0.001	0.0035
Nitrate-N	.	<0.2	.	1	.	1.3	.	1.19
Potassium	3.7	1.7	1.5	0.98	1.3	1.3	1.2	1.7
Sodium	1.2	2.9	2.5	1.9	2.1	2.2	2.2	2
Sulfate	.	6	.	6	.	6	.	7

Groundwater Quality Data, 1991

Well No.	GW-173	GW-174						
Location	CRSP	CRSP						
Date Sampled	10/10/91	02/01/91		05/03/91		08/06/91		10/11/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)								
Aluminum	0.02	0.027	<0.02	0.062	<0.02	0.064	0.025	0.022
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.022	0.065	0.065	0.069	0.062	0.051	0.052	0.031
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.021	0.016	0.013	<0.004	<0.004	<0.004	<0.004	0.021
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	0.025	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.0055	0.0041	<0.004	0.0057	0.0049	<0.004	<0.004	<0.004
Iron	<0.005	0.055	<0.004	0.061	<0.005	0.034	<0.005	0.028
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	4.7	4.5	3.1	1.9	4.7	4.5	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.018	0.091	0.15	0.1	0.14	0.084	0.14	0.04
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	0.001	0.001	0.001	0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0042	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	0.0041
MAJOR IONS (mg/L)								
Alkalinity-HCO3	.	188	.	191	.	187	.	199
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	41	34	20	31	22	36	27	43
Chloride	.	9	.	10	.	9	.	9
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	24	24	19	25	23	23	21	26
Manganese	0.0035	0.001	0.0021	0.0063	0.0055	<0.001	<0.001	0.0013
Nitrate-N	.	1	.	0.58	.	0.6	.	0.6
Potassium	2	2.8	6.8	3.1	5.4	2.7	4.6	1.4
Sodium	2.5	6	23	5.8	18	6.6	14	2.7
Sulfate	.	4	.	3	.	4	.	4

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-174	GW-175						
Location	CRSP	CRSP						
Date Sampled	10/11/91	01/31/91		05/01/91		08/08/91		10/13/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	<0.02	<0.02	0.032	<0.02	0.026	<0.02	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.051	0.043	0.042	0.037	0.034	0.033	0.032	0.034
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.011	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.011
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	0.0031	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	0.014	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	0.011	0.043	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Iron	0.007	0.38	<0.004	0.056	<0.005	0.092	<0.005	0.059
Lead (AAS)	<0.004	0.026	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	3.3	3.2	3.5	3.5	0.9	<0.03	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.053	0.0081	0.0079	0.013	0.014	0.012	0.012	0.011
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	0.001	0.001	0.002	0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0027	<0.001	0.0022	<0.002	<0.002	<0.002	<0.002	0.0048
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	171	.	173	.	185	.	176
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	45	37	33	37	37	39	40	37
Chloride	.	2	.	2	.	2	.	2
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	27	24	21	22	22	23	23	23
Manganese	0.0031	0.0096	<0.001	<0.001	<0.001	0.0021	<0.001	<0.001
Nitrate-N	.	0.3	.	0.3	.	0.25	.	0.28
Potassium	2.1	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Sodium	3.9	<0.02	<0.02	0.75	0.59	0.55	0.55	1.1
Sulfate	.	1	.	1	.	<1	.	1

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-175	GW-176						
Location	CRSP	CRSP						
Date Sampled	10/13/91	02/04/91		05/04/91		08/09/91		10/14/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)								
Aluminum	0.023	0.027	<0.02	<0.02	<0.02	0.03	<0.02	0.25
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.035	0.021	0.016	0.018	0.018	0.016	0.016	0.018
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.018	0.89	0.88	0.63	0.77	0.39	0.38	0.35
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Iron	0.027	0.063	<0.004	<0.005	<0.005	0.031	<0.005	0.38
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	4.9	4.8	2.9	4.8	2.6	2.3	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	0.0068
Strontium	0.011	0.023	0.022	0.021	0.021	0.019	0.019	0.021
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0074	0.0072	0.006	0.0023	0.0048	0.0024	0.0053	0.017
MAJOR IONS (mg/L)								
Alkalinity-HCO3	.	279	.	281	.	260	.	269
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	37	58	49	36	37	54	53	58
Chloride	.	2	.	2	.	1.9	.	2
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	22	33	34	35	34	32	31	34
Manganese	<0.001	0.0015	0.001	<0.001	<0.001	<0.001	<0.001	0.012
Nitrate-N	.	0.5	.	0.5	.	0.5	.	0.44
Potassium	0.61	1.1	1	1.1	1.1	0.95	0.76	1.1
Sodium	1.4	0.77	0.8	0.74	0.87	0.6	0.6	0.7
Sulfate	.	1	.	2	.	1.3	.	1

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-176	GW-177						
Location	CRSP	CRSP						
Date Sampled	10/14/91	02/02/91		05/03/91		08/08/91		10/13/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)								
Aluminum	<0.02	0.029	0.044	0.027	0.021	0.022	0.03	0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.016	0.024	0.025	0.023	0.024	0.018	0.016	0.015
Beryllium	<0.0003	<0.0003	0.00033	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.33	0.035	0.014	<0.004	<0.004	<0.004	0.046	0.0093
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	0.006	<0.004	0.0085	<0.004	<0.004
Iron	<0.005	<0.004	<0.004	0.027	<0.005	0.087	0.0063	0.011
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	0.0065	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	0.013	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	4.3	4.2	3.7	4.2	1.9	4.7	.
Silver	0.042	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.02	0.024	0.024	0.023	0.023	0.018	0.027	0.014
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.01	0.0058	0.0023	<0.002	<0.002	<0.002	0.022	0.007
MAJOR IONS (mg/L)								
Alkalinity-HCO3	.	213	.	207	.	194	.	203
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	57	41	40	33	33	42	44	46
Chloride	.	2	.	2	.	2	.	3
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	34	25	25	25	25	24	28	27
Manganese	0.0029	0.0055	0.0025	0.0078	0.0026	0.011	<0.001	<0.001
Nitrate-N	.	<0.2	.	0.27	.	<0.2	.	0.31
Potassium	1.3	6.8	6.2	4.2	4.1	2.8	<0.6	1.7
Sodium	1.5	1.6	1.3	0.92	0.9	0.87	12	1.1
Sulfate	.	7	.	8	.	6	.	7

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-177	GW-178						
Location	CRSP	CRSP						
Date Sampled	10/13/91	01/15/91		04/22/91		08/08/91		10/13/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	1.1	0.039	0.42	0.027	0.024	0.45	0.031
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.016	0.035	0.018	0.019	0.014	0.017	0.05	0.014
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.0014	<0.0003
Boron	0.016	0.02	0.018	0.017	0.023	0.03	1.3	0.0068
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	0.042	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.049	0.0067	0.011	<0.004	<0.004	0.028	<0.004
Iron	<0.005	8.4	0.021	1	0.0095	0.022	3	0.022
Lead (AAS)	<0.004	0.093	<0.004	0.016	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.038	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	5.2	4.2	5.1	4.5	4.6	4.3	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.015	0.045	0.034	0.03	0.026	0.028	0.12	0.022
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.014	<0.005
Zinc	0.0082	0.53	0.064	0.15	0.053	0.038	0.095	0.035
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	221	.	362	.	215	.	220
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	45	54	40	45	40	45	42	47
Chloride	.	11	.	10	.	7	.	<5
Fluoride	.	0.1	.	0.1	.	<0.1	.	<0.1
Magnesium	27	28	22	25	23	29	13	28
Manganese	<0.001	0.097	0.02	0.038	0.0036	<0.001	0.05	0.0031
Nitrate-N	.	0.5	.	0.5	.	0.42	.	<1
Potassium	1.9	0.89	0.78	0.71	0.6	<0.6	5.3	<0.6
Sodium	1.2	16	16	9.7	9.5	15	130	7.6
Sulfate	.	12	.	9	.	5	.	6

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-178	GW-179						
Location	CRSP	CRSP						
Date Sampled	10/13/91	02/08/91		05/08/91		08/12/91		10/17/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	2	0.046	0.16	<0.02	0.21	<0.02	0.025
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.014	0.034	0.032	0.029	0.028	0.022	0.023	0.027
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.0075	0.026	0.016	<0.004	0.017	0.013	0.0076	0.023
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	0.0041	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	0.033	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.12	<0.004	0.045	0.0095	0.042	0.023	0.032
Iron	<0.005	4.4	0.014	1	<0.005	0.49	0.03	0.11
Lead (AAS)	<0.004	0.025	<0.004	0.0072	<0.004	0.0059	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	6.8	3.3	2.1	4.4	4.2	3.8	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.023	0.046	0.041	0.027	0.024	0.025	0.022	0.023
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	0.001	<0.001	0.001	<0.001	0.001	0.001	<0.001
Vanadium	<0.005	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.022	0.04	0.0027	0.018	0.0055	0.0092	0.011	0.0093
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	309	.	290	.	252	.	265
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	47	110	58	69	57	56	46	56
Chloride	.	2	.	3	.	2	.	2
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	28	62	32	38	31	36	30	35
Manganese	<0.001	0.1	0.004	0.025	0.0061	0.01	0.0034	0.0034
Nitrate-N	.	0.7	.	0.5	.	0.48	.	0.5
Potassium	0.72	4.6	4.3	3.9	4.1	4.2	4.1	4.1
Sodium	7.2	2.5	7	3	2.8	2.5	2.6	2.2
Sulfate	.	4	.	4	.	4	.	4

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-179	GW-180						
Location	CRSP	CRSP						
Date Sampled	10/17/91	02/02/91		05/04/91		08/09/91		10/14/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)								
Aluminum	<0.02	<0.02	<0.02	<0.02	<0.02	0.04	<0.02	0.085
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.027	0.029	0.028	0.029	0.029	0.026	0.025	0.026
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.0095	0.0089	0.013	<0.004	<0.004	<0.004	<0.004	0.007
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.012	<0.004	<0.004	<0.004	0.0043	<0.004	<0.004	<0.004
Iron	<0.005	<0.004	<0.004	<0.005	<0.005	0.049	<0.005	0.049
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	5.1	5.1	5.3	2.7	2.7	2.7	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.022	0.018	0.018	0.02	0.02	0.019	0.018	0.019
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.011	0.0077	0.0066	0.005	0.011	0.0086	0.0092	0.015
MAJOR IONS (mg/L)								
Alkalinity-HCO3	.	300	.	316	.	285	.	276
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	54	58	58	60	64	57	56	57
Chloride	.	2	.	2	.	2	.	2
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	34	37	37	40	40	34	34	35
Manganese	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.019
Nitrate-N	.	0.5	.	0.29	.	0.3	.	0.24
Potassium	4	0.71	0.76	1	1.1	0.77	0.66	1.4
Sodium	2.3	0.71	0.68	0.86	0.74	0.65	0.61	0.86
Sulfate	.	<1	.	<1	.	<1	.	<1

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-180	GW-181						
Location	CRSP	CRSP						
Date Sampled	10/14/91	01/29/91		04/30/91		08/05/91		10/08/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	0.041	0.027	0.032	<0.02	0.046	0.032	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05
Barium	0.027	0.0078	0.0074	0.0082	0.0076	0.0097	0.016	0.0076
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.0048	0.015	0.033	0.0066	0.0087	0.01	0.019	0.028
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	0.0035	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.0057	<0.004	<0.004	0.0059	0.0097	0.0057	<0.004	<0.004
Iron	<0.005	0.15	0.0081	0.12	0.012	0.39	<0.005	0.52
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	4.4	4.1	4.1	4.2	3.9	3.9	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.017	0.018	0.017	0.02	0.021	0.019	0.031	0.02
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.013	0.0034	0.0037	0.0046	0.0059	0.0058	<0.002	0.003
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	167	.	166	.	158	.	162
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	56	31	31	32	32	31	30	32
Chloride	.	1	.	1	.	1	.	1
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	<0.1
Magnesium	35	20	20	20	20	19	19	20
Manganese	0.0012	0.0022	0.0028	0.0015	<0.001	0.0018	0.0016	0.0052
Nitrate-N	.	<0.2	.	<0.2	.	<0.2	.	<0.2
Potassium	1.3	1.3	1.3	1.8	1.9	1.6	1.9	1.7
Sodium	0.82	0.62	0.69	0.7	0.84	0.7	2.1	0.76
Sulfate	.	1	.	1	.	2	.	1

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-181	GW-184				GW-186		
Location	CRSP	RQ				RQ		
Date Sampled	10/08/91	09/08/91		11/18/91		09/08/91		11/18/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
Aluminum	0.033	<0.02	0.029	0.028	<0.02	0.021	<0.02	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0078	0.028	0.032	0.025	0.026	0.12	0.12	0.13
Beryllium	<0.0003	<0.0003	0.00035	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.023	0.069	0.048	0.041	0.03	0.13	0.13	0.15
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	0.0079	0.02	0.0078	<0.004	<0.004	<0.004
Iron	0.023	0.039	0.068	0.026	<0.005	0.88	0.88	0.82
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00031	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	.	.	.	.	.	.	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.02	0.19	0.22	0.2	0.2	1.7	1.7	1.8
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0086	0.0091	0.015	0.013	0.013	0.004	0.0071	0.0044
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	202	.	198	.	388	.	388
Alkalinity-CO3	.	<1	.	<1	.	<1	.	<1
Calcium	33	88	83	88	92	110	110	120
Chloride	.	1	.	1.5	.	13	.	13.6
Fluoride	.	<0.1	.	<0.1	.	0.1	.	0.1
Magnesium	20	9	9.5	9.8	10	34	34	34
Manganese	0.0031	0.0064	0.015	0.018	0.016	0.16	0.16	0.15
Nitrate-N	.	7.2	.	5.1	.	<0.2	.	<1.1
Potassium	1.9	1.3	1.4	1.9	1.8	2.6	2.8	3.3
Sodium	0.77	1.7	1.7	2.1	2.1	26	25	35
Sulfate	.	27	.	28.8	.	67	.	70.2

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-322			GW-339				
Location	CRSP			UNCS				
Date Sampled	08/13/91	10/21/91		01/13/91		04/13/91		07/30/91
	DIS	TOT	DIS	TOT	DIS	TOT	DIS	TOT
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	3.5	<0.02	0.052	<0.02	<0.02	0.034	<0.03
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0084	0.02	0.0089	0.023	0.021	0.02	0.02	0.02
Beryllium	<0.0003	0.00092	<0.0003	<0.0003	<0.0003	<0.0003	0.00035	<0.0003
Boron	0.017	0.017	0.02	0.0091	0.045	0.032	0.0073	0.0061
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.021
Chromium	<0.01	<0.01	<0.01	0.013	<0.01	0.023	<0.01	0.021
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.011	<0.004	<0.004	<0.004	<0.004	0.0045	0.0064
Iron	<0.005	5.8	<0.005	0.075	0.0069	0.063	0.0086	0.64
Lead (AAS)	<0.004	0.024	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	0.024	0.023	0.028	0.02	0.043
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.7	.	.	5.3	5	3.1	4.5	4.2
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.011	0.017	0.012	0.028	0.027	0.023	0.024	0.026
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Vanadium	<0.005	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0041	0.099	0.0052	0.0019	<0.001	0.0049	0.012	<0.002
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	164	.	250	.	252	.	.
Alkalinity-CO3	.	<1	.	<1	.	<1	.	.
Calcium	34	50	32	52	55	45	41	54
Chloride	.	2	.	20	.	17	.	.
Fluoride	.	<0.1	.	<0.1	.	<0.1	.	.
Magnesium	20	33	19	31	33	29	30	31
Manganese	<0.001	0.11	<0.001	0.0063	0.0062	0.0041	0.0041	0.016
Nitrate-N	.	<0.2	.	0.9	.	0.9	.	.
Potassium	<0.6	1.5	<0.6	1.1	1.2	1.1	0.98	0.95
Sodium	0.57	0.6	0.59	7.5	8	8.2	9.2	8.1
Sulfate	.	1	.	5	.	4	.	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-339				GW-511			
Location	UNCS				CRSP			
Date Sampled	07/30/91	08/13/91	10/06/91		01/29/91		04/30/91	
	DIS	TOT	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	.	0.052	<0.02	0.041	0.044	0.052	<0.02
Antimony	<0.05	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.018	.	0.021	0.021	0.008	0.0082	0.0076	0.0078
Beryllium	<0.0003	.	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.011	.	0.012	0.013	0.012	0.02	<0.004	0.0094
Cadmium (AAS)	<0.002	.	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	.	<0.003	<0.003	0.0045	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	.	0.011	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	.	<0.01	0.022	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	.	<0.004	0.0043	<0.004	<0.004	0.0044	0.0094
Iron	<0.005	.	0.29	0.19	0.021	0.0043	0.031	<0.005
Lead (AAS)	<0.004	.	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	.	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	.	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	.	0.015	0.018	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	.	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	4.2	.	.	.	4.6	5.1	4	4
Silver	<0.006	.	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.023	.	0.023	0.022	0.044	0.045	0.042	0.042
Thorium	<0.2	.	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	.	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Vanadium	<0.005	.	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.002	.	0.0072	0.075	0.0036	0.0028	0.0031	0.0025
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	.	249	243	.	145	.	141	.
Alkalinity-CO3	.	<1	<1	.	4	.	<1	.
Calcium	52	.	60	60	26	26	27	27
Chloride	.	9	14	.	3	.	3	.
Fluoride	.	<0.1	<0.1	.	<0.1	.	<0.1	.
Magnesium	31	.	31	31	16	16	16	16
Manganese	<0.001	.	0.0086	0.0064	<0.001	<0.001	<0.001	<0.001
Nitrate-N	.	0.86	0.74	.	<0.2	.	<0.2	.
Potassium	0.89	.	0.96	1.1	4.8	5	5.8	5.2
Sodium	8.8	.	7	7.4	1.6	2	1.6	1.5
Sulfate	.	4	4	.	2	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-511				GW-512			
Location	CRSP				ADB			
Date Sampled	08/05/91		10/08/91		03/19/91		06/16/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	0.061	0.024	<0.02	0.02	0.05	0.067	0.25	0.043
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.0084	0.0075	0.0082	0.0085	0.031	0.027	0.026	0.024
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	0.00034	0.00032	<0.0003	<0.0003
Boron	<0.004	<0.004	0.031	0.023	0.037	0.028	0.023	0.02
Cadmium (AAS)	<0.002	<0.023	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	0.023	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	0.007	<0.004	<0.004	<0.004	<0.004	0.0062	0.0053
Iron	0.032	<0.005	0.016	<0.005	0.11	<0.005	0.23	0.032
Lead (AAS)	<0.004	<0.0045	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.039
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.8	3.5	.	.	6	5.9	6.1	5.6
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.045	0.045	0.05	0.051	0.023	0.022	0.024	0.022
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	0.0064	<0.005	<0.005	<0.005
Zinc	<0.002	0.026	0.004	0.0051	0.017	0.006	0.017	0.0094
MAJOR IONS (mg/L)								
Alkalinity-HCO3	123	.	122	.	173	.	171	.
Alkalinity-CO3	4	.	4	.	<1	.	<1	.
Calcium	25	25	25	25	33	33	32	32
Chloride	3	.	3	.	<1	.	<1	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	0.2	.
Magnesium	15	15	15	15	20	20	19	18
Manganese	<0.001	<0.001	<0.001	<0.001	0.0036	<0.001	0.0045	<0.001
Nitrate-N	<0.2	.	<0.2	.	<0.2	.	<0.2	.
Potassium	5.8	5.1	5.8	8	3.8	4.4	3.3	3.4
Sodium	1.5	1.4	1.7	2.3	0.92	0.91	0.83	0.96
Sulfate	1.8	.	2	.	3	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-512				GW-513			
Location	ADB				ADB			
Date Sampled	09/06/91		11/16/91		03/19/91		06/16/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	0.22	<0.02	0.04	0.55	<0.02	0.026	0.087	0.037
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.024	0.025	0.024	0.033	0.0061	0.0068	0.0081	0.0072
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	0.00033	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.016	0.016	0.0083	0.016	0.026	0.018
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	0.0079	<0.004	<0.004	0.0041	<0.004
Iron	0.15	<0.005	0.023	1.6	0.039	<0.005	0.085	0.013
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	.	.	.	4.1	4.2	4.1	4.2
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.021	0.026	0.022	0.026	0.021	0.021	0.02	0.02
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.016	0.011	0.016	0.023	<0.002	<0.002	0.01	0.0061
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	160	.	157	.	174	.	171	.
Alkalinity-CO3	<1	.	<1	.	2	.	<1	.
Calcium	35	38	36	38	33	34	32	32
Chloride	<1	.	<1	.	1	.	1	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	20	21	22	23	20	21	18	18
Manganese	0.0048	0.0033	0.0012	0.024	<0.001	<0.001	<0.001	<0.001
Nitrate-N	<0.2	.	<0.2	.	<0.2	.	<0.2	.
Potassium	3.9	4.1	2.9	3.6	1.4	1.3	1.5	1.6
Sodium	1.1	1.1	1	1.2	0.59	0.59	1	0.92
Sulfate	3	.	3.9	.	2	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-545				GW-546			
Location	LIIX				LIIX			
Date Sampled	09/15/91		11/26/91		03/17/91		04/11/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	4.3	1	1.7	1.5	<0.02	0.028	<0.02	0.045
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.039	0.015	0.02	0.024	0.0057	0.0052	0.026	0.013
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.017	0.014	0.017	0.013	0.0097	0.035	0.036	0.052
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	0.014	0.013	0.019	0.019	<0.01	<0.01	<0.01	<0.01
Chromium	0.03	0.024	0.025	0.023	<0.01	<0.01	0.049	0.057
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.015	0.014	0.0061	0.0065	0.0072	0.0041	0.0098	0.0088
Iron	1.5	0.034	0.11	0.0059	0.052	0.015	0.035	0.012
Lead (AAS)	0.0071	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	0.023	0.021	0.039	0.04	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	.	.	.	4.3	4.7	4	4.2
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.14	0.11	0.098	0.097	0.018	0.017	0.039	0.024
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.021	0.013	0.024	0.025	<0.005	<0.005	0.0051	0.0062
Zinc	0.02	0.019	0.013	0.0078	0.0095	0.0087	0.011	0.014
MAJOR IONS (mg/L)								
Alkalinity-HCO3	<1	.	<1	.	139	.	132	.
Alkalinity-CO3	30	.	36	.	<1	.	<1	.
Calcium	110	66	62	59	28	27	25	23
Chloride	2	.	2	.	2	.	2	.
Fluoride	0.1	.	0.1	.	<0.1	.	<0.1	.
Magnesium	11	0.083	0.86	0.02	16	15	16	15
Manganese	0.038	<0.001	0.003	<0.001	0.003	<0.001	<0.001	<0.001
Nitrate-N	0.64	.	0.63	.	<0.2	.	<0.2	.
Potassium	21	21	18	19	1.8	1.8	1.4	1.8
Sodium	5.2	5.5	5.4	7	1.9	2.1	2.4	2.6
Sulfate	13	.	18	.	7	.	6	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-546				GW-607			
Location	LIIX				CRSP			
Date Sampled	09/15/91		11/26/91		01/28/91		04/29/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	5.6	0.042	1.8	<0.02	0.081	0.03	0.083	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.025	0.0097	0.013	0.0086	0.0097	0.0092	0.006	0.0091
Beryllium	0.00067	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.012	0.037	0.0086	0.022	0.01	0.012	<0.004	0.021
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	0.012	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	0.018	0.017	0.01	<0.01	0.034	<0.01	0.079	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.016	0.0067	0.012	0.0077	<0.004	<0.004	<0.004	<0.004
Iron	6.6	0.055	1.7	0.0061	0.07	0.018	0.057	<0.005
Lead (AAS)	0.016	<0.004	0.0056	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	0.0004	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.011	<0.01	0.011	<0.01	0.026	<0.01	0.015	0.011
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	.	.	.	.	1.8	3.8	3.4	3.9
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.035	0.016	0.021	0.018	0.031	0.031	0.024	0.029
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	0.018	<0.005	<0.005	<0.005	<0.005	<0.005	0.0051	<0.005
Zinc	0.09	0.015	0.025	0.0087	0.0045	0.0026	0.0085	0.0021
MAJOR IONS (mg/L)								
Alkalinity-HCO3	130	.	139	.	130	.	121	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.
Calcium	74	29	34	29	26	26	23	25
Chloride	<0.2	.	2	.	1	.	1	.
Fluoride	<0.1	.	0.1	.	<0.1	.	<0.1	.
Magnesium	41	16	20	16	14	14	13	13
Manganese	0.54	<0.001	0.075	<0.001	0.0024	<0.001	0.0027	<0.001
Nitrate-N	<0.2	.	<0.2	.	<0.2	.	<0.2	.
Potassium	4	2.1	2.9	3.7	2.7	2.8	2.8	3.3
Sodium	2.6	2.4	2.8	4.6	1	0.9	0.89	0.79
Sulfate	6	.	5	.	2	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-607				GW-608			
Location	CRSP				CRSP			
Date Sampled	08/06/91		10/08/91		01/28/91		04/29/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	0.095	0.03	0.047	<0.02	<0.02	0.027	<0.02	0.022
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.011	0.011	0.01	0.01	0.012	0.01	0.0053	0.0078
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	0.00031	<0.0003
Boron	<0.004	<0.004	0.013	0.023	0.069	0.03	0.032	0.048
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.071	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.0061
Iron	0.039	<0.005	0.015	<0.005	0.63	0.043	1.7	0.062
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.6	3.6	.	.	2.9	3.1	1	1.1
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.042	0.041	0.039	0.039	0.018	0.018	0.013	0.015
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.002	<0.002	0.0028	<0.002	0.0058	0.0049	0.0088	0.024
MAJOR IONS (mg/L)								
Alkalinity-HCO3	129	.	127	.	147	.	122	.
Alkalinity-CO3	8	.	8	.	<1	.	<1	.
Calcium	28	27	29	29	29	29	16	17
Chloride	<1	.	<1	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	15	15	15	15	18	17	17	18
Manganese	0.0099	<0.001	<0.001	<0.001	0.047	0.042	0.26	0.25
Nitrate-N	<0.2	.	<0.2	.	0.4	.	<0.2	.
Potassium	5.1	5.1	6.6	5.4	1.6	1.5	2.7	3.1
Sodium	1.6	1.2	1.3	1.1	0.93	0.84	0.82	0.99
Sulfate	2	.	1	.	2	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-608				GW-609			
Location	CRSP				CRSP			
Date Sampled	08/07/91		10/12/91		01/15/91		04/22/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	<0.02	<0.02	0.023	<0.02	0.033	0.028	0.043	0.038
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.012	0.012	0.013	0.013	0.011	0.011	0.0092	0.0076
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.035	0.022	0.013	0.013	0.012	0.021
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	0.0035	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	<0.004	0.0041	<0.004	<0.004	<0.004
Iron	0.11	<0.005	0.078	<0.005	0.021	0.0065	0.03	<0.005
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.011
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.6	3.2	.	.	4.1	4	3.8	3.8
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.013	0.013	0.012	0.012	0.014	0.013	0.013	0.013
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.007	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.002	<0.002	0.0035	0.0059	0.011	0.0093	0.014	0.013
MAJOR IONS (mg/L)								
Alkalinity-HCO3	145	.	143	.	187	.	191	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.
Calcium	30	30	30	30	34	34	35	34
Chloride	1	.	1.3	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	18	18	18	18	21	21	21	21
Manganese	0.0016	<0.001	0.0024	0.0016	<0.001	<0.001	<0.001	<0.001
Nitrate-N	0.33	.	0.3	.	0.9	.	0.9	.
Potassium	0.86	0.85	1.6	2.2	1.3	1.1	0.9	0.85
Sodium	0.51	0.52	0.75	0.94	0.67	0.59	0.66	0.65
Sulfate	2	.	2.4	.	2	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-609				GW-610			
Location	CRSP				CRSP			
Date Sampled	08/09/91		10/14/91		01/30/91		05/01/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Aluminum	<0.02	0.024	<0.02	<0.02	0.093	<0.02	0.032	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.011	0.011	0.011	0.011	0.079	0.074	0.11	0.11
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.03	<0.004	<0.004	<0.004	<0.004	<0.004
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	0.0022	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	0.0041	<0.004	<0.004	<0.004	<0.004
Iron	0.011	<0.005	0.0085	<0.005	0.19	<0.005	0.04	0.006
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.018	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	1.2	1.7	.	.	4	3.8	4.1	4.1
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.014	0.013	0.014	0.013	0.016	0.015	0.019	0.018
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.016	0.0079	0.011	0.01	0.0036	<0.002	<0.002	<0.002
	.	.	.	.	.	.	.	.
MAJOR IONS (mg/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Alkalinity-HCO3	177	.	184	.	188	.	199	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.
Calcium	37	38	39	39	35	34	40	39
Chloride	1.4	.	1	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	21	22	23	23	22	22	24	24
Manganese	<0.001	<0.001	0.0017	<0.001	0.011	0.0061	0.0026	0.0015
Nitrate-N	1	.	0.93	.	0.6	.	0.5	.
Potassium	1	1.1	1.1	1.5	<0.6	<0.6	<0.6	<0.6
Sodium	0.66	0.64	0.86	0.89	0.75	0.64	0.52	0.54
Sulfate	1.9	.	2	.	1	.	<1	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-610				GW-611			
Location	CRSP				CRSP			
Date Sampled	08/06/91		10/10/91		01/31/91		05/01/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	0.02	<0.02	0.027	<0.02	0.27	<0.02	0.11	0.022
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	0.061	<0.05	<0.05
Barium	0.082	0.081	0.066	0.07	0.026	0.024	0.02	0.022
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.033	0.017	<0.004	<0.004	0.04	<0.004
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	0.0045	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	0.014	0.014	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Iron	0.066	<0.005	0.012	<0.005	1.4	0.01	0.17	<0.005
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	0.0074	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	0.021	0.011	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.8	3.8	.	.	4.4	4.2	4.3	4.4
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.015	0.015	0.017	0.018	0.021	0.016	0.021	0.021
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	0.001	<0.001	<0.001	0.001	0.001	<0.001	0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.002	<0.002	0.0027	0.0056	0.013	<0.001	<0.002	<0.002
MAJOR IONS (mg/L)								
Alkalinity-HCO3	178	.	187	.	246	.	253	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.
Calcium	36	36	37	39	63	56	51	49
Chloride	2	.	2	.	1	.	1	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	21	21	22	23	33	32	31	31
Manganese	0.0045	0.0035	0.005	0.0046	0.027	<0.001	0.0025	<0.001
Nitrate-N	0.5	.	<0.2	.	3	.	3	.
Potassium	<0.6	<0.6	<0.6	<0.6	0.69	0.61	1	1.4
Sodium	0.78	0.79	0.77	0.68	<0.02	<0.02	1.1	1.4
Sulfate	<1	.	<1	.	2	.	1	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-611				GW-612			
Location	CRSP				CRSP			
Date Sampled	08/08/91		10/13/91		02/07/91		05/08/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	0.033	<0.02	0.03	<0.02	0.068	0.072	<0.02	<0.02
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	0.066	<0.05	<0.05
Barium	0.016	0.016	0.015	0.017	0.018	0.017	0.014	0.014
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	<0.004	<0.004	0.0072	0.008	0.13	0.049	0.15	0.13
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	<0.004	<0.004	<0.004	0.0046	0.0091	<0.004	0.0087	<0.004
Iron	0.044	<0.005	0.046	<0.005	0.16	<0.005	0.33	<0.005
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	0.025	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	1.4	1.5	.	.	3.8	1.2	3.8	3.6
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.016	0.016	0.015	0.016	0.015	0.014	0.015	0.015
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	0.001	<0.001	0.001	0.001	0.001	0.001	<0.001
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	<0.002	<0.002	0.01	0.0092	0.023	0.0053	<0.002	<0.002
MAJOR IONS (mg/L)								
Alkalinity-HCO3	232	.	231	.	205	.	203	.
Alkalinity-CO3	<1	.	<1	.	<1	.	<1	.
Calcium	51	50	51	51	37	37	33	33
Chloride	3	.	4	.	2	.	2	.
Fluoride	<0.1	.	<0.1	.	<0.1	.	<0.1	.
Magnesium	28	28	30	30	25	25	24	24
Manganese	<0.001	<0.001	<0.001	<0.001	0.0066	0.0042	0.014	0.012
Nitrate-N	3	.	2.12	.	0.3	.	0.3	.
Potassium	0.83	0.69	0.88	1.1	1.3	0.84	1	<0.6
Sodium	2	1.6	2.5	1.8	0.85	0.8	0.51	0.5
Sulfate	3	.	4	.	3	.	2	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-612				GW-709			
Location	CRSP				LII			
Date Sampled	08/12/91		10/17/91		06/19/91		09/11/91	
	TOT	DIS	TOT	DIS	TOT	DIS	TOT	DIS
METALS (mg/L)								
Aluminum	<0.02	<0.02	<0.02	<0.02	0.022	0.02	<0.02	0.028
Antimony	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	0.011	0.011	0.014	0.014	0.1	0.11	0.033	0.1
Beryllium	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Boron	0.18	0.16	0.16	0.16	0.0081	0.0089	0.0085	0.034
Cadmium (AAS)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Cadmium	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Chromium (AAS)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cobalt	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Copper	0.013	0.0092	<0.004	<0.004	0.0049	<0.004	<0.004	<0.004
Iron	0.15	0.012	0.091	<0.005	0.019	<0.005	0.12	<0.005
Lead (AAS)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
Mercury (CVAA)	<0.0002	<0.0002	<0.0002	<0.0002	0.00022	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Silicon	3.9	4	.	.	3.7	3.6	.	.
Silver	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Strontium	0.015	0.015	0.015	0.015	0.052	0.071	0.015	0.049
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Uranium (Fluor)	0.001	0.001	0.001	<0.001	0.002	0.002	0.001	0.002
Vanadium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc	0.0078	0.0031	0.011	0.0038	0.004	<0.002	0.0066	0.0049
MAJOR IONS (mg/L)								
Alkalinity-HCO3	198	.	206	.	108	.	166	.
Alkalinity-CO3	<1	.	<1	.	4	.	<1	.
Calcium	39	39	39	39	18	18	3.9	12
Chloride	2	.	2	.	1	.	1	.
Fluoride	<0.1	.	<0.1	.	0.1	.	<0.1	.
Magnesium	26	26	26	27	16	16	6.1	19
Manganese	0.0052	0.0034	0.0039	0.0026	<0.001	0.001	<0.001	<0.001
Nitrate-N	0.25	.	0.28	.	<0.2	.	<0.2	.
Potassium	0.64	0.66	0.97	0.69	3.3	3.3	0.76	2.5
Sodium	0.42	0.42	0.67	0.78	3.2	3.3	0.65	2.4
Sulfate	2	.	3	.	7	.	4	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-166	GW-173				GW-174		
Location	CRDT	CRSP				CRSP		
Date Sampled	06/08/91	02/01/91	05/03/91	08/06/91	10/10/91	02/01/91	05/03/91	08/06/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	1	1	1
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	5	3	3
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	G	11	12	11	13	39	35	36
Toluene	G	G	G	G	2	G	G	G
1,1,1-Trichloroethane	G	G	0.6	G	G	3	3	3
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	1	1
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-174	GW-175				GW-176		
Location	CRSP	CRSP				CRSP		
Date Sampled	10/11/91	01/31/91	05/01/91	08/08/91	10/13/91	02/04/91	05/04/91	08/09/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	65	61	25
1,2-Dichloroethane	G	G	G	G	G	1	2	G
1,1-Dichloroethene	G	G	G	2	G	21	24	13
1,2-Dichloroethene	3	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	34	23	5	41	25	7	7	6
Toluene	G	G	G	G	G	G	G	G
1,1,1-Trichloroethane	2	8	5	11	6	110	150	90
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	1	G	G	1	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-176	GW-177				GW-178		
Location	CRSP	CRSP				CRSP		
Date Sampled	10/14/91	02/02/91	05/03/91	08/08/91	10/13/91	01/15/91	04/22/91	08/08/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Acetone	3	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	4	5	3
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	20	7	5	8	11	4	6	6
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	12	G	1	2	3	G	2	2
1,2-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	1	G	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	5	G	G	G	1	G	2	G
Toluene	G	G	G	G	G	G	G	G
1,1,1-Trichloroethane	63	12	10	19	27	23	25	34
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-178	GW-179				GW-180		
Location	CRSP	CRSP				CRSP		
Date Sampled	10/13/91	02/08/91	05/08/91	08/12/91	10/17/91	02/02/91	05/04/91	08/09/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	V	V	V	N	N	N	N
Benzene	G	N	N	N	G	G	G	G
Bromodichloromethane	G	N	N	N	G	G	G	G
Bromoform	G	N	N	N	G	G	G	G
Bromomethane	N	V	V	V	N	N	N	N
2-Butanone	N	V	V	V	N	N	N	N
Carbon disulfide	G	N	N	N	G	G	G	G
Carbon tetrachloride	G	N	N	N	G	G	G	G
Chlorobenzene	G	N	N	N	G	G	G	G
Chlorodibromomethane	G	N	N	N	G	G	G	G
Chloroethane	N	V	V	V	N	N	N	N
Chloroform	G	N	N	N	G	G	G	G
Chloromethane	N	V	V	V	N	N	N	N
1,1-Dichloroethane	5	89	99	90	75	G	4	5
1,2-Dichloroethane	G	N	N	N	G	G	G	G
1,1-Dichloroethene	2	44	43	31	36	G	G	3
1,2-Dichloroethene	G	N	N	N	G	4	6	G
1,2-Dichloropropane	G	N	N	N	G	G	G	G
cis-1,3-Dichloropropene	G	N	N	N	G	G	G	G
trans-1,3-Dichloropropene	G	N	N	N	G	G	G	G
Ethylbenzene	G	N	N	N	G	G	G	G
2-Hexanone	N	V	V	V	N	N	N	N
4-Methyl-2-pentanone	N	V	V	V	N	N	N	N
Methylene chloride	G	N	N	N	G	G	G	G
Styrene	G	N	N	N	G	G	G	G
1,1,2,2-Tetrachloroethane	G	N	N	N	G	G	G	G
Tetrachloroethene	G	.5	4	3	4	61	73	68
Toluene	G	N	N	N	3	G	G	G
1,1,1-Trichloroethane	27	220	230	170	170	2	3	3
1,1,2-Trichloroethane	G	N	N	N	G	G	G	G
Trichloroethene	G	N	N	N	G	1	2	2
Vinyl acetate	N	V	V	V	N	N	N	N
Vinyl chloride	N	V	V	V	N	N	N	N
Xylenes	G	N	N	N	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-180	GW-181				GW-184		GW-186
Location	CRSP	CRSP				RQ		RQ
Date Sampled	10/14/91	01/29/91	04/30/91	08/05/91	10/08/91	09/08/91	11/18/91	09/08/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	2	G	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	1	G	G	G	1	G	1	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	58	G	G	G	G	G	G	G
Toluene	G	G	G	G	G	0.4	G	0.9
1,1,1-Trichloroethane	2	G	G	G	G	G	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	1	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-186	GW-187		GW-188		GW-203		
Location	RQ	RQ		RQ		UNCS		
Date Sampled	11/18/91	09/09/91	11/19/91	09/09/91	11/19/91	01/12/91	04/12/91	07/29/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	5	N	N
Methylene chloride	G	G	G	0.7	G	G	G	16
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	G	G	G	G	G	G	G	G
Toluene	G	G	G	0.7	G	G	G	G
1,1,1-Trichloroethane	G	G	G	G	G	G	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-303			GW-304				GW-305
Location	CRSDB			CRSDB				LIV
Date Sampled	06/04/91	08/24/91	11/02/91	02/28/91	06/01/91	08/23/91	11/02/91	01/06/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
Acetone	N	N	N	N	N	14	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	G	G	G	G	G	G	G	G
Toluene	G	G	1	G	G	G	1	G
1,1,1-Trichloroethane	G	G	G	G	G	G	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-305			GW-321				GW-322
Location	LIV			ADB				CRSP
Date Sampled	04/03/91	07/15/91	10/01/91	03/22/91	06/18/91	09/07/91	11/17/91	02/04/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	Z
Bromodichloromethane	G	G	G	G	G	G	G	Z
Bromoform	G	G	G	G	G	G	G	Z
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	Z
Carbon tetrachloride	G	G	G	G	G	G	G	Z
Chlorobenzene	G	G	G	G	G	G	G	Z
Chlorodibromomethane	G	G	G	G	G	G	G	Z
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	0.8	G	G	G	G	G	G	Z
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	G	G	62
1,2-Dichloroethane	G	G	G	G	G	G	G	Z
1,1-Dichloroethene	G	G	G	G	G	G	G	130
1,2-Dichloroethene	G	G	G	G	G	G	G	Z
1,2-Dichloropropane	G	G	G	G	G	G	G	Z
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	Z
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	Z
Ethylbenzene	G	G	0.5	G	G	G	G	Z
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	G	17	G	G	Z
Styrene	G	G	G	G	G	G	G	Z
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	Z
Tetrachloroethene	G	G	G	G	G	G	G	8
Toluene	G	G	4	G	G	G	G	Z
1,1,1-Trichloroethane	G	G	G	G	G	G	G	480
1,1,2-Trichloroethane	G	G	G	G	G	G	G	Z
Trichloroethene	G	G	G	G	G	G	G	Z
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	Z

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-322			GW-339				
Location	CRSP			UNCS				
Date Sampled	05/04/91	08/13/91	10/21/91	01/13/91	04/13/91	07/30/91	08/13/91	10/06/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Acetone	M	A	M	N	N	N	.	N
Benzene	Z	V	Z	G	G	G	.	G
Bromodichloromethane	Z	V	Z	G	G	G	.	G
Bromoform	Z	V	Z	G	G	G	.	G
Bromomethane	M	A	M	N	N	N	.	N
2-Butanone	M	A	M	N	N	N	.	N
Carbon disulfide	Z	V	Z	G	G	G	.	G
Carbon tetrachloride	Z	V	Z	G	G	G	.	G
Chlorobenzene	Z	V	Z	G	G	G	.	G
Chlorodibromomethane	Z	V	Z	G	G	G	.	G
Chloroethane	M	A	M	N	N	N	.	N
Chloroform	Z	V	Z	G	2	0.9	.	0.7
Chloromethane	M	A	M	N	N	N	.	N
1,1-Dichloroethane	60	78	64	G	G	G	.	G
1,2-Dichloroethane	Z	V	Z	G	G	G	.	G
1,1-Dichloroethene	110	110	100	G	G	G	.	G
1,2-Dichloroethene	Z	V	Z	G	G	G	.	G
1,2-Dichloropropane	Z	V	Z	G	G	G	.	G
cis-1,3-Dichloropropene	Z	V	Z	G	G	G	.	G
trans-1,3-Dichloropropene	Z	V	Z	G	G	G	.	G
Ethylbenzene	Z	V	Z	G	G	G	.	G
2-Hexanone	M	A	M	N	N	N	.	N
4-Methyl-2-pentanone	M	A	M	7	N	N	.	N
Methylene chloride	Z	V	Z	G	G	G	.	G
Styrene	Z	V	Z	G	G	G	.	G
1,1,2,2-Tetrachloroethane	Z	V	Z	G	G	G	.	G
Tetrachloroethene	Z	7	6	G	G	G	.	G
Toluene	Z	V	Z	G	G	G	.	2
1,1,1-Trichloroethane	480	460	370	G	G	G	.	G
1,1,2-Trichloroethane	Z	V	Z	G	G	G	.	G
Trichloroethene	Z	V	Z	G	G	G	.	G
Vinyl acetate	M	A	M	N	N	N	.	N
Vinyl chloride	M	A	M	N	N	N	.	N
Xylenes	Z	V	Z	G	G	G	.	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-511				GW-512			
Location	CRSP				ADB			
Date Sampled	01/29/91	04/30/91	08/05/91	10/08/91	03/19/91	06/16/91	09/06/91	11/16/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	1	G	G	G	1
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	G	G	G	G	G	G	G	G
Toluene	0.6	G	G	G	G	G	G	G
1,1,1-Trichloroethane	G	G	G	G	G	0.5	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-611				GW-612			
Location	CRSP				CRSP			
Date Sampled	01/31/91	05/01/91	08/08/91	10/13/91	02/07/91	05/08/91	08/12/91	10/17/91
VOLATILE ORGANICS (ug/L)	.	.	.	.	.	.	.	.
Acetone	N	N	N	N	N	V	V	V
Benzene	G	G	G	G	G	N	N	N
Bromodichloromethane	G	G	G	G	G	N	N	N
Bromoform	G	G	G	G	G	N	N	N
Bromomethane	N	N	N	N	N	V	V	V
2-Butanone	N	N	N	N	N	V	V	V
Carbon disulfide	G	G	G	G	G	N	N	N
Carbon tetrachloride	G	G	G	2	G	N	N	N
Chlorobenzene	G	G	G	G	G	N	N	N
Chlorodibromomethane	G	G	G	G	G	N	N	N
Chloroethane	N	N	N	N	N	V	V	V
Chloroform	G	G	G	G	G	N	N	N
Chloromethane	N	N	N	N	N	V	V	V
1,1-Dichloroethane	1	G	1	2	130	130	120	110
1,2-Dichloroethane	G	G	G	G	4	4	5	3
1,1-Dichloroethene	G	G	G	2	60	57	69	50
1,2-Dichloroethene	G	G	G	G	G	N	N	N
1,2-Dichloropropane	G	G	G	G	G	N	N	N
cis-1,3-Dichloropropene	G	G	G	G	G	N	N	N
trans-1,3-Dichloropropene	G	G	G	G	G	N	N	N
Ethylbenzene	G	G	G	G	G	N	N	N
2-Hexanone	N	N	N	N	N	V	V	V
4-Methyl-2-pentanone	N	N	N	N	N	V	V	7
Methylene chloride	G	G	G	1	G	N	N	N
Styrene	G	G	G	G	G	N	N	N
1,1,2,2-Tetrachloroethane	G	G	G	G	G	N	N	N
Tetrachloroethene	G	G	G	G	12	9	11	11
Toluene	G	G	G	G	1	N	N	6
1,1,1-Trichloroethane	14	10	8	G	240	270	290	220
1,1,2-Trichloroethane	G	G	G	G	G	N	N	N
Trichloroethene	G	G	G	G	G	N	1	N
Vinyl acetate	N	N	N	N	N	V	V	V
Vinyl chloride	N	N	N	N	N	V	V	V
Xylenes	G	G	G	G	3	N	N	N

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-709			GW-731		GW-732	
Location	LII			CRSDB		CRSDB	
Date Sampled	06/19/91	09/11/91	11/21/91	09/27/91	10/31/91	09/27/91	10/30/91
VOLATILE ORGANICS (ug/L)							
Acetone	N	N	N	77	40	N	N
Benzene	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N
Chloroform	1	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G
1,2-Dichloroethene	G	G	G	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	3
Methylene chloride	16	G	G	G	G	G	G
Styrene	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G
Tetrachloroethene	G	G	G	G	G	G	G
Toluene	G	0.9	G	3	0.8	3	2
1,1,1-Trichloroethane	G	G	G	G	G	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G
Trichloroethene	G	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G

Groundwater Quality Data, 1991

Well No.	GW-609				GW-610			
Location	CRSP				CRSP			
Date Sampled	01/15/91	04/22/91	08/09/91	10/14/91	01/30/91	05/01/91	08/06/91	10/10/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	N	N	N	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	5	3	1	G	G	G	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	G	G
1,2-Dichloroethene	21	51	30	12	G	G	G	G
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	N	N	N	N	N
Methylene chloride	G	G	G	1	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	14	58	37	15	1	G	G	1
Toluene	G	G	G	G	G	G	G	2
1,1,1-Trichloroethane	1	4	2	0.9	G	G	G	G
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	2	7	4	2	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-607				GW-608			
Location	CRSP				CRSP			
Date Sampled	01/28/91	04/29/91	08/06/91	10/08/91	01/28/91	04/29/91	08/07/91	10/12/91
VOLATILE ORGANICS (ug/L)								
Acetone	N	N	N	9	N	N	N	N
Benzene	G	G	G	G	G	G	G	G
Bromodichloromethane	G	G	G	G	G	G	G	G
Bromoform	G	G	G	G	G	G	G	G
Bromomethane	N	N	N	N	N	N	N	N
2-Butanone	N	N	N	N	N	N	N	N
Carbon disulfide	G	G	G	G	G	G	G	G
Carbon tetrachloride	G	G	G	G	G	G	G	G
Chlorobenzene	G	G	G	G	G	G	G	G
Chlorodibromomethane	G	G	G	G	G	G	G	G
Chloroethane	N	N	N	N	N	N	N	N
Chloroform	G	G	G	G	G	G	G	G
Chloromethane	N	N	N	N	N	N	N	N
1,1-Dichloroethane	G	G	G	G	3	2	2	G
1,2-Dichloroethane	G	G	G	G	G	G	G	G
1,1-Dichloroethene	G	G	G	G	G	G	2	2
1,2-Dichloroethene	G	G	G	G	G	G	G	2
1,2-Dichloropropane	G	G	G	G	G	G	G	G
cis-1,3-Dichloropropene	G	G	G	G	G	G	G	G
trans-1,3-Dichloropropene	G	G	G	G	G	G	G	G
Ethylbenzene	G	G	G	G	G	G	G	G
2-Hexanone	N	N	N	N	N	N	N	N
4-Methyl-2-pentanone	N	N	N	2	N	N	N	N
Methylene chloride	G	G	G	1	G	G	G	G
Styrene	G	G	G	G	G	G	G	G
1,1,2,2-Tetrachloroethane	G	G	G	G	G	G	G	G
Tetrachloroethene	G	G	G	G	3	G	5	7
Toluene	G	G	G	G	G	G	G	G
1,1,1-Trichloroethane	G	G	G	G	9	9	9	9
1,1,2-Trichloroethane	G	G	G	G	G	G	G	G
Trichloroethene	G	9	G	G	G	G	G	G
Vinyl acetate	N	N	N	N	N	N	N	N
Vinyl chloride	N	N	N	N	N	N	N	N
Xylenes	G	G	G	G	G	G	G	G

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-161		GW-165		GW-166		GW-173	
Location	LIII		CRDT		CRDT		CRSP	
Date Sampled	08/21/91	10/25/91	02/27/91	06/07/91	02/24/91	06/08/91	02/01/91	05/03/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	5.2	5.6	3.9	3.1	2.7	2.7	8.5	7.3
pH, Field (pH units)	7.5	7.3	7.8	7.7	8.3	7.8	6.9	7.5
Redox, Field (mV)	76	157	270	310	295	236	310	330
Sp. Cond., Field (umho/cm)	331	342	242	245	210	210	328	358
Temp, Field (degrees C)	16.5	15.5	13.1	15.3	13.7	14.1	13.6	15.6
COD (mg/L)	<5	<5	.	.	.	.	.	.
Cyanide (mg/L)	<0.1	<0.1	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	8	7.6	6.8	5.9	6.8	5.9	6.8	6.4
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	409	390	241	255	192	252	343	351
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	2	<1	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	<10	<10	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	192	190	172	192	146	166	200	202
TSS (mg/L)	<1	<1	72	122	1	2	4	4
Turbidity (NTU)	4	3.3	90	100	3.1	4.4	5.8	3.7
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.88	2.30	1.17	3.03	0.49	3.01	0.99	0.87
Gross Alpha (CE+/-)	1.60	2.00	1.30	1.60	1.10	1.60	1.20	1.30
Gross Beta (pCi/L)	3.06	1.24	4.31	3.04	5.80	3.93	2.00	2.28
Gross Beta (CE+/-)	3.30	2.70	3.50	3.40	3.60	3.50	3.40	3.40
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-173		GW-174				GW-175	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/06/91	10/10/91	02/01/91	05/03/91	08/06/91	10/11/91	01/31/91	05/01/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	3.5	7.3	4.4	4.3	1.4	4.9	9.1	9
pH, Field (pH units)	7.7	7.6	8.2	8.1	8.1	7.9	7.6	8.2
Redox, Field (mV)	139	234	237	297	125	200	282	220
Sp. Cond., Field (umho/cm)	349	323	314	360	343	331	315	306
Temp, Field (degrees C)	18	16.3	14.6	16.5	20.5	15.8	11.2	16
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.9	7.6	7	6.4	8.2	7.8	7.1	6.3
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	409	392	350	355	422	406	266	301
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	214	204	206	214	240	234	166	180
TSS (mg/L)	7	1	2	10	4	2	1	8
Turbidity (NTU)	5.5	3.9	1.3	2.7	1.2	2.1	2.5	8.9
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.80	2.65	4.17	2.17	3.28	3.58	2.84	1.10
Gross Alpha (CE+/-)	1.30	1.40	1.70	1.50	1.50	1.60	1.50	1.40
Gross Beta (pCi/L)	-0.10	4.35	7.80	8.04	4.28	5.69	0.70	2.55
Gross Beta (CE+/-)	3.30	3.50	3.70	3.70	3.50	3.50	3.40	3.50
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-175		GW-176				GW-177	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/08/91	10/13/91	02/04/91	05/04/91	08/09/91	10/14/91	02/02/91	05/03/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	3.8	10	6	6	5.6	2.8	7.1	2.1
pH, Field (pH units)	7.9	7.9	6.8	6.9	6.9	7	7.4	7.8
Redox, Field (mV)	127	224	344	245	247	277	365	300
Sp. Cond., Field (umho/cm)	312	301	538	488	449	425	424	398
Temp, Field (degrees C)	17	14.1	16.5	15.8	16.6	15.4	15	19.1
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	8.1	7.9	6.7	6.5	7.3	7.3	6.9	6.4
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	386	323	475	484	552	478	346	369
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	194	204	298	284	268	294	218	216
TSS (mg/L)	6	<1	<1	<1	<1	7	<1	3
Turbidity (NTU)	4.9	2.5	1.3	1.1	0.7	13	0.4	0.35
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	2.79	4.39	2.24	2.92	2.02	0.63	2.61	1.31
Gross Alpha (CE+/-)	1.40	1.70	1.40	1.50	1.30	1.80	1.50	1.40
Gross Beta (pCi/L)	2.08	1.20	5.32	1.33	2.81	3.07	10.05	4.37
Gross Beta (CE+/-)	3.40	3.30	3.60	3.50	3.40	2.90	3.80	3.60
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

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Groundwater Quality Data, 1991

Well No.	GW-177		GW-178				GW-179	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/08/91	10/13/91	01/15/91	04/22/91	08/08/91	10/13/91	02/08/91	05/08/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	6.7	8.7	7.2	7.6	7.6	7.6	6.5	5
pH, Field (pH units)	7.6	7.4	7.1	7.5	7.4	7.3	7.4	7.2
Redox, Field (mV)	168	233	267	202	176	267	289	160
Sp. Cond., Field (umho/cm)	347	362	449	414	407	406	478	481
Temp, Field (degrees C)	19	13.9	11.5	13.3	18	14.5	12.2	17.3
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.9	7.4	7.6	7.5	7.7	7.4	6.9	6.5
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	436	380	486	463	494	419	489	494
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	220	230	292	288	278	288	276	282
TSS (mg/L)	2	<1	9	7	1	<1	233	95
Turbidity (NTU)	3.5	2.4	1300	280	9.6	960	216	3.5
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.81	3.56	0.51	0.53	4.52	8.40	3.61	3.67
Gross Alpha (CE+/-)	1.30	1.50	2.80	2.80	4.60	5.30	1.70	1.60
Gross Beta (pCi/L)	4.17	3.55	-1.43	-0.07	-0.61	5.89	11.16	9.25
Gross Beta (CE+/-)	3.50	3.40	7.10	6.20	13.10	13.00	3.80	3.90
Uranium 234 (pCi/L)	.	.	0.44	0.43	.	.	.	.
Uranium 234 (CE+/-)	.	.	0.90	0.90	.	.	.	.
Uranium 235 (pCi/L)	.	.	0.00	0.00	.	.	.	.
Uranium 235 (CE+/-)	.	.	1.50	1.50	.	.	.	.
Uranium 238 (pCi/L)	.	.	0.44	0.00	.	.	.	.
Uranium 238 (CE+/-)	.	.	0.90	1.50	.	.	.	.

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Groundwater Quality Data, 1991

Well No.	GW-179		GW-180				GW-181	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/12/91	10/17/91	02/02/91	05/04/91	08/09/91	10/14/91	01/29/91	04/30/91
MISCELLANEOUS PARAMETERS								
DO, Field (ppm)	7.6	7.2	5.5	5.7	4.4	5.4	6.2	6.7
pH, Field (pH units)	7.5	7.5	6.9	7.1	7.3	7.3	7.5	7.6
Redox, Field (mV)	192	192	364	321	193	262	294	234
Sp. Cond., Field (umho/cm)	438	467	512	545	499	434	338	292
Temp, Field (degrees C)	16.2	14.7	13.7	14.7	16.2	16.3	13.6	16
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	8.2	7.5	7	6.6	7.5	7.5	6.9	6.3
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	529	479	482	541	588	514	266	287
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	266	294	300	304	296	300	168	162
TSS (mg/L)	124	8	<1	<1	<1	1	1	<1
Turbidity (NTU)	34	24	0.28	0.26	0.25	0.45	1.3	0.6
RADIOCHEMICAL PARAMETERS								
Gross Alpha (pCi/L)	1.70	1.10	1.34	2.55	2.80	2.50	1.22	2.07
Gross Alpha (CE+/-)	1.30	1.90	1.30	1.40	1.40	2.10	1.40	1.50
Gross Beta (pCi/L)	7.43	4.57	-0.55	0.17	0.64	2.66	3.63	2.44
Gross Beta (CE+/-)	3.60	3.00	3.30	3.40	3.30	2.90	3.50	3.50
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

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Groundwater Quality Data, 1991

Well No.	GW-181		GW-184		GW-186		GW-187	
Location	CRSP		RQ		RQ		RQ	
Date Sampled	08/05/91	10/08/91	09/08/91	11/18/91	09/08/91	11/18/91	09/09/91	11/19/91
MISCELLANEOUS PARAMETERS								
DO, Field (ppm)	6.2	6.9	0.6	0.6	1.3	0.5	0.4	0.4
pH, Field (pH units)	7.8	7.7	7.2	7.2	7	7.1	7.6	7.1
Redox, Field (mV)	91	174	156	193	-72	-76	-229	-228
Sp. Cond., Field (umho/cm)	286	251	448	457	880	849	711	686
Temp, Field (degrees C)	15.3	13.8	15.2	14	17	15.1	17.1	15.7
COD (mg/L)								
Cyanide (mg/L)								
Phenols (mg/L)								
pH, 1 (pH units)	8.3	7.9	7.2	8.5	7.1	7.7	7.5	7.92
pH, 2 (pH units)								
pH, 3 (pH units)								
pH, 4 (pH units)								
Sp. Cond., 1 (umho/cm)	1050	364	528	491	918	897	698	735
Sp. Cond., 2 (umho/cm)								
Sp. Cond., 3 (umho/cm)								
Sp. Cond., 4 (umho/cm)								
TOC, 1 (mg/L)								
TOC, 2 (mg/L)								
TOC, 3 (mg/L)								
TOC, 4 (mg/L)								
TOX, 1 (ug/L)								
TOX, 2 (ug/L)								
TOX, 3 (ug/L)								
TOX, 4 (ug/L)								
TDS (mg/L)	192	158	308	304	536	536	400	406
TSS (mg/L)	<1	1	<1	1	<1	2	<1	<1
Turbidity (NTU)	2.4	2.4	0.5	0.56	8.4	0.95	14	15
RADIOCHEMICAL PARAMETERS								
Gross Alpha (pCi/L)	1.38	2.26	0.88	0.32	0.63	0.00	2.64	2.33
Gross Alpha (CE+/-)	1.40	1.30	1.20	1.60	1.10	1.80	1.50	2.10
Gross Beta (pCi/L)	1.36	5.22	2.13	-0.42	2.47	1.28	3.72	3.72
Gross Beta (CE+/-)	3.20	3.50	3.30	2.80	3.40	3.00	3.40	3.10
Uranium 234 (pCi/L)								
Uranium 234 (CE+/-)								
Uranium 235 (pCi/L)								
Uranium 235 (CE+/-)								
Uranium 238 (pCi/L)								
Uranium 238 (CE+/-)								

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Groundwater Quality Data, 1991

Well No.	GW-305	GW-321				GW-322		
Location	LIV	ADB				CRSP		
Date Sampled	10/01/91	03/22/91	06/18/91	09/07/91	11/17/91	02/04/91	05/04/91	08/13/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	7.8	8.8	6.6	8.5	7.8	7.9	8.2	5.2
pH, Field (pH units)	7.8	7.8	7.9	8.2	7.9	7.6	7.7	7.8
Redox, Field (mV)	195	321	128	135	224	322	336	209
Sp. Cond., Field (umho/cm)	225	233	239	203	240	310	325	285
Temp, Field (degrees C)	18.4	14.5	15.1	16.5	15.8	14.1	16.2	16
COD (mg/L)	<5	.	.	.	.	.	.	.
Cyanide (mg/L)	<0.1	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.9	6.9	8.2	7.9	7.9	6.8	6.2	8.2
pH, 2 (pH units)	.	.	.	.	7.9	.	.	.
pH, 3 (pH units)	.	.	.	.	8	.	.	.
pH, 4 (pH units)	.	.	.	.	7.9	.	.	.
Sp. Cond., 1 (umho/cm)	262	237	255	241	237	259	287	360
Sp. Cond., 2 (umho/cm)	.	.	.	.	240	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	238	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	240	.	.	.
TOC, 1 (mg/L)	2	<1	<1	<1	2	.	.	.
TOC, 2 (mg/L)	.	<1	<1	.	.	.	.	.
TOC, 3 (mg/L)	.	<1	<1	.	.	.	.	.
TOC, 4 (mg/L)	.	<1	<1	.	.	.	.	.
TOX, 1 (ug/L)	<10	11	<10	10	12	.	.	.
TOX, 2 (ug/L)	.	<10	<10	.	.	.	.	.
TOX, 3 (ug/L)	.	<10	<10	.	.	.	.	.
TOX, 4 (ug/L)	.	<10	<10	.	.	.	.	.
TDS (mg/L)	134	128	148	110	128	190	164	180
TSS (mg/L)	1	1	<1	<1	<1	8	48	49
Turbidity (NTU)	3.7	0.24	0.45	0.7	2.5	15	23	20
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	5.53	3.10	1.73	1.03	1.76	1.21	1.65	2.73
Gross Alpha (CE+/-)	1.90	1.40	1.40	1.30	1.80	1.30	1.30	1.50
Gross Beta (pCi/L)	10.60	4.01	-1.13	5.18	0.90	2.76	-0.20	3.98
Gross Beta (CE+/-)	3.40	3.20	3.30	3.20	2.90	3.50	3.40	3.40
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

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Groundwater Quality Data, 1991

Well No.	GW-322	GW-339					GW-511	
Location	CRSP	UNCS					CRSP	
Date Sampled	10/21/91	01/13/91	04/13/91	07/30/91	08/13/91	10/06/91	01/29/91	04/30/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	7.3	3	2.8	2.7	2.3	3.5	6	6.5
pH, Field (pH units)	7.8	7.6	7.7	7.5	7.6	7.5	8.2	8.1
Redox, Field (mV)	197	308	314	213	193	217	258	243
Sp. Cond., Field (umho/cm)	296	478	434	514	465	432	288	259
Temp, Field (degrees C)	15.3	12.4	15.7	17.9	16.4	15.7	13.6	14.5
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.8	7.3	7.7	.	8.1	7.7	7.1	6.2
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	310	444	505	.	577	522	213	229
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	224	284	272	.	288	260	144	150
TSS (mg/L)	74	2	<1	.	5	<1	1	1
Turbidity (NTU)	150	1.2	0.5	.	3.4	1.1	0.2	0.3
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	4.61	0.50	1.40	1.86	.	0.74	0.53	-0.20
Gross Alpha (CE+/-)	2.10	1.40	1.00	1.40	.	1.30	1.30	1.20
Gross Beta (pCi/L)	4.83	-1.55	2.61	2.50	.	4.00	4.13	4.81
Gross Beta (CE+/-)	2.80	3.50	3.20	3.60	.	3.20	3.50	3.60
Uranium 234 (pCi/L)	.	.	.	0.00	.	0.00	.	.
Uranium 234 (CE+/-)	.	.	.	1.70	.	1.70	.	.
Uranium 235 (pCi/L)	.	.	.	0.00	.	0.44	.	.
Uranium 235 (CE+/-)	.	.	.	1.70	.	0.87	.	.
Uranium 238 (pCi/L)	.	.	.	0.43	.	-0.44	.	.
Uranium 238 (CE+/-)	.	.	.	1.50	.	0.87	.	.

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Groundwater Quality Data, 1991

Well No.	GW-511		GW-512				GW-513	
Location	CRSP		ADB				ADB	
Date Sampled	08/05/91	10/08/91	03/19/91	06/16/91	09/06/91	11/16/91	03/19/91	06/16/91
MISCELLANEOUS PARAMETERS								
DO, Field (ppm)	4.9	6.3	6.1	5.1	5.1	5.5	7	4.8
pH, Field (pH units)	8.5	8.6	7	7	7.1	7.2	7.5	7.7
Redox, Field (mV)	81	158	330	192	205	170	314	142
Sp. Cond., Field (umho/cm)	234	211	300	277	282	337	317	286
Temp, Field (degrees C)	16.2	14.6	14.9	16.2	16	15	14.4	16
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	8.4	8.3	6.8	7.5	7.1	7.14	7	8
pH, 2 (pH units)	.	.	.	.	.	7.1	.	.
pH, 3 (pH units)	.	.	.	.	.	7.13	.	.
pH, 4 (pH units)	.	.	.	.	.	7.11	.	.
Sp. Cond., 1 (umho/cm)	280	256	319	344	327	321	319	342
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	317	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	320	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	319	.	.
TOC, 1 (mg/L)	.	.	<1	<1	<1	<1	<1	<1
TOC, 2 (mg/L)	.	.	<1	<1	.	.	<1	<1
TOC, 3 (mg/L)	.	.	<1	<1	.	.	<1	<1
TOC, 4 (mg/L)	.	.	<1	<1	.	.	<1	<1
TOX, 1 (ug/L)	.	.	<10	<10	15	<10	<10	<10
TOX, 2 (ug/L)	.	.	<10	<10	.	.	<10	<10
TOX, 3 (ug/L)	.	.	<10	<10	.	.	<10	<10
TOX, 4 (ug/L)	.	.	<10	<10	.	.	<10	<10
TDS (mg/L)	140	148	184	182	168	182	210	168
TSS (mg/L)	<1	<1	1	2	<1	1	4	<1
Turbidity (NTU)	2.8	0.5	1.9	4	6.2	6.7	1.1	1.8
RADIOCHEMICAL PARAMETERS								
Gross Alpha (pCi/L)	1.78	1.39	0.02	1.80	1.35	2.42	0.14	0.65
Gross Alpha (CE+/-)	1.50	1.20	1.20	1.50	1.30	2.00	1.30	1.30
Gross Beta (pCi/L)	4.22	7.55	6.94	1.96	5.11	2.06	3.85	0.66
Gross Beta (CE+/-)	3.40	3.60	3.50	3.40	3.20	3.00	3.30	3.40
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-513		GW-514				GW-521	
Location	ADB		ADB				LIV	
Date Sampled	09/06/91	11/16/91	03/20/91	06/17/91	09/07/91	11/16/91	01/08/91	04/04/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
DO, Field (ppm)	5.1	5.5	3.5	4.1	3.4	4.2	8.4	7.8
pH, Field (pH units)	7.7	7.6	7.6	7.9	8.4	7.6	7.7	7.9
Redox, Field (mV)	120	210	283	103	132	162	298	261
Sp. Cond., Field (umho/cm)	287	327	316	340	314	344	214	268
Temp, Field (degrees C)	16.1	14.8	14.8	15.6	16.3	15.7	12.5	14.7
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.7	7.47	6.9	8.2	7.7	7.8	6.9	6.9
pH, 2 (pH units)	.	7.44	.	.	.	7.7	.	.
pH, 3 (pH units)	.	7.68	.	.	.	7.7	.	.
pH, 4 (pH units)	.	7.7	.	.	.	7.7	.	.
Sp. Cond., 1 (umho/cm)	342	332	323	305	352	345	238	236
Sp. Cond., 2 (umho/cm)	.	327	.	.	.	346	.	.
Sp. Cond., 3 (umho/cm)	.	335	.	.	.	346	.	.
Sp. Cond., 4 (umho/cm)	.	330	.	.	.	345	.	.
TOC, 1 (mg/L)	<1	2	<1	<1	1	<1	<1	1
TOC, 2 (mg/L)	.	.	<1	<1	.	.	<1	.
TOC, 3 (mg/L)	.	.	<1	<1	.	.	<1	.
TOC, 4 (mg/L)	.	.	<1	<1	.	.	<1	.
TOX, 1 (ug/L)	16	<10	<10	<10	<10	<10	.	.
TOX, 2 (ug/L)	.	.	<10	<10	.	.	.	.
TOX, 3 (ug/L)	.	.	<10	<10	.	.	.	.
TOX, 4 (ug/L)	.	.	<10	<10	.	.	.	.
TDS (mg/L)	166	184	294	180	170	182	136	150
TSS (mg/L)	<1	2	<1	1	<1	1	1	<1
Turbidity (NTU)	0.75	4	5	2.9	2.5	2.6	4	2.3
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	0.37	0.75	2.59	0.69	0.37	0.75	1.04	0.04
Gross Alpha (CE+/-)	1.20	1.70	1.30	1.30	1.20	1.70	1.10	0.80
Gross Beta (pCi/L)	2.14	1.40	3.64	4.23	2.43	1.15	1.15	3.42
Gross Beta (CE+/-)	3.00	2.90	3.20	3.50	3.00	2.90	3.20	3.20
Uranium 234 (pCi/L)	.	.	.	.	.	.	0.00	-0.42
Uranium 234 (CE+/-)	.	.	.	.	.	.	1.50	0.90
Uranium 235 (pCi/L)	.	.	.	.	.	.	0.43	0.00
Uranium 235 (CE+/-)	.	.	.	.	.	.	0.90	1.40
Uranium 238 (pCi/L)	.	.	.	.	.	.	0.43	0.00
Uranium 238 (CE+/-)	.	.	.	.	.	.	0.90	1.40

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-545		GW-546				GW-607	
Location	LIIX		LIIX				CRSP	
Date Sampled	09/15/91	11/26/91	03/17/91	04/11/91	09/15/91	11/26/91	01/28/91	04/29/91
MISCELLANEOUS PARAMETERS								
DO, Field (ppm)	5	9.8	3.8	3.3	7.4	9.5	7.8	7.9
pH, Field (pH units)	11.7	11.7	7.4	7.9	8.2	8.2	7.9	7.8
Redox, Field (mV)	2	30	295	215	133	174	308	202
Sp. Cond., Field (umho/cm)	854	747	270	235	263	251	269	217
Temp, Field (degrees C)	19.3	7.8	13.5	15.3	16.7	8	13.6	15
COD (mg/L)	<5	<5	<5	<5	<5	<5	.	.
Cyanide (mg/L)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	11.7	11.73	6.8	7	8.1	8.36	6.8	6.8
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	857	765	271	254	253	288	210	219
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	6	<1	4	<1	1	<1	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	<10	<10	<10	<10	<10	<10	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	268	186	114	152	246	156	132	118
TSS (mg/L)	45	14	2	<1	235	88	1	<1
Turbidity (NTU)	29	23	2.1	1.6	200	80	3.2	6.5
RADIOCHEMICAL PARAMETERS								
Gross Alpha (pCi/L)	35.30	-0.51	1.85	0.88	6.12	3.62	0.10	1.20
Gross Alpha (CE+/-)	4.10	1.10	1.50	0.90	1.80	2.00	1.30	1.50
Gross Beta (pCi/L)	85.80	15.40	3.65	0.57	11.20	5.81	4.62	6.48
Gross Beta (CE+/-)	6.40	3.40	3.30	3.10	3.60	2.90	3.50	3.50
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

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Groundwater Quality Data, 1991

Well No.	GW-607		GW-608				GW-609	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/06/91	10/08/91	01/28/91	04/29/91	08/07/91	10/12/91	01/15/91	04/22/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	5.9	7.2	5.6	1	6.4	7.1	6.2	7
pH, Field (pH units)	8.7	8.6	7.4	8	7.7	7.7	7.6	7.7
Redox, Field (mV)	162	139	347	74	175	201	260	203
Sp. Cond., Field (umho/cm)	239	220	306	2.19	261	260	343	332
Temp, Field (degrees C)	16	14.4	13.7	15.6	16.8	17	13.3	14.4
COD (mg/L)	.	.	.	.	.	.	.	.
Cyanide (mg/L)	.	.	.	.	.	.	.	.
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	8.7	8.5	6.8	6.9	8	7.4	7.1	7
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	338	263	227	219	322	279	294	344
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	.	.
TOC, 2 (mg/L)	.	.	.	.	.	.	.	.
TOC, 3 (mg/L)	.	.	.	.	.	.	.	.
TOC, 4 (mg/L)	.	.	.	.	.	.	.	.
TOX, 1 (ug/L)	.	.	.	.	.	.	.	.
TOX, 2 (ug/L)	.	.	.	.	.	.	.	.
TOX, 3 (ug/L)	.	.	.	.	.	.	.	.
TOX, 4 (ug/L)	.	.	.	.	.	.	.	.
TDS (mg/L)	162	146	148	134	156	178	190	170
TSS (mg/L)	2	3	<1	3	<1	<1	1	3
Turbidity (NTU)	1.5	1.3	7.3	1.7	0.8	0.79	0.5	0.25
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	4.00	0.94	1.07	0.65	3.56	3.18	2.06	1.69
Gross Alpha (CE+/-)	1.60	1.10	1.40	1.40	1.60	1.50	1.50	1.60
Gross Beta (pCi/L)	5.72	5.12	-0.43	3.91	0.27	6.15	-2.83	0.92
Gross Beta (CE+/-)	3.60	3.50	3.20	3.40	3.30	3.60	3.30	3.10
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-609		GW-610				GW-611	
Location	CRSP		CRSP				CRSP	
Date Sampled	08/09/91	10/14/91	01/30/91	05/01/91	08/06/91	10/10/91	01/31/91	05/01/91
MISCELLANEOUS PARAMETERS								
DO, Field (ppm)	4.6	7	7.3	6.2	4.8	6.7	11.9	8.1
pH, Field (pH units)	7.8	7.5	7.4	7.7	7.7	7.7	7.5	7.8
Redox, Field (mV)	220	256	288	181	141	232	293	206
Sp. Cond., Field (umho/cm)	325	301	303	322	309	310	478	434
Temp, Field (degrees C)	16.8	14.7	13.1	14.5	17.2	15.5	14.3	17.3
COD (mg/L)								
Cyanide (mg/L)								
Phenols (mg/L)								
pH, 1 (pH units)	7.9	7.8	6.9	6.4	7.9	7.7	7.1	6.6
pH, 2 (pH units)								
pH, 3 (pH units)								
pH, 4 (pH units)								
Sp. Cond., 1 (umho/cm)	386	492	315	351	375	354	433	466
Sp. Cond., 2 (umho/cm)								
Sp. Cond., 3 (umho/cm)								
Sp. Cond., 4 (umho/cm)								
TOC, 1 (mg/L)								
TOC, 2 (mg/L)								
TOC, 3 (mg/L)								
TOC, 4 (mg/L)								
TOX, 1 (ug/L)								
TOX, 2 (ug/L)								
TOX, 3 (ug/L)								
TOX, 4 (ug/L)								
TDS (mg/L)	190	206	178	210	204	192	252	260
TSS (mg/L)	<1	1	9	3	2	<1	3	10
Turbidity (NTU)	0.22	0.35	3.6	0.5	0.24	0.71	3.1	6.3
RADIOCHEMICAL PARAMETERS								
Gross Alpha (pCi/L)	2.06	1.67	0.99	1.41	1.50	4.48	2.39	1.25
Gross Alpha (CE+/-)	1.30	1.90	1.40	1.40	1.20	1.70	1.50	1.40
Gross Beta (pCi/L)	0.49	3.88	2.17	1.27	-0.10	3.55	1.93	3.13
Gross Beta (CE+/-)	3.30	2.90	3.40	3.40	3.30	3.40	3.40	3.50
Uranium 234 (pCi/L)								
Uranium 234 (CE+/-)								
Uranium 235 (pCi/L)								
Uranium 235 (CE+/-)								
Uranium 238 (pCi/L)								
Uranium 238 (CE+/-)								

(CONTINUED)

Groundwater Quality Data, 1991

Well No.	GW-611		GW-612				GW-709	
Location	CRSP		CRSP				LII	
Date Sampled	08/08/91	10/13/91	02/07/91	05/08/91	08/12/91	10/17/91	06/19/91	09/11/91
MISCELLANEOUS PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
DO, Field (ppm)	3.8	8.9	5.6	5.6	4.5	5.4	6.4	3.2
pH, Field (pH units)	7.7	7.8	7.6	7.4	7.7	7.6	8.9	8.9
Redox, Field (mV)	104	231	282	148	200	192	174	203
Sp. Cond., Field (umho/cm)	443	431	378	354	368	376	216	213
Temp, Field (degrees C)	18.2	16.4	13	16.5	17.3	14.8	16.7	15.3
COD (mg/L)	.	.	.	.	.	.	.	<5
Cyanide (mg/L)	.	.	.	.	.	.	.	<0.1
Phenols (mg/L)	.	.	.	.	.	.	.	.
pH, 1 (pH units)	7.8	7.6	6.9	6.3	8.1	7.7	8.8	8.2
pH, 2 (pH units)	.	.	.	.	.	.	.	.
pH, 3 (pH units)	.	.	.	.	.	.	.	.
pH, 4 (pH units)	.	.	.	.	.	.	.	.
Sp. Cond., 1 (umho/cm)	513	442	343	358	415	386	247	283
Sp. Cond., 2 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 3 (umho/cm)	.	.	.	.	.	.	.	.
Sp. Cond., 4 (umho/cm)	.	.	.	.	.	.	.	.
TOC, 1 (mg/L)	.	.	.	.	.	.	<1	<1
TOC, 2 (mg/L)	.	.	.	.	.	.	<1	.
TOC, 3 (mg/L)	.	.	.	.	.	.	1	.
TOC, 4 (mg/L)	.	.	.	.	.	.	<1	.
TOX, 1 (ug/L)	.	.	.	.	.	.	<10	<10
TOX, 2 (ug/L)	.	.	.	.	.	.	<10	.
TOX, 3 (ug/L)	.	.	.	.	.	.	<10	.
TOX, 4 (ug/L)	.	.	.	.	.	.	<10	.
TDS (mg/L)	272	280	240	200	180	220	160	154
TSS (mg/L)	6	3	2	1	1	1	<1	1
Turbidity (NTU)	8.9	1.6	1.9	2	2.6	0.65	0.35	0.8
	.	.	.	.	.	.	.	.
RADIOCHEMICAL PARAMETERS	.	.	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Gross Alpha (pCi/L)	1.99	1.78	0.96	2.37	1.98	1.52	1.89	2.42
Gross Alpha (CE+/-)	1.30	1.30	1.30	1.40	1.40	1.90	1.50	1.40
Gross Beta (pCi/L)	-0.28	-0.90	3.46	-0.20	2.48	3.39	0.26	2.69
Gross Beta (CE+/-)	3.30	3.20	3.40	3.40	3.30	2.90	3.40	3.40
Uranium 234 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 234 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 235 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 235 (CE+/-)	.	.	.	.	.	.	.	.
Uranium 238 (pCi/L)	.	.	.	.	.	.	.	.
Uranium 238 (CE+/-)	.	.	.	.	.	.	.	.

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ANNUAL AVERAGES

MONITORING WELL	GW-173					
PARAMETER						
	1986	1987	1988	1989	1990	1991
METALS (mg/L)						
Aluminum	1.73				0.31	0.097
Antimony	<0.05				<0.05	<0.05
Arsenic	0.006***		0.005***	<0.005	<0.05	<0.05
Barium	0.013		0.24***	<0.1	0.0122	0.013
Beryllium	<0.0003		0.003***	<0.001	0.00043*	<0.0003
Boron	0.084				0.11	0.03**
Cadmium	<0.003		0.002***	<0.002	<0.003	<0.003
Calcium	39.25		68.5	39.5	39.25	37.25
Chromium	0.023**		0.0267*	<0.01	0.013***	<0.01
Cobalt	<0.005				<0.005	<0.005
Copper	0.075*				0.0323	0.0105**
Iron	14.13				1.0987	0.2028
Lead	0.03		0.164*	0.0105*	0.0078	<0.004
Lithium	<0.004					
Magnesium	24.5		35.25	24.75	23.75	23.5
Manganese	0.052				0.0218	0.0039
Mercury	0.0004***		0.0005**	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01				<0.01	<0.01
Nickel	0.050*			<0.01	0.014***	<0.01
Niobium	<0.007					
Phosphorous	0.35***					
Potassium	2.025		4.025	2.7*	1.35	1.42
Selenium	<0.005		<0.005	<0.005	<0.05	<0.05
Silver	<0.008		<0.01	<0.01	<0.008	<0.008
Sodium	1.75		2.325	2.625	2.425	2.25
Strontium	0.009*				0.0183	0.0168
Thallium	<0.01					
Thorium	<0.2		<0.2	<0.2	<0.2	<0.2
Titanium	0.035					
Uranium	0.005		0.0047*	<0.001	<0.001	<0.001
Vanadium	0.0054***			<0.005	<0.005	<0.005
Zinc	0.047**				0.02	0.0148*
Zirconium	<0.005					
VOLATILE ORGANICS (ug/L)						
Acetone	<10	5*		5***	<10	<10
Benzene	<5	2*	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<10	<10
2-Butanone	<10	8*		2***	<10	<10
Carbon Disulfide	<5	<5		<5	<5	<5
Carbon Tetrachloride	<5	<5	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<5	<5
Chlorodibromomethane			<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<10	<10
2-Chloroethyl Vinyl Ether	<10	<10	<10			
Chloroform	4**	2*	0.45**	<5	<5	<5
Chloromethane	<10	<10	<10	<10	<10	<10
Dibromochloromethane	<5	<5				
1,1-Dichloroethane	<5	<5	<5	<5	<5	<5
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<5	<5	<5	<5	<5	<5
Trans-1,2-Dichloroethene	<5	<5	<5	<5	<5	<5
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5
Cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
Trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<5	<5
2-Hexanone	<10	<10		<10	<10	<10
Methylene Chloride	<5	<5	1.4**	<5	<5	<5
4-Methyl-2-Pentanone	<10	<10		1***	<10	<10
Styrene	<5	<5		<5	<5	<5
1,1,2,2-Tetrachloroethane	4***	<5	<5	<5	<5	<5
Tetrachloroethene			16.5	16.25	12.75	11.75
Toluene	7**	1.5	<5	<5	<5	2***
1,1,1-Trichloroethane	4**	3.5	1.75	1.5**	0.9333*	0.6***
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5
Trichloroethene	2***	1*	0.7***	<5	<5	<5
Vinyl Acetate	<10	<10		<10	<10	<10
Vinyl Chloride	<10	<10	<10	<10	<10	<10
Xylenes	1***	2*		<5	<5	<5
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	37.5**	<2	5.788	3.225	0.546*	1.5775
Gross Beta (pCi/L)	47.31*	7.75	679	7.3	2.385	2.1825
Radium (Bq/L)	<0.1	<0.1		0.015		
ANIONS (mg/L)						
Chloride	3*	5.5	4	3	3	2.5
Fluoride	0.16*	0.1*	0.11***	<0.2	<0.1	<0.1
Nitrate (as N)	1.057	1.415	1.495	1.25	1.375	1.163*
Sulfate	7.125	5.5	11.6	9.5	7.75	6.25
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	325	270	367.25	363.25	347	339.5
pH	8.1	7.9	7.725	7.3	7.725	7.425
Dissolved Oxygen (mg/L)	8.025	10		7.7	6.275	6.65
Redox (mV)	159	363		290.75	268.725	253.25
Temperature (degrees Celsius)	19.5	14.15		16.1	14.675	15.875
Water Level (ft +/- grade)	-152.63	-141.3		-130.82	-122.08	
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	69.67*			7.2	11.15	4.725
Total Suspended Solids (mg/L)		4.5	66.25	5.5**	14	4
Total Dissolved Solids (mg/L)			233	197.5	200	205

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-173					
PARAMETER	1986	1987	1988	1989	1990	1991
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.02					
2,4-D	<2					
Endrin	<0.1					
Methoxychlor	<0.08					
Silvex	<0.2					
Toxaphene	<2					
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	<10					
Acenaphthylene	<10					
Anthracene	<10					
Benzidine	<80					
Benzo(a)Anthracene	<10					
Benzo(a)Pyrene	<10					
Benzo(b)Fluoranthene	<10					
Benzo(g,h,i)Perylene	<10					
Benzo(k)Fluoranthene	<10					
Benzyl Alcohol	<10					
Benzyl Butyl Phthalate	<10					
Bis(2-Chloroethoxy)Methane	<10					
Bis(2-Chloroethyl)Ether	<10					
Bis(2-Chloroisopropyl)Ether	<10					
Bis(2-Ethylhexyl)Phthalate	168.6**					
4-Bromophenyl Phenyl Ether	<10					
4-Chloroaniline	<10					
2-Chloronaphthalene	<10					
4-Chlorophenyl Phenyl Ether	<10					
Chrysene	<10					
Di-n-Butyl Phthalate	2***					
Di-n-Octyl Phthalate	6**					
Dibenzo(a,h)Anthracene	<10					
Dibenzofuran	<10					
1,2-Dichlorobenzene	<10					
1,3-Dichlorobenzene	<10					
1,4-Dichlorobenzene	<10					
3,3'-Dichlorobenzidine	<20					
Diethyl Phthalate	1***					
Dimethyl Phthalate	<10					
2,4-Dinitrotoluene	<10					
2,6-Dinitrotoluene	<10					
Fluoranthene	<10					
Fluorene	<10					
Hexachlorobenzene	<10					
Hexachlorobutadiene	<10					
Hexachlorocyclopentadiene	<10					
Hexachloroethane	<10					
Indeno(1,2,3-cd)Pyrene	<10					
Isophorone	<10					
2-Methylnaphthalene	<10					
N-Nitrosodi-N-Propylamine	<10					
Naphthalene	<10					
2-Nitroaniline	<50					
3-Nitroaniline	<50					
4-Nitroaniline	<50					
Nitrobenzene	<10					
Phenanthrene	<10					
Pyrene	<10					
1,2,4-Trichlorobenzene	<10					
2,4,5-Trichlorophenol	<50					
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	<50					
4-Chloro-3-Methylphenol	<10					
2-Chlorophenol	<10					
2,4-Dichlorophenol	<10					
2,4-Dimethylphenol	<10					
2,4-Dinitrophenol	<50					
2-Methyl-4,6-Dinitrophenol	<50					
2-Methyl Phenol	<10					
3-Methyl Phenol	<10					
4-Methyl Phenol	<10					
2-Nitrophenol	<10					
4-Nitrophenol	<50					
Pentachlorophenol	<50					
Phenol	8***					
2,4,6-Trichlorophenol	<10					

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-174					
PARAMETER	1986	1987	1988	1989	1990	1991
METALS (mg/L)						
Aluminum	12	3.6			0.229	0.0438
Antimony	<0.05	<0.05			<0.05	<0.05
Arsenic	0.021	0.009*	<0.005	<0.005	<0.05	<0.05
Barium	0.14	0.338	0.43***	<0.1	0.0483	0.054
Beryllium	0.0012	0.0014*	<0.002	0.0015**	<0.0003	<0.0003
Boron	0.093	0.08			0.0167	0.0185**
Cadmium	<0.003	<0.003	0.002***	<0.002	<0.002	<0.003
Calcium	48	36.5	33.75	43.55	29	36
Chromium	0.074	0.0285	0.0288	0.0723*	0.027**	<0.01
Cobalt	<0.005	<0.005			<0.005	<0.005
Copper	0.084	0.0805			0.0129*	0.0049**
Iron	110	5.25			0.4633	0.0445
Lead	0.085	0.027	0.014	0.0393	0.0075**	<0.004
Lithium	0.0078	0.0097*				
Magnesium	36	23	22.75	28.5	21.25	24.5
Manganese	0.42	0.1245			0.012	0.0029*
Mercury	<0.002	<0.0002	<0.0002	0.0003**	<0.0002	<0.0002
Molybdenum	<0.01	<0.01			<0.01	<0.01
Nickel	0.032	0.0195		0.17**	0.034***	<0.01
Niobium	<0.007	0.024*				
Phosphorous	1.1	<0.2				
Potassium	11	3.6	3.875	4.375	3.65	2.5
Selenium	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05
Silver	<0.006	<0.006	<0.01	<0.01	<0.006	<0.006
Sodium	10	8.45	8.6	12.05	0.1023	5.275
Strontium	0.1	0.028			0.0227	0.0788
Thallium	<0.01					
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	0.084	0.12*				
Uranium	0.008	0.0025	0.0015	0.005***	<0.001	0.001**
Vanadium	0.0072	0.011*		0.018**	<0.005	<0.005
Zinc	0.15	0.097			0.0143	0.0041**
Zirconium	<0.005	<0.005				
VOLATILE ORGANICS (ug/L)						
Acetone	<10	<10		<10	7.5**	<10
Benzene	<5	<5	<5	<5	<5	<5
Bromodichloromethane	<5	<5	<5	<5	<5	<5
Bromoform	<5	<5	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10	<10	<10
2-Butanone	<10	4*		<5	<10	<10
Carbon Disulfide	<5	1*		<5	<5	<5
Carbon Tetrachloride	<5	2*	0.7***	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5	<5	<5
Chlorodibromomethane			<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10	<10	<10
2-Chloroethyl Vinyl Ether	<10	<10	<10			
Chloroform	<5	2*	0.4***	<5	<5	<5
Chloromethane	<10	<10	<10	<10	<10	<10
Dibromochloromethane	<5	<5				
1,1-Dichloroethane	<5	<5	1**	1*	1.5**	1*
1,2-Dichloroethane	<5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<5	1*	0.95**	1***	1***	<5
Trans-1,2-Dichloroethene	<5	2*	3*	3.667*	4.333*	3.5
1,2-Dichloropropane	<5	<5	<5	<5	<5	<5
Cis-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
Trans-1,3-Dichloropropene	<5	<5	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5	<5	<5
2-Hexanone	<10	<10		<10	<10	<10
Methylene Chloride	<5	<5	2***	<5	<5	<5
4-Methyl-2-Pentanone	<10	<10		<10	<10	<10
Styrene	<5	<5		<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<5	<5
Tetrachloroethene			41	38	38.75	38
Toluene	<5	1*	0.8***	0.3***	<5	<5
1,1,1-Trichloroethane	<5	13.5	6.33*	4.75	4	2.75
1,1,2-Trichloroethane	<5	<5	<5	<5	<5	<5
Trichloroethene	<5	2	3*	1.5	1.5	1*
Vinyl Acetate	<10	<10		<10	2***	<10
Vinyl Chloride	<10	<10	<10	<10	<10	<10
Xylenes	<5	<5		<5	<5	<5
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	51	8.9*	4	2.2	1.9325	3.3
Gross Beta (pCi/L)	108	6	21.5	14.325	18.58	8.4525
Radium (Bq/L)	0.4	<0.1		0.033		
ANIONS (mg/L)						
Chloride	<1	1.85	5.75	7	9.5	9.25
Fluoride	0.14	<0.1	<0.1	<0.2	<0.1	<0.1
Nitrate (as N)	0.18	0.395	0.49	0.505	0.525	0.695
Sulfate	9.8	3.5	3.85	3.75	4	3.75
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	270	365	342.5	344.5	363.75	337
pH	7.9	7.65	8.1	7.95	8.125	8.075
Dissolved Oxygen (mg/L)	3.2	8.7		7.85	6.775	3.75
Redox (mV)	110	234		231.75	272.8	214.75
Temperature (degrees Celsius)	17	9.35		16.125	14.975	16.85
Water Level (ft +/- grade)	-3	111.15		-109.743	-103.18	
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	>200			57.667	41.05	1.825
Total Suspended Solids (mg/L)		38	44	81.333*	33.75	7
Total Dissolved Solids (mg/L)			219.5	183	213	223.5

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-174					
PARAMETER						
	1986	1987	1988	1989	1990	1991
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.02					
2,4-D	<2					
Endrin	<0.1					
Methoxychlor	<0.08					
Silvex	<0.2					
Toxaphene	<2					
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	<10					
Acenaphthylene	<10					
Anthracene	<10					
Benzidine	<80					
Benzo(a)Anthracene	<10					
Benzo(a)Pyrene	<10					
Benzo(b)Fluoranthene	<10					
Benzo(g,h,i)Perylene	<10					
Benzo(k)Fluoranthene	<10					
Benzyl Alcohol	<10					
Benzyl Butyl Phthalate	<10					
Bis(2-Chloroethoxy)Methane	<10					
Bis(2-Chloroethyl)Ether	<10					
Bis(2-Chloroisopropyl)Ether	<10					
Bis(2-Ethylhexyl)Phthalate	<10					
4-Bromophenyl Phenyl Ether	<10					
4-Chloroaniline	<10					
2-Chloronaphthalene	<10					
4-Chlorophenyl Phenyl Ether	<10					
Chrysene	<10					
Di-n-Butyl Phthalate	<10					
Di-n-Octyl Phthalate	<10					
Dibenzo(a,h)Anthracene	<10					
Dibenzofuran	<10					
1,2-Dichlorobenzene	<10					
1,3-Dichlorobenzene	<10					
1,4-Dichlorobenzene	<10					
3,3'-Dichlorobenzidine	<20					
Diethyl Phthalate	<10					
Dimethyl Phthalate	<10					
2,4-Dinitrotoluene	<10					
2,6-Dinitrotoluene	<10					
Fluoranthene	<10					
Fluorene	<10					
Hexachlorobenzene	<10					
Hexachlorobutadiene	<10					
Hexachlorocyclopentadiene	<10					
Hexachloroethane	<10					
Indeno(1,2,3-cd)Pyrene	<10					
Isophorone	<10					
2-Methylnaphthalene	<10					
N-Nitrosodi-N-Propylamine	<10					
Naphthalene	<10					
2-Nitroaniline	<50					
3-Nitroaniline	<50					
4-Nitroaniline	<50					
Nitrobenzene	<10					
Phenanthrene	<10					
Pyrene	<10					
1,2,4-Trichlorobenzene	<10					
2,4,6-Trichlorophenol	<50					
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	<50					
4-Chloro-3-Methylphenol	<10					
2-Chlorophenol	<10					
2,4-Dichlorophenol	<10					
2,4-Dimethylphenol	<10					
2,4-Dinitrophenol	<50					
2-Methyl-4,6-Dinitrophenol	<50					
2-Methyl Phenol						
3-Methyl Phenol	<10					
4-Methyl Phenol	<10					
2-Nitrophenol	<10					
4-Nitrophenol	<50					
Pentachlorophenol	<50					
Phenol	<10					
2,4,6-Trichlorophenol	<10					

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-176					
PARAMETER	1986	1987	1988	1989	1990	1991
METALS (mg/L)						
Aluminum	10.02	0.155			0.0485*	0.1023*
Antimony	<0.05	<0.05			<0.05	<0.05
Arsenic	0.108***	<0.005	<0.005	<0.005	<0.05	<0.05
Barium	0.0365	0.506	0.22***	<0.1	0.0173	0.0183
Beryllium	0.014***	<0.0003	<0.001	<0.001	<0.0003	<0.0003
Boron	1.31	1.95			0.64	0.565
Cadmium	<0.003	<0.003	<0.002	<0.002	<0.002	<0.002
Calcium	63.5	47.5	37.25	55	54	51.5
Chromium	0.0245**	0.011*	<0.01		<0.01	<0.01
Cobalt	0.029***	<0.005			<0.005	<0.005
Copper	0.085**	0.024*			0.0053**	<0.004
Iron	24.986	0.1435			0.0196	0.158*
Lead	0.081	0.0045	0.0053**	0.0054**	0.0042**	<0.004
Lithium	0.0887	0.098				
Magnesium	38	32.5	24.675	33.5	34	33.5
Manganese	0.7085	0.0077			0.0028*	0.0068**
Mercury	0.0008**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01			<0.01	<0.01
Nickel	0.091**	<0.01		<0.01	<0.1	<0.1
Niobium	<0.007	<0.007				
Phosphorous	1.7***	<0.2				
Potassium	2.567*	0.84	2.3	2.453*	1.0725	1.0825
Selenium	<0.005	<0.005	<0.005	<0.005	<0.05	<0.05
Silver	<0.006	<0.006	<0.01	<0.01	<0.006	0.0068**
Sodium	0.63	0.65	0.685	0.6475	0.7825	0.7025
Strontium	0.022***	0.0149			0.0227	0.021
Thallium	<0.01	<0.01				
Thorium	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Titanium	0.209*	0.011*				
Uranium	0.0047*	0.0015	<0.001	<0.001	<0.001	0.001***
Vanadium	0.17***	<0.005		<0.005	<0.005	<0.005
Zinc	0.405*	0.0128			0.0084	0.0072
Zirconium	0.017***	<0.005				
VOLATILE ORGANICS (ug/L)						
Acetone	<10	<10		4***	43***	3***
Benzene	<5	<5	<5	<5	0.8***	<5
Bromodichloromethane	<5	<5	<5	<5	<10	<5
Bromoform	<5	<5	<5	<5	<10	<5
Bromomethane	<10	<10	<10	<10	<20	<10
2-Butanone	<10	10		<10	<20	<10
Carbon Disulfide	<5	<5		<5	<10	<5
Carbon Tetrachloride	29.5**	<5	16***	<5	14***	<5
Chlorobenzene	<5	<5	<5	<5	<10	<5
Chlorodibromomethane			<5	<5	<10	<5
Chloroethane	<10	<10	<10	<10	<20	<10
2-Chloroethyl Vinyl Ether	<10	<10	<10			
Chloroform	3**	2*	0.6**	<5	<10	<5
Chloromethane	<10	<10	<10	<10	<20	<10
Dibromochloromethane	<5	<5				
1,1-Dichloroethane	18	29	34.25	72.75	55.5	42.75
1,2-Dichloroethane	<5	3*	3***	4.667*	2.5**	1.5**
1,1-Dichloroethene	9*	13	15	18.5	20.5	17.5
Trans-1,2-Dichloroethene	<5	<5	<5	<5	<10	<5
1,2-Dichloropropane	<5	<5	<5	<5	<10	<5
Cis-1,3-Dichloropropene	<5	<5	<5	<5	<10	<5
Trans-1,3-Dichloropropene	<5	<5	<5	<5	<10	<5
Ethylbenzene	<5	<5	<5	<5	<10	<5
2-Hexanone	<10	<10		<10	<20	<10
Methylene Chloride	1***	1*	<5	<5	2***	1***
4-Methyl-2-Pentanone	<10	<10		<10	<20	<10
Styrene	<5	<5		<5	<10	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	<10	<5
Tetrachloroethene			10.5	10.5	8.25	6.25
Toluene	<5	1	<5	1***	<10	<5
1,1,1-Trichloroethane	211.25	189.5	187.5	180	147.5	103.25
1,1,2-Trichloroethane	<5	<5	<5	<5	<10	<5
Trichloroethene	7***	<5	<5	<5	<10	<5
Vinyl Acetate	<10	<10		<10	<20	<10
Vinyl Chloride	<10	<10	<10	<10	<20	<10
Xylenes	1***	1*		<5	<10	<5
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	30.68*	<3	1.925	2	1.4775	1.9525
Gross Beta (pCi/L)	28.38	3.6	7.5	4.6	1.7	3.1325
Radium (Bq/L)	0.24***	<0.1		0		
ANIONS (mg/L)						
Chloride	1.67*	2.2	2.5	3	2.25	1.975
Fluoride	0.1**	<0.1	0.2***	<0.2	<0.1	<0.1
Nitrate (as N)	0.7025	0.72	0.6725	0.55	0.55	0.485
Sulfate	1.16**	1.3*	1.05**	1	1.25	1.325
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	390	555	453.25	486	471.75	475
pH	7.33	7.35	6.875	6.725	6.9	6.9
Dissolved Oxygen (mg/L)	7.625	8.3		6.15	6.025	6.1
Redox (mV)	198.5	364.5		286.5	326.75	278.25
Temperature (degrees Celsius)	20.95	13.95		16.73	15.425	16.075
Water Level (ft +/- grade)	-115.7	-113.25		-114.08	-113.25	
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	24.333*			1.117	2.325	4.025
Total Suspended Solids (mg/L)		5*	4*	1***	3.5**	7***
Total Dissolved Solids (mg/L)			298.5	283.5	289	286

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-176					
PARAMETER						
	1986	1987	1988	1989	1990	1991
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.02					
2,4-D	<2					
Endrin	<0.1					
Methoxychlor	<0.08					
Silvex	<0.2					
Toxaphene	<2					
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	<10					
Acenaphthylene	<10					
Anthracene	<10					
Benzidine	<80					
Benzo(a)Anthracene	<10					
Benzo(a)Pyrene	<10					
Benzo(b)Fluoranthene	<10					
Benzo(g,h,i)Perylene	<10					
Benzo(k)Fluoranthene	<10					
Benzyl Alcohol	<10					
Benzyl Butyl Phthalate	<10					
Bis(2-Chloroethoxy)Methane	<10					
Bis(2-Chloroethyl)Ether	<10					
Bis(2-Chloroisopropyl)Ether	<10					
Bis(2-Ethylhexyl)Phthalate	6**					
4-Bromophenyl Phenyl Ether	<10					
4-Chloroaniline	<10					
2-Chloronaphthalene	<10					
4-Chlorophenyl Phenyl Ether	<10					
Chrysene	<10					
Di-n-Butyl Phthalate	2***					
Di-n-Octyl Phthalate	0.1***					
Dibenzo(a,h)Anthracene	<10					
Dibenzofuran	<10					
1,2-Dichlorobenzene	<10					
1,3-Dichlorobenzene	<10					
1,4-Dichlorobenzene	<10					
3,3'-Dichlorobenzidine	<20					
Diethyl Phthalate	<10					
Dimethyl Phthalate	<10					
2,4-Dinitrotoluene	<10					
2,6-Dinitrotoluene	<10					
Fluoranthene	<10					
Fluorene	<10					
Hexachlorobenzene	<10					
Hexachlorobutadiene	<10					
Hexachlorocyclopentadiene	<10					
Hexachloroethane	<10					
Indeno(1,2,3-cd)Pyrene	<10					
Isophorone	<10					
2-Methylnaphthalene	<10					
N-Nitrosodi-N-Propylamine	<10					
Naphthalene	<10					
2-Nitroaniline	<50					
3-Nitroaniline	<50					
4-Nitroaniline	<50					
Nitrobenzene	<10					
Phenanthrene	<10					
Pyrene	<10					
1,2,4-Trichlorobenzene	<10					
2,4,6-Trichlorophenol	<50					
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	<50					
4-Chloro-3-Methylphenol	<10					
2-Chlorophenol	<10					
2,4-Dichlorophenol	<10					
2,4-Dimethylphenol	<10					
2,4-Dinitrophenol	<50					
2-Methyl-4,6-Dinitrophenol	<50					
2-Methyl Phenol						
3-Methyl Phenol	<10					
4-Methyl Phenol	<10					
2-Nitrophenol	<10					
4-Nitrophenol	<50					
Pentachlorophenol	<50					
Phenol	9***					
2,4,6-Trichlorophenol	<10					

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-178			
PARAMETER				
	1988	1989	1990	1991
METALS (mg/L)				
Aluminum			1.3887	0.3938
Antimony			<0.6	<0.06
Arsenic	<0.005	<0.005	<0.6	<0.06
Barium	0.17***	<0.1	0.0553	0.0213
Beryllium	<0.001	<0.001	<0.003	<0.0003
Boron			0.038*	0.0186
Cadmium	<0.002	<0.002	<0.002	<0.002
Calcium	41	49	62.25	47.75
Chromium	<0.01	<0.01	<0.1	0.02***
Cobalt			<0.06	<0.006
Copper			0.15*	0.03**
Iron			5.175	2.361
Lead	<0.004	0.0107	0.141*	0.0545**
Lithium				
Magnesium	26.5	28.25	30	27.5
Manganese			0.192	0.0460*
Mercury	<0.0002	<0.0002	0.00038*	<0.0002
Molybdenum			<0.1	<0.01
Nickel		<0.01	<0.1	<0.1
Niobium				
Phosphorous				
Potassium	1.6425	2.9**	0.63***	0.8**
Selenium	<0.005	<0.005	<0.6	<0.06
Silver	<0.01	<0.01	<0.06	<0.006
Sodium	1.325	1.75	18.325	12.075
Strontium			0.0787	0.0313
Thallium				
Thorium	<0.2	<0.2	<2	<0.2
Titanium				
Uranium	<0.001	<0.001	0.001***	<0.001
Vanadium		<0.005	<0.06	<0.006
Zinc			1.1633	0.1883
Zirconium				
VOLATILE ORGANICS (ug/L)				
Acetone		<10	<10	<10
Benzene	<5	<5	<5	<5
Bromodichloromethane	<5	<5	2***	<5
Bromoform	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10
2-Butanone		<10	<10	<10
Carbon Disulfide		<5	<5	<5
Carbon Tetrachloride	4***	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10
2-Chloroethyl Vinyl Ether	<10			
Chloroform	<5	<5	15**	4*
Chloromethane	<10	<10	<10	<10
Dibromochloromethane				
1,1-Dichloroethane	3.333*	5.5	4.5**	5.25
1,2-Dichloroethane	<5	<5	<5	<5
1,1-Dichloroethene	2***	2	<5	2*
Trans-1,2-Dichloroethene	<5	<5	<5	<5
1,2-Dichloropropane	<5	<5	<5	<5
Cis-1,3-Dichloropropene	<5	<5	<5	<5
Trans-1,3-Dichloropropene	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5
2-Hexanone		<10	<10	<10
Methylene Chloride	<5	4***	<5	<5
4-Methyl-2-Pentanone		<10	<10	<10
Styrene		<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5
Tetrachloroethene	4***	0.85**	0.8***	2***
Toluene	<5	<5	<5	<5
1,1,1-Trichloroethane	32.75	35.5	20.5	27.25
1,1,2-Trichloroethane	<5	<5	<5	<5
Trichloroethene	<5	<5	<5	<5
Vinyl Acetate		<10	<10	<10
Vinyl Chloride	<10	<10	<10	<10
Xylenes		<5	<5	<5
RADIOCHEMICAL PARAMETERS				
Gross Alpha (pCi/L)	3.4275	2.1	1.385	3.49
Gross Beta (pCi/L)	34	5	0.8025	0.945
Radium (Bq/L)		0		
ANIONS (mg/L)				
Chloride	1.95	2	11.5	9.333*
Fluoride	<0.1	<0.2	0.35**	0.1**
Nitrate (as N)	0.28	0.285	0.425	0.4733*
Sulfate	1.925	1.75	13.75	8
FIELD MEASUREMENTS				
Conductivity (umhos/cm)	400	371	409	419
pH	7.775	7.125	7.6	7.325
Dissolved Oxygen (mg/L)		9.75	8	7.5
Redox (mV)		307.75	315.6	228
Temperature (degrees Celsius)		15.15	15.375	14.325
Water Level (ft +/- grade)		-88.61	-85.25	
MISCELLANEOUS PARAMETERS				
Turbidity (NTU)		24.2333	1600.975	637.4
Total Suspended Solids (mg/L)	9.25	19.333*	39.5	5.667*
Total Dissolved Solids (mg/L)	248	207.5	282	286.5

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-179					
PARAMETER	1986	1987	1988	1989	1990	1991
METALS (mg/L)						
Aluminum	3.655	2.8935			0.135	0.5988
Antimony	<0.05	<0.05			<0.05	<0.05
Arsenic	0.013***	<0.005	<0.005		0.051**	<0.05
Barium	0.0165	1.2595	0.22***		0.03	0.028
Beryllium	0.0013**	<0.0013*	<0.001	<0.0003	<0.0003	<0.0003
Boron	0.0695	0.034			0.02	0.0207*
Cadmium	<0.003	<0.003	<0.002		<0.002	0.0041**
Calcium	288.75	46	93	88	86.75	72.75
Chromium	0.116**	0.0176	0.0176*	0.012	0.029**	0.033***
Cobalt	0.013***	<0.005			<0.005	<0.005
Copper	0.3978	0.0416			0.0727	0.0698
Iron	10.18	4.315			0.39	1.6
Lead	0.0283	0.038*	0.1087	0.0058	0.0375	0.0127*
Lithium	0.02***	0.011*				
Magnesium	156.5	30.5	56.333	50	52.5	42.75
Manganese	0.2878	0.1455			0.019	0.0348
Mercury	0.0003**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum	<0.01	<0.01			<0.01	<0.01
Nickel	0.15***	0.024*		<0.01	<0.1	<0.1
Niobium	0.0074**	0.026*				
Phosphorous	0.75***	<0.2				
Potassium	4.333*	2.25	3.567	<0.6	4.1	4.2
Selenium	<0.005	<0.005	<0.005		<0.05	<0.05
Silver	<0.006	<0.006	<0.01		<0.006	<0.006
Sodium	1.45	2.35	3.2	4.3	2.875	2.65
Strontium	0.0274	0.0495			0.031	0.0303
Thallium	<0.01	<0.01				
Thorium	<0.2	<0.2	<0.2		<0.2	<0.2
Titanium	0.1675**	0.13*				
Uranium	0.0058	0.0045	0.002	<0.001	0.001**	0.001*
Vanadium	0.045***	0.0084*		<0.005	<0.005	0.005***
Zinc	0.215	0.0935			0.021*	0.0191
Zirconium	0.0095**	<0.005				
VOLATILE ORGANICS (ug/L)						
Acetone	<10	15		<10	7.5**	<20
Benzene	1***	<5	<5	<5	1***	<10
Bromodichloromethane	<5	<5	<5	<5	<25	<10
Bromoform	<5	<5	<5	<5	<25	<10
Bromomethane	<10	<10	<10	<10	<50	<20
2-Butanone	<10	10*		1	<50	<20
Carbon Disulfide	<5	<5		<5	<25	<10
Carbon Tetrachloride	110***	<5	100**	<5	40***	<10
Chlorobenzene	<5	<5	<5	<5	<25	<10
Chlorodibromomethane			<5	<5	<25	<10
Chloroethane	6**	<10	3**	<10	<50	<20
2-Chloroethyl Vinyl Ether	<10	<10	<10			
Chloroform	6.5**	1*	2.5*	<5	<25	<10
Chloromethane	<10	<10	<10	<10	<50	<20
Dibromochloromethane	<5	<5				
1,1-Dichloroethane	182.5	215	263.333	200	115	88.25
1,2-Dichloroethane	2***	1*	1.5*	<5	<25	<10
1,1-Dichloroethene	60.5	35.5	65	75	50.5	38.5
Trans-1,2-Dichloroethene	1***	<5	<5	<5	<25	<10
1,2-Dichloropropane	<5	<5	<5	<5	<25	<10
Cis-1,3-Dichloropropene	<5	<5	<5	<5	<25	<10
Trans-1,3-Dichloropropene	<5	<5	<5	<5	<25	<10
Ethylbenzene	<5	<5	0.8**	<5	<25	<10
2-Hexanone	<10	<10		<10	<50	<20
Methylene Chloride	1***	1*	<5	<5	2***	<10
4-Methyl-2-Pentanone	<10	<10		<10	<50	<20
Styrene	1***	<5		<5	<25	<10
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5	13***	<10
Tetrachloroethene			11	12	5*	4
Toluene	8.5**	1.5	<5	<5	<25	3***
1,1,1-Trichloroethane	795	760	856.667	550	272.5	197.5
1,1,2-Trichloroethane	<5	<5	<5	<5	<25	<10
Trichloroethene	5***	<5	<5	<5	<25	<10
Vinyl Acetate	<10	<10		<10	<50	<20
Vinyl Chloride	<10	<10	<10	<10	<50	<20
Xylenes	1**	1*		<5	<25	<10
RADIOCHEMICAL PARAMETERS						
Gross Alpha (pCi/L)	5.4**	<3	6	6	2.945	2.62
Gross Beta (pCi/L)	110**	4.6*	18.333	15	11.27	8.1025
Radium (Bq/L)	0.15***	<0.1				
ANIONS (mg/L)						
Chloride	1.525	1.55	1.2	1	2	2.25
Fluoride	0.0967*	<0.1	<0.1	<0.1	<0.1	<0.1
Nitrate (as N)	0.14***	0.18	0.21	0.2	0.3	0.545
Sulfate	12.45	8.95	7	6	4.5	4
FIELD MEASUREMENTS						
Conductivity (umhos/cm)	447.5	425	503	521	500.5	468
pH	7.925	6.4	7.333	7.8	7.8	7.4
Dissolved Oxygen (mg/L)	8.85	7.35		10.8	7.025	6.575
Redox (mV)	231	278		252	178.25	208.25
Temperature (degrees Celsius)	15.825	14.05		17.1	16.175	15.1
Water Level (ft +/- grade)	-109.8	-109.1		-111.3	-109	
MISCELLANEOUS PARAMETERS						
Turbidity (NTU)	111**	89		18	142.5	69.375
Total Suspended Solids (mg/L)		545	169	122	292.25	116
Total Dissolved Solids (mg/L)			258.5	298	275	279.5

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-179					
PARAMETER	1986	1987	1988	1989	1990	1991
PESTICIDES (ug/L)						
gamma-BHC (Lindane)	<0.02					
2,4-D	<2					
Endrin	<0.1					
Methoxychlor	<0.08					
Silvex	<0.2					
Toxaphene	<2					
BASE/NEUTRAL EXTRACTABLES (ug/L)						
Acenaphthene	<10					
Acenaphthylene	<10					
Anthracene	<10					
Benzidine	<80					
Benzo(a)Anthracene	<10					
Benzo(a)Pyrene	<10					
Benzo(b)Fluoranthene	<10					
Benzo(g,h,i)Perylene	<10					
Benzo(k)Fluoranthene	<10					
Benzyl Alcohol	<10					
Benzyl Butyl Phthalate	0.8**					
Bis(2-Chloroethoxy)Methane	<10					
Bis(2-Chloroethyl)Ether	<10					
Bis(2-Chloroisopropyl)Ether	<10					
Bis(2-Ethylhexyl)Phthalate	656**					
4-Bromophenyl Phenyl Ether	<10					
4-Chloroaniline	<10					
2-Chloronaphthalene	<10					
4-Chlorophenyl Phenyl Ether	<10					
Chrysene	<10					
Di-n-Butyl Phthalate	3**					
Di-n-Octyl Phthalate	16**					
Dibenzo(a,h)Anthracene	<10					
Dibenzofuran	<10					
1,2-Dichlorobenzene	<10					
1,3-Dichlorobenzene	<10					
1,4-Dichlorobenzene	<10					
3,3'-Dichlorobenzidine	<20					
Diethyl Phthalate	1**					
Dimethyl Phthalate	<10					
2,4-Dinitrotoluene	<10					
2,6-Dinitrotoluene	<10					
Fluoranthene	<10					
Fluorene	<10					
Hexachlorobenzene	<10					
Hexachlorobutadiene	<10					
Hexachlorocyclopentadiene	<10					
Hexachloroethane	<10					
Indeno(1,2,3-cd)Pyrene	<10					
Isophorone	<10					
2-Methylnaphthalene	<10					
N-Nitrosodi-N-Propylamine	<10					
Naphthalene	<10					
2-Nitroaniline	<50					
3-Nitroaniline	<50					
4-Nitroaniline	<50					
Nitrobenzene	<10					
Phenanthrene	<10					
Pyrene	<10					
1,2,4-Trichlorobenzene	<10					
2,4,6-Trichlorophenol	<50					
ACID EXTRACTABLES (ug/L)						
Benzoic Acid	<50					
4-Chloro-3-Methylphenol	<10					
2-Chlorophenol	<10					
2,4-Dichlorophenol	<10					
2,4-Dimethylphenol	<10					
2,4-Dinitrophenol	<50					
2-Methyl-4,6-Dinitrophenol	<50					
2-Methyl Phenol						
3-Methyl Phenol	<10					
4-Methyl Phenol	<10					
2-Nitrophenol	<10					
4-Nitrophenol	<50					
Pentachlorophenol	<50					
Phenol	<10					
2,4,6-Trichlorophenol	<10					

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-180			
PARAMETER				
	1988	1989	1990	1991
METALS (mg/L)				
Aluminum			0.0405*	0.0825**
Antimony			<0.6	<0.06
Arsenic	<0.005	<0.005	0.083***	<0.05
Barium	0.19***	<0.1	0.0277	0.0275
Beryllium	<0.001	<0.001	<0.0003	<0.0003
Boron			0.0125*	0.0080**
Cadmium	<0.002	<0.002	<0.003	<0.003
Calcium	48.75	59.25	57.75	58
Chromium	0.014**	<0.01	<0.01	<0.01
Cobalt			<0.005	<0.005
Copper			0.03915*	<0.004
Iron			0.0251*	0.049**
Lead	0.0048**	0.0059**	0.013***	<0.004
Lithium				
Magnesium	31.25	37.75	37	38.5
Manganese			<0.001	0.019***
Mercury	<0.0002	<0.0002	<0.0002	<0.0002
Molybdenum			<0.01	<0.01
Nickel		<0.01	<0.01	<0.01
Niobium				
Phosphorous				
Potassium	2.6475	3.05	1.08	0.97
Selenium	<0.005	<0.005	<0.05	<0.05
Silver	<0.01	<0.01	<0.008	<0.008
Sodium	0.935	0.8475	0.6375	0.77
Strontium			0.0203	0.019
Thallium				
Thorium	<0.2	<0.2	<.2	<0.2
Titanium				
Uranium	<0.001	0.004***	<0.001	<0.001
Vanadium		<0.005	<0.005	<0.005
Zinc			0.0103	0.0091
Zirconium				
VOLATILE ORGANICS (ug/L)				
Acetone		<10	6***	<10
Benzene	<5	<5	0.9***	<5
Bromodichloromethane	<5	<5	5	<5
Bromoform	<5	<5	<5	<5
Bromomethane	<10	<10	<10	<10
2-Butanone		<10	<10	<10
Carbon Disulfide		<5	<5	<5
Carbon Tetrachloride	<5	<5	<5	<5
Chlorobenzene	<5	<5	<5	<5
Chlorodibromomethane	<5	<5	<5	<5
Chloroethane	<10	<10	<10	<10
2-Chloroethyl Vinyl Ether	<10			
Chloroform	0.6***	<5	<5	<5
Chloromethane	<10	<10	<10	<10
Dibromochloromethane				
1,1-Dichloroethane	14.75	11.25	3.5	3.667*
1,2-Dichloroethane	<5	<5	<5	<5
1,1-Dichloroethene	1***	1***	<5	3***
Trans-1,2-Dichloroethene	24.333	13*	7.75	5**
1,2-Dichloropropane	<5	<5	<5	<5
Cis-1,3-Dichloropropene	<5	<5	<5	<5
Trans-1,3-Dichloropropene	<5	<5	<5	<5
Ethylbenzene	<5	<5	<5	<5
2-Hexanone		<10	<10	<10
Methylene Chloride	3***	<5	2***	<5
4-Methyl-2-Pentanone		<10	<10	<10
Styrene		<5	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5	<5	<5
Tetrachloroethene	182.5	116.5	82.25	85
Toluene	1***	<5	<5	<5
1,1,1-Trichloroethane	9	8	3.5	2.5
1,1,2-Trichloroethane	<5	<5	<5	<5
Trichloroethene	6.25	4	2.5	1.5
Vinyl Acetate		<10	2***	<10
Vinyl Chloride	<10	<10	<10	<10
Xylenes		<5	<5	<5
RADIOCHEMICAL PARAMETERS				
Gross Alpha (pCi/L)	0.0125	2.2	1.2525	2.2975
Gross Beta (pCi/L)	4.375	48.25	2.38	0.73
Radium (Bq/L)		0.011		
ANIONS (mg/L)				
Chloride	2	2	2	2
Fluoride	0.8***	<0.2	0.1***	<0.1
Nitrate (as N)	0.12***	0.14***	0.2*	0.3325
Sulfate	4.4667*	1.5	1**	<1
FIELD MEASUREMENTS				
Conductivity (umhos/cm)	483.25	579.5	487.5	497.5
pH	7.425	6.975	7.05	7.15
Dissolved Oxygen (mg/L)		7.45	6.65	5.25
Redox (mV)		287.25	185.1	286
Temperature (degrees Celsius)		14.325	14.65	15.225
Water Level (ft +/- grade)		-91.03	-91.5	
MISCELLANEOUS PARAMETERS				
Turbidity (NTU)		0.8667	1.575	0.31
Total Suspended Solids (mg/L)	1**	1.5**	2.5**	1***
Total Dissolved Solids (mg/L)	288.5	291.5	295.5	300

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-322			
PARAMETER				
	1988	1989	1990	1991
METALS (mg/L)				
Aluminum			2.2433	1.1398
Antimony			<0.05	<0.05
Arsenic	0.00975*	<0.005	<0.05	<0.05
Barium	0.45***	<0.1	0.0184	0.0131
Beryllium	0.00165*	<0.001	0.0015**	0.00092*
Boron			0.018*	0.0918
Cadmium	<0.002	<0.002	<0.003	<0.003
Calcium	53.75	30.75	52	39.75
Chromium	0.012**	<0.01	<0.01	<0.01
Cobalt			0.0085**	<0.005
Copper			0.029	0.011***
Iron			3.9867	1.8983
Lead	0.03167*	0.0081	0.0227**	0.0142**
Lithium				
Magnesium	30.5	19	32.75	25.5
Manganese			0.1723	0.0408
Mercury	<0.0002	<0.0002	0.0004**	<0.0002
Molybdenum			<0.01	<0.01
Nickel		0.013**	0.011***	<0.01
Niobium				
Phosphorous				
Potassium	2.325	2.0087*	0.97	1.5***
Selenium	<0.005	<0.005	<0.05	<0.05
Silver	<0.01	<0.01	<0.008	<0.008
Sodium	0.575	0.5275	0.545	0.6825
Strontium			0.0197	0.014
Thallium				
Thorium	<0.2	<0.2	<0.2	<0.2
Titanium				
Uranium	0.003**	<0.001	0.002***	0.001***
Vanadium		<0.005	0.022***	0.016***
Zinc			0.0689	0.0373
Zirconium				
VOLATILE ORGANICS (ug/L)				
Acetone		20***	38***	<50
Benzene	<5	<25	4***	<25
Bromodichloromethane	<5	<25	<25	<25
Bromoform	<5	<25	<25	<25
Bromomethane	<10	<50	<50	<50
2-Butanone		<50	<50	<50
Carbon Disulfide		<25	<25	<25
Carbon Tetrachloride	83**	<25	<25	<25
Chlorobenzene	<5	<25	<25	<25
Chlorodibromomethane	<5	<25	<25	<25
Chloroethane	<10	<50	<50	<50
2-Chloroethyl Vinyl Ether	<10			
Chloroform	0.7333*	1**	<25	<25
Chloromethane	<10	<50	<50	<50
Dibromochloromethane				
1,1-Dichloroethane	33.75	40.25	57.5	66
1,2-Dichloroethane	2.333*	2.5**	<25	<25
1,1-Dichloroethene	92.25	90.75	103.75	112.5
Trans-1,2-Dichloroethene	<5	<25	<25	<25
1,2-Dichloropropane	<5	<25	<25	<25
Cis-1,3-Dichloropropene	<5	<25	<25	<25
Trans-1,3-Dichloropropene	<5	<25	<25	<25
Ethylbenzene	<5	<25	<25	<25
2-Hexanone		<50	<50	<50
Methylene Chloride	<5	<25	11***	<25
4-Methyl-2-Pentanone		<50	<50	<50
Styrene		<25	<25	<25
1,1,2,2-Tetrachloroethane	<5	<25	<25	<25
Tetrachloroethene	5.75	5*	6.333*	7**
Toluene	<5	<25	<25	<25
1,1,1-Trichloroethane	687.5	560	582.5	447.5
1,1,2-Trichloroethane	<5	<25	<25	<25
Trichloroethene	2***	<25	<25	<25
Vinyl Acetate		<50	9***	<50
Vinyl Chloride	<10	<50	<50	<50
Xylenes		<25	<25	<25
RADIOCHEMICAL PARAMETERS				
Gross Alpha (pCi/L)	6.3525	1.85	1.6933*	2.55
Gross Beta (pCi/L)	25.745	40.875	1.905**	2.8425
Radium (Bq/L)		0.037		
ANIONS (mg/L)				
Chloride	1.95	2	2	2
Fluoride	0.1***	<0.2	<0.1	<0.1
Nitrate (as N)	0.23	0.255	0.2667*	0.5***
Sulfate	1***	1*	1.333*	1**
FIELD MEASUREMENTS				
Conductivity (umhos/cm)	275	286.5	291.75	304
pH	7.75	7.525	7.85	7.725
Dissolved Oxygen (mg/L)		7.825	7.125	7.15
Redox (mV)		283.25	282.025	268
Temperature (degrees Celsius)		15.45	15.475	15.4
Water Level (ft +/- grade)		-148.088	-143.5	
MISCELLANEOUS PARAMETERS				
Turbidity (NTU)		3.0667	110.75	52
Total Suspended Solids (mg/L)	61.75	6**	174	44.75
Total Dissolved Solids (mg/L)	178	143	180	189.5

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-611	
PARAMETER		
	1990	1991
METALS (mg/L)		
Aluminum	0.113	0.1108
Antimony	<0.6	<0.06
Arsenic	0.081**	<0.06
Barium	0.233	0.01925
Beryllium	<0.0003	<0.0003
Boron	0.0145*	0.0236**
Cadmium	0.003**	<0.003
Calcium	42.25	54
Chromium	0.018***	0.014***
Cobalt	<0.005	<0.005
Copper	0.0108	<0.004
Iron	0.203	0.415
Lead	<0.004	0.0074**
Lithium		
Magnesium	28	30.5
Manganese	0.0074	0.0148*
Mercury	<0.0002	<0.0002
Molybdenum	<0.01	<0.01
Nickel	0.019***	0.011***
Niobium		
Phosphorous		
Potassium	6.46	0.85
Selenium	<0.05	<0.05
Silver	<0.008	<0.008
Sodium	1.9	1.8667*
Strontium	0.0213	0.0183
Thallium		
Thorium	<0.2	<0.2
Titanium		
Uranium	0.0017*	0.001**
Vanadium	<0.005	<0.005
Zinc	0.0112	0.0116**
Zirconium		
VOLATILE ORGANICS (ug/L)		
Acetone	<10	<10
Benzene	<5	<5
Bromodichloromethane	<5	<5
Bromoform	<5	<5
Bromomethane	<10	<10
2-Butanone	<10	<10
Carbon Disulfide	<5	<5
Carbon Tetrachloride	<5	2***
Chlorobenzene	<5	<5
Chlorodibromomethane	<5	<5
Chloroethane	<10	<10
2-Chloroethyl Vinyl Ether		
Chloroform	<5	<5
Chloromethane	<10	<10
Dibromochloromethane		
1,1-Dichloroethane	1.5**	1.333*
1,2-Dichloroethane	<5	<5
1,1-Dichloroethene	2**	2***
Trans-1,2-Dichloroethene	<5	<5
1,2-Dichloropropane	<5	<5
Cis-1,3-Dichloropropene	<5	<5
Trans-1,3-Dichloropropene	<5	<5
Ethylbenzene	<5	<5
2-Hexanone	<10	<10
Methylene Chloride	<5	1***
4-Methyl-2-Pentanone	<10	<10
Styrene	<5	<5
1,1,2,2-Tetrachloroethane	<5	<5
Tetrachloroethene	<5	<5
Toluene	<5	<5
1,1,1-Trichloroethane	14.25	10.667*
1,1,2-Trichloroethane	<5	<5
Trichloroethene	<5	<5
Vinyl Acetate	<10	<10
Vinyl Chloride	<10	<10
Xylenes	<5	<5
RADIOCHEMICAL PARAMETERS		
Gross Alpha (pCi/L)	1.8925	1.8525
Gross Beta (pCi/L)	6.3	0.97
Radium (Bq/L)		
ANIONS (mg/L)		
Chloride	1.5	2.25
Fluoride	0.1***	<0.1
Nitrate (as N)	3.15	2.78
Sulfate	6.5	2.5
FIELD MEASUREMENTS		
Conductivity (umhos/cm)	355.5	446.5
pH	8.3	7.7
Dissolved Oxygen (mg/L)	8.625	8.175
Redox (mV)	245.2	208.5
Temperature (degrees Celsius)	14.925	16.55
Water Level (ft +/- grade)	-94.87	
MISCELLANEOUS PARAMETERS		
Turbidity (NTU)	16	4.975
Total Suspended Solids (mg/L)	18.5	5.5
Total Dissolved Solids (mg/L)	217	288

ANNUAL AVERAGES - Continued

MONITORING WELL	GW-612	
PARAMETER		
	1990	1991
METALS (mg/L)		
Aluminum	0.036**	0.088***
Antimony	<0.05	<0.05
Arsenic	0.072**	<0.05
Barium	0.0137	0.0143
Beryllium	<0.0003	<0.0003
Boron	0.17	0.165
Cadmium	<0.003	<0.003
Calcium	36	37
Chromium	<0.01	<0.01
Cobalt	<0.005	<0.005
Copper	0.017**	0.0103*
Iron	0.1783	0.1828
Lead	0.0092**	<0.004
Lithium		
Magnesium	26.25	25.25
Manganese	0.0105*	0.0074
Mercury	<0.0002	<0.0002
Molybdenum	<0.01	<0.01
Nickel	<0.01	0.025***
Niobium		
Phosphorous		
Potassium	2.15	0.9775
Selenium	<0.05	<0.05
Silver	<0.008	<0.008
Sodium	0.745	0.6125
Strontium	0.0157	0.015
Thallium		
Thorium	<0.2	<0.2
Titanium		
Uranium	<0.001	0.001
Vanadium	<0.005	<0.005
Zinc	0.0127	0.0139*
Zirconium		
VOLATILE ORGANICS (ug/L)		
Acetone	11***	<20
Benzene	2***	<10
Bromodichloromethane	<25	<10
Bromoform	<25	<10
Bromomethane	<50	<20
2-Butanone	<50	<20
Carbon Disulfide	<25	<10
Carbon Tetrachloride	<25	<10
Chlorobenzene	<25	<10
Chlorodibromomethane	<25	<10
Chloroethane	<50	<20
2-Chloroethyl Vinyl Ether		
Chloroform	<25	<10
Chloromethane	<50	<20
Dibromochloromethane		
1,1-Dichloroethane	160	122.5
1,2-Dichloroethane	5**	4
1,1-Dichloroethene	61.5	69
Trans-1,2-Dichloroethene	<25	<10
1,2-Dichloropropane	<25	<10
Cis-1,3-Dichloropropene	<25	<10
Trans-1,3-Dichloropropene	<25	<10
Ethylbenzene	<25	<10
2-Hexanone	<50	<20
Methylene Chloride	5***	<10
4-Methyl-2-Pentanone	<50	7***
Styrene	<25	<10
1,1,2,2-Tetrachloroethane	<25	<10
Tetrachloroethene	8.25	10.75
Toluene	<25	3.5**
1,1,1-Trichloroethane	282.5	255
1,1,2-Trichloroethane	<25	<10
Trichloroethene	<25	1***
Vinyl Acetate	3***	<20
Vinyl Chloride	<50	<20
Xylenes	<25	<10
RADIOCHEMICAL PARAMETERS		
Gross Alpha (pCi/L)	1.7475	1.7075
Gross Beta (pCi/L)	2.9075	2.2825
Radium (Bq/L)		
ANIONS (mg/L)		
Chloride	2.075	2
Fluoride	<0.1	<0.1
Nitrate (as N)	0.225	0.2825
Sulfate	2.85	2.5
FIELD MEASUREMENTS		
Conductivity (umhos/cm)	342.25	389
pH	8.025	7.575
Dissolved Oxygen (mg/L)	6.475	5.275
Redox (mV)	234	205.5
Temperature (degrees Celsius)	15.075	15.4
Water Level (ft +/- grade)	-112.2	
MISCELLANEOUS PARAMETERS		
Turbidity (NTU)	1.75	1.7875
Total Suspended Solids (mg/L)	2.75	1.25
Total Dissolved Solids (mg/L)	207.5	210

* one reading below detection limit
** two readings below detection limit
*** three readings below detection limit

APPENDIX B

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR Y-12 CHESTNUT RIDGE OPERABLE UNIT 1

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR Y-12 CHESTNUT RIDGE OPERABLE UNIT ONE

1. Introduction

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 was passed by Congress and signed into law on December 11, 1980 (Public Law 96-510). This act was intended to provide for "liability, compensation, cleanup, and emergency response for hazardous substances released into the environment and the cleanup of inactive waste disposal sites." The Superfund Amendments and Reauthorization Act (SARA), adopted on October 17, 1986 (Public Law 99-499), did not substantially alter the original structure of CERCLA but provided extensive amendments to it.

In particular, §121 of CERCLA specifies that remedial actions for cleanup of hazardous substances must comply with requirements or standards under federal or more stringent state environmental laws that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site. Inherent in the interpretation of applicable or relevant and appropriate requirements (ARARs) is the assumption that protection of human health and the environment is ensured.

The purpose of this report is to supply a preliminary list of available federal and state chemical- and location-specific ARARs that might be considered for cleanup of Chestnut Ridge Operable Unit 1 (CROU1). CROU1 is the Chestnut Ridge Security Pits Hazardous Waste Disposal Unit (HWDU) located on the crest of Chestnut Ridge, southeast of the central portion of the Y-12 Plant. Operated since 1973, the unit consists of a series of trenches that were used for the disposal of classified hazardous and nonhazardous wastes until December 1984 and November 1988, respectively. The Unit was closed in 1988 in accordance with a Tennessee Department of Environment and Conservation (TDEC)-approved Resource Conservation and Recovery Act (RCRA) closure plan which required a low-permeability, low-maintenance cover over the trenches. Groundwater impacts from the disposal operations are the primary focus of this Remedial Investigation (RI). Soil samples will be taken around the perimeter of the cap to determine the possible spread of contamination beyond the boundaries of the cap. Remedial alternatives analyzed during the feasibility study (FS) will address on-site control of the source of any groundwater contamination and, possibly, direct remediation of the groundwater itself depending on the nature and extent of the contamination identified. Contaminants of concern identified for CROU1 include volatile organic compounds (VOCs), metals and radionuclides.

The Chestnut Ridge Security Pits HWDU was afforded interim status under TDEC Rule 1200-1-11-.07(3). The waste disposed of in the trenches is known to have been RCRA-hazardous. Therefore, the Chestnut Ridge HWDU was closed under RCRA as an interim status hazardous waste landfill in 1988, pursuant to TDEC Rule 1200-1-11-.05(14)(e). Final closure certification was approved by TDEC in November 1990, and the site is subject to post-closure care under TDEC Rule 1200-1-11-.06(7)(g) and (h). Accordingly, any ARARs identified under RCRA will be legally applicable at this site for cleanup under CERCLA. RCRA ARARs pertain, for the most part, to specific types of actions or facilities and will be addressed more thoroughly as remedial alternatives are developed during the FS.

The process of ARAR identification is an iterative one that is continually changing as the RI/FS progresses. Therefore, this list of ARARs represents a compilation of potential ARARs, of which subsets will be used or additional ARARs added as further site characterization is done.

It is understood that the Department of Energy (DOE) will comply with the requirements of the National Environmental Policy Act (NEPA) as specified in DOE Order 5440.1D (*National Environmental Policy Act Compliance Program*). Further, DOE Order 5400.4 (*Comprehensive Environmental Response, Compensation, and Liability Act Requirements*) calls for integration of NEPA and CERCLA requirements for DOE remedial actions at CERCLA sites. This issue has been reaffirmed in the Federal Facilities Agreement (FFA) for the Oak Ridge Reservation (ORR) §I(A)(3) and §III(A)(2) and Secretary of Energy Notice (SEN) of February 5, 1990 (SEN-15-90), which was issued to ensure that DOE's NEPA activities are carried out in a centralized and uniform manner. Therefore, the regulations found in NEPA will not be addressed in this report as ARARs; however, the regulations that are triggered by the presence of certain resources are discussed below (Sect. 4).

Similarly, DOE addresses occupational safety in DOE Orders 5480.11 (*Radiation Protection for Occupational Workers*), 5480.4 (*Environmental Protection, Safety, and Health Protection Standards*), 5483.1A (*Occupational Safety and Health Program for Contractors at GOCO Facilities*), 5480.9 (*Construction Safety and Health Program*), and 5480.10 (*Contractor Industrial Hygiene Program*). However, ARARs apply to those federal and state regulations that are designed to protect the environment, and do not generally apply to occupational safety regulations. Therefore, the DOE Orders related to occupational safety, as well as the regulations promulgated by the Occupational Safety and Health Administration (OSHA), are not addressed as ARARs unless they specifically apply to remedial action goals. The OSHA regulations will be addressed in the Health and Safety Plan for this OU.

1.1 Definitions

Applicable requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site" (40 CFR 300.5).

Relevant and appropriate requirements are "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site" (40 CFR 300.5).

Requirements under federal or state law may be *either* applicable *or* relevant and appropriate to CERCLA cleanup actions, but not both. However, requirements must be *both* relevant *and* appropriate for compliance to be necessary. In the case where a federal and a state ARAR are available, or where there are two potential ARARs addressing the same issue, the more stringent regulation must be selected. However, CERCLA §121(d)(4) provides several ARAR waiver options that may be invoked, providing that the basic premise of protection of human health and the environment is not ignored. A waiver is available for state standards that have not been

applied uniformly in similar circumstances across the state. In addition, CERCLA §121(d)(2)(C) forbids state standards that effectively prohibit land disposal of hazardous substances.

CERCLA on-site remedial response actions must only comply with the substantive requirements of a regulation and not the administrative requirements to obtain federal, state, or local permits [CERCLA §121(e) and FFA §XXII]. To ensure that CERCLA response actions proceed as rapidly as possible, EPA has reaffirmed this position in the final NCP (55 *FR* 8756, March 8, 1990). **Substantive requirements** pertain directly to the actions or conditions at a site, while **administrative requirements** facilitate their implementation. The Environmental Protection Agency (EPA) recognizes that certain of the administrative requirements, such as consultation with state agencies and reporting, are accomplished through the state involvement and public participation requirements of the NCP. These administrative requirements should be observed if they are useful in determining cleanup standards at the site (55 *FR* 8757).

In the absence of federal- or state-promulgated regulations, there are many criteria, advisories, guidance values, and proposed standards that are not legally binding but may serve as useful guidance for setting protective cleanup levels. These are not potential ARARs but are **"to-be-considered" (TBC)** guidance.

2. Chemical-specific ARARs

"Chemical-specific requirements set health- or risk-based concentration limits or discharge limitations in various environmental media for specific hazardous substances, pollutants, or contaminants" (53 *FR* 51437). These requirements generally set protective cleanup levels for the chemicals of concern in the designated media or else indicate a safe level of discharge that may be incorporated when considering a specific remedial activity. Although limited in number, chemical-specific standards have been established under several statutes, including RCRA, the Safe Drinking Water Act (SDWA), the Clean Water Act (CWA), and the Clean Air Act (CAA).

2.1 Groundwater

As stated in the NCP (55 *FR* 8666, March 8, 1990), the goal of EPA's approach to cleanup of contaminated groundwater is to return usable groundwater to its beneficial use within a given time frame that is reasonable for the particular circumstances at a CERCLA site. The Ground Water Management Section of the Tennessee Division of Water Supply is in the process of developing a groundwater classification system for Tennessee groundwaters. The draft classification has been revised several times and will be resubmitted for public comment in July 1993; a final version is expected by late 1993. At that time, the document should be consulted to determine which groundwater classification will be legally applicable to CROU1 groundwater. Final determination of ARARs will depend on the chosen groundwater classification.

In the NCP, EPA states the preference for SDWA maximum contaminant levels (MCLs) and nonzero maximum contaminant level goals (MCLGs) or other health-based standards, criteria, or guidance for cleanup of Class I and Class II (current or potential sources of drinking water) groundwater at CERCLA sites (55 *FR* 8732). Alternate concentration limits (ACLs) may also be used when active restoration of the groundwater to MCLs or nonzero MCLGs is not practicable (55 *FR* 8754). For Class III (not a potential source of drinking water) groundwaters, EPA establishes remediation levels based on specific site conditions, the beneficial use of the

groundwater, and environmental receptors (55 *FR* 8732). Federal MCLs/MCLGs and action levels for contaminants of concern at CROU1 are listed in Table 1.

MCLs are enforceable standards that take into consideration human health effects, available treatment technologies, and costs of treatment. MCLGs are strictly health-based standards that disregard cost or treatment feasibility and are not legally enforceable. MCLs are legally applicable to water "at the tap" but are not usually legally applicable to cleanup of groundwater or surface water. However, they may be considered as relevant and appropriate in situations where groundwater or surface water may be used for drinking water. CERCLA §121(d)(2)(A) specifically mentions that remedial actions must require a level or standard of control that at least attains MCLGs and federal ambient water quality criteria (WQC) where such goals or criteria are relevant and appropriate under the circumstances of the release. Although MCLGs and WQC are nonenforceable guidelines, Congress elevated them to a higher status by specifically mentioning them in CERCLA. Therefore, promulgated MCLGs are also listed in Table 1. At present, EPA is planning to use the SDWA MCLs for remedial action compliance for carcinogens that have an MCLG of zero and any nonzero MCLG for systemic toxicants (55 *FR* 8752).

EPA has revised its drinking water standards for lead, eliminating the MCL and replacing it with an "action level" of 15 μg/L (56 *FR* 26460, June 7, 1991), applicable to community and nontransient, noncommunity water systems. Included in the national primary drinking water regulation is a treatment technique requirement. If the action level for lead is exceeded at the tap, a state is required to analyze source water samples and to decide what treatment levels are necessary to minimize lead levels delivered to users from the affected distribution system. In the instance of contaminated groundwater at CROU1, the action level for lead is neither legally applicable nor relevant and appropriate at this time, although the Tennessee proposed draft rule, *Hazardous Substance Site Remedial Action* (Chapter 1200-1-13, August 4, 1992), cites federal MCLs and action levels as cleanup levels for groundwater remedial action sites. The EPA Office of Solid Waste and Emergency Response (OSWER) has recommended that a final cleanup level of 15 μg/L for lead in groundwater usable for drinking water is protective of sensitive populations (OSWER memorandum dated June 21, 1990). This might be considered TBC guidance for remediation of lead-contaminated groundwater.

Chapter 1200-5-1 of the Rules of the Tennessee Department of Environment and Conservation (TDEC), as amended effective January 10, 1991, lists MCLs for public water systems which are identical to the federal MCLs in effect at that time. These regulations have since been revised to incorporate the recent revisions in federal MCLs, therefore they are not repeated here.

National Secondary Drinking Water Standards (NSDWS) regulate contaminants that affect the aesthetic qualities related to public acceptance of drinking water and are implemented in 40 CFR 143.3 as secondary maximum contaminant levels (SMCLs). These regulations are not federally enforceable but rather are intended to serve as guidelines for use by states in regulating water supplies. Tennessee has promulgated SMCLs in TDEC Rule 1200-5-.12. These regulations are designed to provide water to the consumer which is aesthetically pleasing. They apply to all community water systems and to those noncommunity water systems "as may be deemed necessary" by TDEC. In that context, they would not be legally applicable to cleanup of groundwater or surface water but may be considered as relevant and appropriate in instances where these media may provide private drinking water sources. SMCLs are listed and footnoted as such in Table 1 for those contaminants which currently have no MCL or MCLG.

Since CROU1 has been closed under RCRA, it is subject to RCRA corrective action regulations. The 40 CFR 264 Subpart F regulations on groundwater protection at RCRA regulated units are legally applicable; these include groundwater protection standards and groundwater requirements. Subtitle C of RCRA lists maximum concentration levels for 14 chemicals; the concentration of these chemicals in groundwater at the plant boundary of a RCRA-permitted treatment, storage, or disposal (TSD) facility may not exceed the stated maximum concentration level [Title 40, Code of Federal Regulations, Part 264, §94 (40 CFR 264.94)]. In addition, background concentrations or ACLs are established in 40 CFR 264.94 as groundwater protection standards. Table 1 lists RCRA maximum concentration levels; however, as mentioned above, EPA has specified SDWA MCLs and nonzero MCLGs for cleanup of Class I and Class II groundwater and site-specific remediation levels for Class III groundwaters. This approach is consistent with the substantive requirements of RCRA maximum concentration levels, ACLs, or background limits (53 *FR* 51433).

The TDEC Division of Superfund has issued a draft rule, *Hazardous Substance Site Remedial Action* (Chapter 1200-1-13, issued August 4, 1992), governing cleanup of remedial action Superfund sites in the state of Tennessee. Chapter 1200-1-13-.08 of the proposed rule lists cleanup levels for hazardous substance remediation and states that the objectives of this section are "...(a) To establish clear, objective cleanup levels by identifying and/or developing chemical specific ARAR's, and (b) To insure consistent procedures for the development and usage of cleanup levels." The proposed rule states that where groundwater is classified for drinking water, cleanup levels shall either meet federal SDWA MCLs and action levels, SMCLs if MCLs are not available, or naturally occurring background levels. Chapter 1200-1-13-.08(5)(a) states that "Where numerical standards are not available, a ground water cleanup level should be developed based on (a) ingestion and inhalation effects by utilizing the EPA *Human Health Evaluation Manual, Part B*, December 1991, or (b) a risk assessment shall be developed utilizing site-specific justifications, or (c) guidance levels established under the RCRA Hazardous Waste Regulations shall be utilized. Where ground water is not classified for drinking water, cleanup levels shall be established in accordance with Chapter 1200-4-3.07(3)(d)(2)." Chapter 1200-4-3.07(3)(d)(2) is not yet promulgated; it is part of the TDEC groundwater classification rule which is under development and due to be issued in late 1993. When the draft *Hazardous Substance Site Remedial Action* rule is promulgated, it will be legally applicable to cleanup of groundwater at CROU1; until that time it can be considered TBC guidance.

2.2. Surface water

Chestnut Ridge forms a topographic divide between East Fork Poplar Creek watershed to the northwest and McCoy Branch and several numbered tributaries and their watersheds to the southeast. McCoy Branch and tributary No. 4 are adjacent to CROU1; therefore, they are the most likely to be hydraulically connected to CROU1. Flows in these tributaries originate from surface water run-off from Chestnut Ridge and from groundwater that enters the drainages through the stream beds and springs along the tributaries (Radian 1992).

East Fork Poplar Creek and McCoy Branch are classified by the Tennessee Water Quality Control Board for industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife uses [Tennessee Department of Environment and Conservation (TDEC) Rules, Chap. 1200-4-4]. The state water quality criteria for protection of fish and aquatic life, and for the consumption of aquatic organisms (the criteria for protection of recreation uses), are listed in Table 1 for comparison to any surface water sampling results to determine

extent of any contamination. In the absence of a state criterion for a specific chemical, a federal criterion is listed if available. If surface water contamination from CROU1 is identified, one goal of any remedial actions taken will be to control the onsite source of that contamination; surface water itself will not be remediated as part of this OU.

2.3 Soils

Very little legislation or guidance is available governing cleanup criteria for contaminated soils at CERCLA sites. RCRA has addressed land disposal of treated hazardous wastes in its land disposal restrictions (LDRs) (40 CFR 268), and these will be addressed as action-specific ARARs during the FS. Since CROU1 has been closed under RCRA, it is subject to RCRA corrective action regulations. Requirements for corrective action for solid waste management units (SWMUs) have been proposed as a new Subpart S of 40 CFR 264 (55 *FR* 30798, July 27, 1990). EPA has proposed a risk-based approach to establish media cleanup standards for surface water, groundwater, soil, and air. These standards are to be established at concentrations that ensure protection of human health and the environment, and are to be set for each media of concern during the remedy selection process. Target cleanup levels may initially be set at the RCRA action levels, but modified as appropriate to reflect site-specific exposure assumptions (55 *FR* 30826). Final promulgation of this rule is projected for December, 1993.

EPA has determined that the RCRA treatment standards are generally inappropriate or infeasible when applied to contaminated soil or debris (55 *FR* 8760). Therefore, EPA proposed separate rulemakings to establish treatment standards for disposal of such contaminated soil and debris. The Notice of Proposed Rulemaking (NPRM) for debris appeared January 9, 1992 (57 *FR* 958); final rule, August 18, 1992 (57 *FR* 37194). The revised standards (40 CFR 268.45) require contaminated debris to be treated prior to land disposal using extraction, destruction, or immobilization technologies.

The ANPRM for soil appeared October 24, 1991 (56 *FR* 55160); the NPRM is scheduled for August, 1993, final rule August, 1994 (Houlberg et al. 1993). The rule will be analyzed for ARARs or TBC when available. In the interim, EPA has developed guidance for obtaining and complying with a treatability variance for soil and debris that are contaminated with RCRA hazardous wastes for which treatment standards have already been set (OSWER Directive 9347.3-06FS, July 1989). These will be considered as TBC guidance when remedial alternatives are selected and more information becomes available on waste types.

The TDEC proposed a *Hazardous Substance Site Remedial Action Rule* (Rules of the TDEC, Chap. 1200-1-13) that is currently undergoing revisions based on public comments. This rule states that, where numerical standards are not available for cleanup of soils at hazardous waste sites, soil cleanup levels shall be developed based on methods approved or determined by TDEC, or by utilizing a site specific risk assessment approved by TDEC. When promulgated, this rule will be legally applicable to cleanup at CROU1; in the interim, it will serve as TBC guidance.

2.4 Other "to-be-considered" (TBC) guidance

EPA has suggested cleanup values for lead in soils based on studies of blood lead levels in exposed children. The EPA OSWER Directive 9355.4-02 (dated September 7, 1989) recommends a cleanup level for soils of 500 to 1000 ppm lead. However, EPA has distributed a draft memorandum (dated June 1992) recommending a cleanup level for lead in soil of 500

ppm, based on a new lead uptake/biokinetic model. This threshold level could be revised based on site-specific information (DOE 1993).

In the absence of federally or state-promulgated ARARs, or in the case where ARARs are not adequately protective, EPA states a preference for Reference Doses (RfDs) or reference concentrations (RfCs) for systemic toxicants, carcinogen slope factors (CSFs) for carcinogens, or Office of Drinking Water (ODW) Health Advisories (HAs) (USEPA 1988) for drinking water contaminants. The RfDs, RfCs, and CSFs are available through *IRIS* (USEPA 1991) and the EPA *Health Effects Assessment Summary Tables* (USEPA 1992a).

The EPA ODW has developed nonregulatory HAs for concentrations of noncarcinogenic contaminants in drinking water at which no adverse health effects would be expected to occur. Lifetime HAs available for those COCs at CROU1 which do not have promulgated maximum contaminant levels/secondary maximum contaminant levels (MCLs/SMCLs) are listed in Table 1.

3. Radiation Protection Standards

Very few applicable standards are available for the cleanup of radioactively contaminated CERCLA sites. The Atomic Energy Act (AEA) of 1954 and its amendments delegated authority for control of nuclear energy to DOE, the U.S. Nuclear Regulatory Commission (NRC), and EPA. In addition, certain states have regulatory authority and programs for radioactive waste. EPA's regulations are derived from several other statutes as well and cover many types of activities and all types of radioactive materials. The NRC licenses the possession and use of various types of radioactive materials at certain types of facilities. Tennessee is an NRC-Agreement state and, as such, has its own authority and licensing regulations.

DOE is authorized to control all types of nuclear materials at sites under its jurisdiction and is exempt from the NRC licensing and regulatory requirements. Therefore, NRC regulations are not generally considered to be ARARs for CERCLA cleanup at DOE facilities. The DOE regulations for handling and cleanup of radioactive materials are outlined in a series of internal DOE Orders that are legally binding to DOE contractors but are not considered by EPA to be ARARs. The DOE Orders, however, are functionally equivalent to the NRC requirements, and include all "appropriate" requirements from the NRC regulations. For the purposes of development of ARARs, DOE Orders will be treated as TBC guidance rather than the NRC regulations. Sections of the NRC regulations may supply ARARs or TBC guidance in situations where the DOE Orders do not adequately address a specific situation at a site, and will be addressed during selection of remedial alternatives during the FS.

In addition to RCRA hazardous wastes, CROU1 shows evidence of contamination with radionuclides, including several isotopes of uranium as well as gross alpha and beta activity. The proper definition of "mixed low-level radioactive and hazardous waste" has caused considerable debate with regard to dual jurisdiction by EPA and NRC. However, EPA has published a clarification of the problem (53 *FR* 37045, September 23, 1988), as did DOE previously [52 *FR* 15937, May 1, 1987 and DOE Order 5400.3 (*Hazardous and Radioactive Mixed Waste Program*, dated February 22, 1989)]. In effect, mixed wastes are those containing a RCRA hazardous waste as defined in 40 CFR 261 and a radioactive waste subject to the AEA. RCRA regulations apply to the hazardous component of the waste, and AEA regulations apply to the radioactive component. When the application of both standards is conflicting or inconsistent, RCRA yields

to the AEA. Tennessee received final authorization to regulate radioactive mixed waste on July 3, 1986 (53 *FR* 37045, September 23, 1988); however, the state has not implemented any regulations or guidance related to the handling of mixed waste.

On May 26, 1992, EPA published a notice in the *Federal Register* (57 *FR* 22024) proposing to find that DOE has made all but one of the demonstrations required in its application, under RCRA rules in 40 CFR 268.5, for a one-year, case-by-case extension of the May 8, 1992 effective date of the LDRs applicable to certain mixed wastes generated or stored at K-25, Y-12, and Oak Ridge National Laboratory, as well as 28 other DOE facilities. Comments were due back to EPA by July 27, 1992, and no official final action has been taken on this proposal as yet. In June, 1992, EPA and DOE signed a Federal Facilities Compliance Agreement (mixed waste-FFCA) to bring mixed waste generation and storage facilities on the Reservation (ORR) into compliance with environmental law. The mixed waste-FFCA allows DOE ORR facilities to continue to generate and store mixed wastes while addressing LDR mixed waste compliance issues. The mixed wastes covered under the mixed waste-FFCA include flammable and corrosive liquids, solvents, paint waste, waste oils and organics, and solid mixed wastes.

3.1 EPA regulations

EPA has promulgated MCLs for radionuclides in community water systems (see Table 2). These MCLs appear in two forms—concentration limits for certain alpha-emitting radionuclides (40 CFR 141.15) and an annual dose limit for the ingestion of certain beta- and gamma-emitting radionuclides (40 CFR 141.16). MCLs and MCLGs were proposed for uranium and reproposed for ^{226}Ra and ^{228}Ra, beta emitters, and photon emitters on July 18, 1991, and are included in Table 2. Final promulgation of the concentration limits is not expected until December 1993. These concentration limits may be relevant and appropriate for cleanup of contaminated groundwater at CROU1 and would become legally applicable when the Tennessee *Hazardous Substance Site Remedial Action* rule is promulgated.

Table 3 lists EPA, NRC, and DOE radiation protection standards that are described below. Subpart H of 40 CFR 61 addresses atmospheric radionuclide emissions from DOE facilities and may be applicable to airborne emissions during cleanup of CROU1. EPA has issued a final National Emissions Standard for Hazardous Air Pollutants (NESHAPs) rule (54 *FR* 51654, December 15, 1989) that limits emissions of radionuclides to the ambient air from all sources at DOE facilities to amounts that would not cause any member of the public to receive an effective dose equivalent of 10 mrem/year (40 CFR 61.92).

3.2 DOE Orders

DOE Orders are not promulgated regulations and thus are not considered to be ARARs by EPA. They are, however, binding between DOE and Martin Marietta Energy Systems, Inc. (MMES) because of contractual agreements. In particular, the derived maximum radionuclide concentration guidelines for discharges of radioactively contaminated liquids to surface waters, aquifers, and soil that appear in the final DOE Order 5400.5 (*Radiation Protection of the Public and the Environment*) may be useful as TBC guidance. A basic dose limit of 100 mrem/year is given for routine DOE activities, including remedial action monitoring, cleanup, and control of residual radioactive material, and a dose of less than 500 mrem/year as a temporary maximum exemption under specially permitted and DOE-approved circumstances (see Table 3). In addition, effluent releases to surface water must not result in exposures to aquatic organisms exceeding an

absorbed dose of 1 rad/day. The over-riding principle of the Order is that all exposures of the public shall be ALARA. DOE proposed this Order for codification under 10 CFR 834 on March 25, 1993 (58 *FR* 16268); final rule expected March, 1994. When promulgated, these standards will then become legally applicable to cleanup at CROU1.

DOE Order 5400.5 lists Derived Concentration Guides (DCGs) for radionuclide isotopes which are based on a committed effective dose equivalent of 100 mrem/year for ingestion of air or water. For liquid wastes containing radionuclides which are discharged to surface waters, the best available technology (BAT) must be used if the receiving water, at the point of discharge, would receive radioactive material at a concentration greater than the DCG. Implementation of the BAT process is not required if annual releases to surface water are below the DCG. In the case of releases of multiple radionuclides, the sum of the fractional DCGs must not exceed unity. In addition, effluent releases to surface water must not result in exposures to aquatic organisms which exceed an absorbed dose of 1 rad/d. These DCGs will be addressed if any remedial alternatives result in effluent releases to air or water.

DOE Order 5820.2A (*Radioactive Waste Management*, September 9, 1988) states that the management of low-level radioactive waste must ensure that external exposure to the waste and concentrations of radioactive material that may be released into surface water and soil does not exceed 25 mrem/year to any member of the public. Releases to the atmosphere shall not exceed 10 mrem/year. Reasonable effort should be made to maintain releases to the environment to ALARA levels.

DOE Order 5480.11 (*Radiation Protection for Occupational Workers*) contains guidelines for worker protection which are similar to those of 10 CFR 20, i.e., 5 rem/year and 50 rem/year annual effective dose equivalent for stochastic (cancer) and nonstochastic (systemic) effects, respectively, from both internal and external sources for continuous exposures. Also included in the Order are standards for the general public when entering a controlled area. Exposures to the public are limited to an effective dose equivalent of 100 mrem/year. As with other DOE Orders, the ALARA principle prevails. DOE has proposed for codification in 10 CFR 835 the primary standards for radiation protection of occupational workers from normal operation of DOE facilities (56 *FR* 64334, December 9, 1991). A final rule is expected in July, 1993. When promulgated, these standards will then be legally applicable to cleanup activities at CROU1.

In the event that DOE Orders are more stringent or cover remedial action activities not addressed by existing ARARs, they should be used as TBC guidance for developing protective remedies at CROU1. The DOE Orders will be addressed in detail following selection of remedial alternatives for CROU1.

3.4 TBC guidance for radiological risk assessment

The EPA Office of Radiation Programs has derived slope and unit risk factors for radionuclides of concern at remedial sites for each of three major exposure pathways (inhalation, ingestion, and external exposure to contaminated soil). These are available in the EPA *Health Effects Assessment Summary Tables* (EPA 1992a), and will be considered as TBC when the radionuclide contamination at CROU1 is more clearly defined.

4. Location-specific ARARs

Location-specific requirements "set restrictions upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations" (53 *FR* 51437).

Wetlands and floodplains. CROU1 is approximately 200 feet above the highest elevation of the 100-year floodplain (Radian 1992). Although there are a number of wetlands located in and around ORR, a draft report of a recent wetlands survey released in March 1991 does not appear to list any near CROU1 (Cunningham and Pounds 1991). Before any remedial action is taken, this report should be consulted and a survey conducted of the particular site that will be impacted. If wetlands are affected, Executive Order 11990, 40 CFR 6.302(a), 40 CFR 6 (Appendix A), 10 CFR 1022, CWA §404, 40 CFR 230, and 33 CFR 323 may supply ARARs.

Aquatic resources. There are no known designated wilderness areas, wildlife refuges, or scenic rivers on ORR, or within range of the reservation such that remedial action would likely impact these resources.

Slightly over 5,000 acres of ORR have been designated as a DOE National Environmental Research Park (NERP), which also includes Research Areas (RSAs) both within and without the NERP itself. In addition, DOE has also designated areas on ORR as DOE-NERP Reference Areas (RAs) and DOE-NERP Natural Areas (NAs). However, none of the designated RSAs, RAs or NAs are on or near CROU1 (Parr and Pounds 1987), therefore, none of the uses and restrictions applicable to these resources would be ARARs for CROU1.

Rare, threatened, or endangered species. From a compilation of a number of surveys of the rare plants conducted on the reservation, 14 plant species occurring on the ORR are listed as endangered, threatened, or of special concern by the state of Tennessee, and 3 of these are also candidates for federal listing (Parr 1992). In addition, there are a number of federal and state-listed endangered or threatened animal species on the ORR. An in-depth discussion of these species appears in Volume No. 24 of *The Resource Management Plan of the Oak Ridge Reservation* (Kroodsma 1987). The state of Tennessee has also designated approximately 80 species of wildlife as "in need of management," and some of those occur in the area including ORR (Tennessee Wildlife Resources Commission Proclamation 86-29). Pursuant to TCA 70-8-104(b), it is unlawful for any person to knowingly destroy the habitat of "wildlife in need of management." Should any remedial actions at the CROU1 site impact any federally listed endangered or threatened species, the provisions found in the Endangered Species Act of 1973 (16 USC 1531 *et seq.*), 50 CFR 492, 40 CFR 6.302(h), and the Fish and Wildlife Coordination Act (16 USC 661 *et seq.*) may be implicated as ARARs. If any proposed actions impact state-listed endangered or threatened animal species, the Tennessee Non-Game and Endangered or Threatened Wildlife Species Conservation Act of 1974 (TCA 70-8-101 *et seq.*) may provide ARARs. The prohibitions of the Tennessee Rare Plant Protection and Conservation Act of 1985 (TCA 11-26-201 *et seq.*) do not apply to a landowner, lessee, or other person entitled to possession of the land on which the species is located (TCA 11-26-209). This also includes managers in the case of publicly-owned land and those with written permission of the landowner or manager (TCA 11-26-209). These exclusions would apparently apply to ORR. However, the purpose of the statute, to protect and preserve rare plants, should be considered TBC guidance for any remedial actions at CROU1 if rare plants are identified.

Historic sites and archaeological findings. The region surrounding ORR is rich in both archaeological and historic resources and a number of studies have indicated the presence of abundant resources on the reservation. These surveys are summarized in Volume 3, Appendix B of the *Resource Management Plan for the U.S. Department of Energy Oak Ridge Reservation* (Sanders 1984). No archaeological sites were identified at the Y-12 plant. However, in the event a survey indicates the presence of archeological resources at the CROU1 site, the Archaeological Resources Recovery Act (16 USC 470aa-ll), the Archaeological and Historic Preservation Act (16 USC 469a-c), 43 CFR 7, and 40 CFR 6.301 may provide ARARs.

4.5 Action-ARARs

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to the management of hazardous waste (52 *FR* 32496). Selection of a particular remedial action at a site will invoke the appropriate action-specific ARARs that may specify particular performance standards or technologies, as well as specific environmental levels for discharged or residual chemicals. Action-specific ARARs are established under RCRA, CAA, CWA, SDWA, and TSCA. Action-specific ARARs for CROU1 will be developed during selection of remedial alternatives.

5. References

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Kroodsma, R. L. January 1987. *Resource Management Plan for the Oak Ridge Reservation, Volume 24: Threatened and Endangered Animal Species*, ORNL/ESH-1/24, Martin Marietta Energy Systems, Inc., Oak Ridge Natl. Lab., Oak Ridge, Tennessee.

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Radian Corporation. 1992. *Y-12 Plant: Chestnut Ridge Security Pits Remedial Investigation Data Adequacy Summary*, DOE/OR-1000&D2, 92-225-161-77, Radian Corporation, Oak Ridge, Tennessee, December.

Sanders, M. 1984. *Resource Management Plan for the U. S. Department of Energy Oak Ridge Reservation, Volume 3, Appendix B: Archaeological Considerations*, ORNL-6026/V4, July.

Table 1. Chemical-specific criteria for COCs at CROU1 (μg/L)

Chemical	RCRA MCLs	Federal SDWA MCLs[a]	Federal SDWA MCLGs[a]	TDEC WQC Recreation[b]	TDEC WQC Fish & Aquatic Life[c]	
					CMC	CCC
Acetone	—	—	—	—	—	—
Aluminum	—	50-200[d]	—	—	750[e,f]	87[g]
Barium	1,000	2,000	2,000	—	—	—
Boron	—	600[h]	—	—	—	750[i]
Carbon tetrachloride	—	5	0	44	—	—
Chromium (III)	—	—	—	670,000	984.32[e,j]	117.32[g,j]
Chromium (VI)	—	—	—	—	16	11
Chromium (total)	50	100	100	—	—	100
Copper	—	TT[k]	1,300	—	9.22[j]	6.54[j]
1,1-Dichloroethane	—	—	—	—	—	—
1,2-Dichloroethane	—	5	0	990	—	—
1,1-Dichloroethylene	—	7	7	32	—	—
cis-1,2-Dichloroethylene	—	70	70	—	—	—
trans-1,2-Dichloroethylene	—	100	100	—	—	—
Iron	—	300[d]	—	—	—	1000[g]
Lead	50	TT[k]	0	—	33.78[j]	1.32[j]
Methylene chloride (Dichloromethane)	—	5[l]	0[l]	16,000	—	—
Nickel	—	100[l]	100[l]	4,600	789.00[j]	87.71[j]
Silicon	—	—	—	—	—	—
Strontium	—	17,000[h]	—	—	—	—
Tetrachloroethylene	—	5	0	88	—	—
1,1,1-Trichloroethane	—	200	200	170,000	—	—
Trichloroethylene	—	5	0	807	—	—
Zinc	—	5000[d]	—	—	65.04[j]	58.91[j]

[a]Federal and state criteria; Tennessee state criteria are identical to the federal.
[b]Chapter 1200-4-3 of the Rules of the TDEC. These recreational use criteria are human health criteria derived to protect the consumer from consumption of contaminated fish, and are similar to the federal human health water quality criteria for consumption of aquatic organisms alone; however, they are based on a 10^{-5} risk level for carcinogens rather than the federal level of 10^{-6}.
[c]Chapter 1200-4-3 of the Rules of the TDEC.
[d]Federal and Tennessee secondary MCL; no primary MCL is available.
[e]Federal WQC; Tennessee does not have a fish and aquatic life criterion for this chemical. One-hour average concentration not to be exceeded more than once every 3 years. Source: EPA 1992.

[f]At pH 6.5-9.0.
[g]Federal WQC; Tennessee does not have a fish and aquatic life criterion for this chemical. Four-day average concentration not to be exceeded more than once every 3 years. Source: EPA 1992.
[h]EPA Office of Drinking Water lifetime Health Advisory (November 1992).
[i]Federal WQC; Tennessee does not have a fish and aquatic life criterion for this chemical. This value represents the minimum standard for long-term irrigation of sensitive crops. Source: EPA 1992.
[j]Water hardness dependent criterion (50 mg/L as $CaCO_3$).
[k]When the "action level" of 15 or 1300 µg/L, for lead or copper, respectively, measured in the 90th percentile at the consumer's tap, is exceeded for lead or copper, corrosion control studies and treatment requirements are triggered. However, an OSWER memorandum (dated June 21, 1990) recommends that a final cleanup level of 15 µg/L for lead in groundwater usable for drinking water is protective of sensitive subpopulatons; this is guidance, not an ARAR
[l]57 *FR* 31776 (July 17, 1992). Effective January 17, 1994.

COCs = contaminants of concern
CROU1 = Chestnut Ridge Operable Unit 1
RCRA MCLs = Resource Conservation and Recovery Act "maximum concentration limits"
SDWA MCLs/MCLGs = Safe Drinking Water Act maximum contaminant levels/maximum contaminant level goals
TN WQC = Tennessee water quality criteria
CMC = criterion maximum concentration
CCC = criterion continuous concentration
TDEC = Tennessee Department of Environment and Conservation
TT = treatment technique

Table 2. Radionuclide-specific standards under the SDWA for potential COCs in groundwater and surface water at CROU1 (pCi/L)

Radionuclide	Current SDWA MCLs[a]	Proposed SDWA MCLs[b]
Gross alpha[c]	15	15
Gross beta	4 mrem/year	4 mrem/year
Strontium-90[d]	8	42
Tritium[d]	20,000	60,900
Natural uranium		20 μg/L[e]
All other manmade radionuclides	4 mrem/year[f]	4 mrem/year[f]

[a]SDWA MCL = Safe Drinking Water Act maximum contaminant level.
[b]Proposed rule, July 18, 1991 (56 *FR* 33050); final rule expected December 1993.
[c]The present MCL excludes radon and uranium but includes ^{226}Ra; the proposed MCL excludes all three radionuclides.
[d]These values are not MCLs; rather they are concentrations that result in the effective dose equivalent (EDE) of 4 mrem/year, the MCL for gross beta emissions.
[e]Approximately equal to 30 pCi/L.
[f]If two or more radionuclides are present, the sum of their annual dose equivalent to the total body or to any organ shall not exceed 4 mrem/year.

Table 3. Radiation protection standards that may be ARAR or TBC for CROU1

Regulation	Applicability	Exposure conditions	Standard
40 CFR 61	National Emission Standards for Hazardous Air Pollutants for DOE facilities	Public exposure, airborn emissions	10 mrem/year
40 CFR 141	Drinking water maximum contaminant levels	Community water systems, gross beta	4 mrem/year
DOE Order 5400.5[a]	Radiation Protection of the Public and the Environment	Public exposure, all sources	100 mrem/year
		Temporary exemption, maximum limit	500 mrem/year
		Aquatic organism exposure, absorbed dose	1 rad/d
DOE Order 5820.2A	Radioactive Waste Management	Public exposure, all sources, excluding air	25 mrem/year
		Public exposure, atmospheric releases	10 mrem/year
DOE Order 5480.11[b]	Radiation Protection for Occupational Workers	Worker exposure limits, continuous exposure	5 rem/year, cancer effects
			50 rem/year, noncancer effects, any organ or tissue
		Public exposures, controlled areas, effective dose equivalent	100 mrem/year

[a]Proposed as 10 CFR 834 (58 *FR* 16268, March 25, 1993). Final rule expected March, 1994.
[b]Proposed as 10 CFR 835 (56 *FR* 64334, December 9, 1991). Final rule expected July, 1993.

APPENDIX C

STANDARD OPERATING PROCEDURE FOR Y-12 CHESTNUT RIDGE OPERABLE UNIT 1

GEOPROBE SOIL SAMPLING SURVEY

SOP 3-1
Revision: 0
Date: December 31, 1992
Page 1 of 5

Prepared: James A. Bartik 12/15/92 Technical Review: [signature] 12/17/92
Signature/Date Signature/Date

QA Review: Jeannette M. Davis 12/21/92 Approved: [signature] 1/4/93
Signature/Date Signature/Date

Issued: Rose Mary Ellerick 4/5/93
Signature/Date

1.0 OBJECTIVE

The purpose of this standard operating procedure (SOP) is to collect surface and subsurface soil samples with a Geoprobe in order to determine the extent of soil contamination in a shorter time period compared with conventional boring methods. In addition, the Geoprobe does not produce drill cuttings.

2.0 BACKGROUND

2.1 Definitions

Geoprobe - A hydraulic device installed in the back of a van or pickup truck, used to advance a hollow stem probe into soil for the purpose of collecting a soil sample.

Probe-Drive Sampler - A soil sampling device designed for use with the Geoprobe.

2.2 Discussion

The Geoprobe unit utilizes the Probe-Drive sampler to retrieve approximately 100 gram (or larger) soil samples at the working depth of the Geoprobe. Unlike split-spoon samplers, the Probe-Drive sampler remains completely sealed by a piston tip at the end of the sample tube while it is pushed or driven to the desired sampling depth. A piston stop-pin at the opposite end of the sampler is removed by means of extension rods inserted down the inside diameter of the probe rods after the sampler has been driven to depth. This enables the piston to retract into the sample tube while the sample is taken.

Prior to conducting the Geoprobe survey, ensure that underground utilities and structures have been delineated on the ground. Keep the Geoprobe a safe distance from these utilities and structures during probing.

3.0 RESPONSIBILITIES

Site Manager - The Site Manager is responsible for ensuring that the field personnel have been trained in conducting the Geoprobe survey in accordance with the project requirements and this and related SOPs.

Field Team Leader - The Field Team Leader is responsible for ensuring that the Field Team conducts the Geoprobe survey in accordance with the project requirements.

4.0 REQUIRED EQUIPMENT

The usual Geoprobe rods and driving accessories with the following tools are required to sample soil using the Probe-Drive system:

- Assembled Sampler
- Extension Rods
- Extension Rod Couplers
- Extension Rod Handle
- Extruder Rack*
- Extruder Piston*

* Kansas Stainless and Large Bore Samplers feature removable hardened cutting shoes that thread onto the sample tube. Large Bore Sampler also utilizes an acetate liner inside of the sample tube for easy removal of soil sample.

5.0 PROCEDURES

5.1 Assembly

After decontaminating probe rods and sampler parts according to FPC SOP 4-5, Field Equipment Decontamination, assemble the soil sampler. All parts must fit tightly. The stop-pin is reverse threaded and should be tightened with a wrench so that it exerts pressure against the piston rod. Damage could occur during probing if pin is not tight.

5.2 Probing

Attach assembled sampler onto leading Geoprobe probe rod. Place the drive cap on top of the probe rod. A 12-inch probe rod is recommended to start the Standard 24-inch and Large Bore Samplers. Replace the 12-inch rod with a 36-inch rod as soon as the sampler is driven below the surface.

Drive the sampler with the attached probe rods to the top of the interval to be sampled using manual probe rod driver or hydraulically-powered Geoprobe unit. The drive cap must be installed prior to driving the probe.

IMPORTANT: Some soil conditions may warrant using a retractable or solid drive point to pre-probe the hole to the desired sampling depth. Do not drive the sampler into bedrock or other impenetrable layers.

5.3 Stop-pin Removal

If using the Geoprobe driver, move the driver unit back from the top of the probe rods to allow room to work.

Remove the drive cap and lower extension rods into the inside diameter of the probe rods using couplers to join rods together.

Attach the extension rod handle to the top extension rod. Rotate the extension rod handle clockwise until the leading extension rod is screwed into the piston stop-pin downhole.

Continue to rotate the handle clockwise until the reverse-threaded stop-pin has disengaged from the drive head.

Remove the extension rods and attached stop-pin from the probe rods.

5.4 Sampling

If the top of probe rod is already in the lowest driving position, attach another probe rod before driving. Replace the drive cap onto the top probe rod.

Mark the top probe rod with a marker or tape at the appropriate distance above the ground surface (i.e. 10 inches for Standard Sampler, 12 inches for Kansas Sampler, and 24 inches for Large Bore Sampler).

Drive the probe rods and sampler the designated distance. Be careful not to over-drive the sampler which could compact the soil sample in the tube making it difficult to extrude.

Retract probe rods from the hole and recover the sampler. Inspect the sampler to confirm that a sample was recovered.

5.5 Extrusion - Standard And Kansas Samplers

Machine:

1. Disassemble the sampler. Remove all parts. Screen sampler with a photoionization detector (PID), if required.

2. Position the extruder rack on the foot of the Geoprobe derrick.

3. Insert the sample tube into the extruder rack with the cutting end up.

4. Position the extruder piston and push the sample out of the tube using the "probe" function on the Geoprobe.

5. Catch the sample as it is extruded beneath the extruder in the sample container or mixing bowl. Volatile organic compound samples will be collected directly into the sample container.

CAUTION: Use care when performing this task. Apply down pressure gradually. Use of excessive force could result in injury to the operator or damage to tools.

Hand: (Good for use with sandy soils)

1. Disassemble the sampler. Remove all parts.

2. Screen sampler with a PID, if required.

3. Deposit sample into container by lightly tapping the side of the sample tube with a hammer.

5.6 Plugging Geoprobe Holes

When driving the Geoprobe through pavement or concrete using a hammer attachment, the resultant hole may be plugged with neat cement (cement and water mixture) after the probe rods have br retracted.

When driving the Geoprobe through surface soils, the resultant hole may be plugged with neat cement if the soils do not close the hole naturally. The neat cement is poured down the hole after the probe rods have been retracted.

Specific procedures for sealing geoprobe holes will be specified in the site-specific plans.

6.0 RESTRICTIONS/LIMITATIONS

The Geoprobe soil sampling system is not intended for collecting large sample volumes. The Standard Sampler will obtain approximately 100 grams of soil.

The Geoprobe is limited to sampling up to depths of approximately 40 feet in unconsolidated, sandy soils and to shallower depths in compacted gravelly soils and tills.

7.0 REFERENCES

Geoprobe Systems, *The Probe-Drive Soil Sampling System*, September 1991.

CDM FEDERAL PROGRAMS CORPORATION

Standard Measurement Procedure for:

PHOTOVAC PORTABLE GAS CHROMATOGRAPH

SECTION 7

7.0 INTRODUCTION

This document describes procedures that field personnel should follow when using the Photovac portable gas chromatograph. The procedures performed by the CDM FPC warehouse manager will be documented in the CDM Field Equipment Operation, Maintenance, and Calibration Manual.

7.1 PURPOSE OF MEASUREMENT

The Photovac identifies and measures specific chemicals in a gas sample. The measurement allows technicians to monitor the concentration of volatile organic compounds in soil gas, ambient air, or other vapors.

7.2 SUPPLIES AND EQUIPMENT

7.2.1 Equipment needed

- Photovac 10S55 portable gas chromatograph
- Carbopack BHT backflush gas chromatography column (#SA-315)
- High-purity low-pressure (10 psi) compressed gas regulator
- High-purity mid-pressure (40 psi) compressed gas regulator
- Photovac AC power mains cord
- Photovac #SA-205 dual channel flowmeter
- Flat head screwdrivers; 1/8", 3/16", and 1/4"
- 3/8" open end box wrench
- Plastic letter opener with hook

7.2.2 Supplies needed

- Calibration gases
- 1/8" Teflon^{R} tubing (approximately 10')
- 1/4" Teflon^{R} tubing (approximately 1')
- 4 Swagelock^{R} 1/8" tubing adapters
- Spare ultraviolet lamp
- Ultra-pure air (Scott Ultra-Zero or equivalent)
- Glass 40 ml. VOA vials (for headspace analysis)
- Tedlar^{R} bags
- 2 adapters (Tedlar^{R} bag fitting to 1/8" tubing)
- Photovac plotter paper (#SA-303)
- Plotter pens
- Laboratory tissues (e.g. Kimwipes^{R})

7.3 START UP

a. Check to see that the Photovac has been stored as required by Section 7.6.

b. If the instrument has not been left on, press ON. The machine will read "LAMP NOT READY". After pressing ON, wait 20 minutes for the lamp and circuits to warm up.

c. Rotate the red FLOW valve until one of the float balls on the Photovac #SA-205 flowmeter rests between 5 and 10 ml/minute.

d. If the float balls in the two channels of the flowmeter do not rest in the same position, rotate the needle valve on the Aux Out port until they agree.

e. Rotate the red flow valve until both flowmeter float balls rest between 10 and 15 ml/minute.

f. Press START STOP P. Press ENTER. The Photovac will analyze the air in the trailer. It will print a chromatogram (a chart of the instrument's response) and some analysis information. If the chromatogram indicates peaks, perform an analytical zero (Section 7.4.3).

g. If the paper in the printer does not move, press FEED.

h. Review the information printed (see example, Exhibit 7-3) change the operating parameters as described in Section 7.6.3.2. Note: the information in the Setup box will appear only when ON WITH SETUP has been set (Section 7.6.3.1)

i. Perform the calibration procedure (Section 7.4.2)

7.4 INSTRUMENT CALIBRATION

7.4.1 Frequency of Calibration

Test	SOP Section	Calibration Standard	Frequency
On-board computer switches	7.6.3	Exhibits 7-1 to 7-3	1/week
Start-up	7.3	None	1/day
Operational zero	7.4.2 (1)	Ambient air	At start up 1/5 samples
Field Calibration	7.4.2	Certified gas standard	At start up 1/5 samples
Lab Calibration	7.8	Photovac Service	1/year

7.4.2 Calibration

a. Install a calibration standard for the compound(s) you want to analyze for as described in Section 7.6.2. Note the concentration of the standard.

b. Perform start up procedures (Section 7.3).

c. Press START STOP P. Press the DOWN ARROW to select "CAL IN". [Note: The instrument can also be calibrated against standard gas in a Tedlar^{R} bag by selecting "PROBE IN".]

d. Press ENTER. The Photovac will analyze the calibration standard. If the standard contains only one compound, there should be just one peak. If extra peaks appear, repeat this step before proceeding.

e. When the printer stops printing, press CAL.

f. When the LCD says; "PLOTTER PEAK #?", press 1 and ENTER.

g. When the LCD says; "ID NUMBER 1 - 25?", enter the number at which you want to store the compound and press ENTER.

h. When the LCD says; "CONC IN PPM?", enter the concentration of the standard in ppm and press ENTER.

i. Repeat steps c. and d.

j. If the concentration reported in this recalibration differs from the one you entered in step h. by 20% or more, repeat steps e. to h.

k. Press EDIT and the ID number of the new peak. Type the name of the compound in.

l. Press START STOP P. Press ENTER. The Photovac will analyze the air in the trailer. If a peak appears on the chromatogram, obtain an analytical zero (Section 7.4.3).

m. Proceed to Section 7.5.2.

7.4.3 Analytical Zero

a. Fill a clean Tedlar^{R} bag with ultra-pure air.

b. Attach the Tedlar^{R} bag containing ultra-pure air to 1/8" Teflon^{R} tubing on the Probe In port.

c. Press START STOP P. If the LCD does not say "PROBE IN", press the DOWN ARROW to set the inlet to "PROBE IN".

d. Press ENTER. The Photovac will analyze the ultra-pure air.

e. When the printer stops printing, write "ultra-pure air" next to its chromatogram.

f. No peak should appear. If a peak appears on the chromatogram, repeat steps b. to e. two more times.

g. If the peak appears in either or both of these repeat runs, trouble shoot the problem (Section 7.7.1)

7.5 FIELD MEASUREMENTS

7.5.1 Measuring Compounds

The Photovac can demonstrate the presence of many compounds, but it identifies and evaluates only those compounds for which it has been calibrated by the procedure described in Section 7.4.2. Follow the procedures described in Section 7.5.1 to evaluate the presence of other compounds with the Photovac. Be certain to write the analyte and the location sampled on the chromatogram.

a. Perform start up (Section 7.3) and calibration (Section 7.4.2) each day before taking any measurements.

b. Introduce the sample gas through the 1/8" Teflon^{R} tubing on the Probe In port. The sample gas may be collected in the Tedlar bags, headspace vials, or from ambient air.

c. Press START STOP P. If the LCD does not say "PROBE IN", press the DOWN ARROW to set the inlet to "PROBE IN".

d. Press ENTER. The Photovac will analyze the sample gas.

e. When the printer stops printing, write the location sampled (for instance, Probe #MW-3A) next to its chromatogram.

f. Transfer the concentration value from the printout to the log book or data collection form.

g. Perform steps 7.5.1 b. - f. with each sample.

h. Perform replicate analysis (repeat steps c. - f.) on at least two samples a day. Record the replicate readings on the data form.

i. Re-calibrate the instrument (Section 7.4.2) at least once every five samples. You may recalibrate less often if the calibration is very stable (Section 7.5.4 a.).

7.5.2 Calculation and Recording

a. The Photovac prints the date and time of the sample on the print-out.

b. Write the number of the sample from which each sample was drawn on its chromatogram.

c. Write the number of the sample from which the sample was drawn and the word, "REPLIC" next to any chromatogram that represents a replicate analysis.

d. Write "CALIB" on any chromatogram that represents a calibration run.

e. Write "AIR" beside any chromatogram that represents an analysis of ambient air.

f. The Photovac automatically calculates the concentrations of compounds in the gas sample. Write the concentration that appears on the Photovac's printer down on the logbook or data form.

7.5.3 Quality Control Measures

a. Recalibrate the Photovac after the first five samples. If the value found on the calibration run differs from previous value by 5% or less, recalibrate every ten samples. If it differs by more than 5%, recalibrate every five samples.

b. Repeat analysis [(Section 7.5.1 (h)] of at least one sample a day. Record the second value in the "Replicate analysis" space on the logbook or data form.

7.6 STORAGE

The Photovac should be permanently installed in the equipment trailer as described in this section.

7.6.1 Installation Procedure

a. Attach the DETECTOR OUT port to the left side of the flow meter with 1/4" Teflon tubing.

b. Attach the AUX OUT port to the right side of the flow meter with 1/4" Teflon tubing.

c. Direct the flowmeter discharge exhaust through the window with 1/4" Teflon tubing.

d. Exhaust the CAL OUT and PUMP OUT ports through the window with 1/4" Teflon tubing.

e. Attach the Photovac to a 115V electrical outlet with the power cord.

f. Leave the Photovac on at all times. Unless the Photovac is in use, the LCD should always read "Ready Enter Command".

7.6.2 Calibration and Carrier Gases

a. The calibration gas cylinder should be permanently installed in an enclosure outside the trailer. The gas should flow through a high-purity gas regulator and a 1/8" Teflon® tube that penetrates the trailer wall to the Cal In port of the Photovac. Leave the calibration gas line at 10 psi pressure unless changing the cylinder.

b. The carrier gas (ultra-pure compressed air) cylinder should be permanently installed in a corner of the trailer near the Photovac. The cylinder must be braced so that it is secure. The carrier gas should flow through a high purity gas regulator and a 1/8" Teflon® tube that terminates in a Swagelock® quick connect fitting to the Carrier In port of the Photovac. The discharge gauge on the regulator should always read 40 psi.

c. Maintain a continuous flow of carrier gas, even overnight when the Photovac is not in use. Set the "maintenance flow" at 1 ml/min by adjusting the red flow valve until the flow meter reads 1 ml/min through each column.

d. The Photovac can operate properly without gas in the on-board carrier gas cylinder.

7.6.3 On-board Computer Settings

7.6.3.1 Testing On-board Computer Settings

a. Press TEST, then press ENTER.

b. The printer will produce a status report. An example status report with date, time, and event times is shown in Exhibit 7-1. Settings may be changed as described in Section 7.6.3.2.

c. Press LIST. When the LCD says; "LIST LIBRARY #?," press 1 and ENTER

d. An example print-out is shown in Exhibit 7-2. Change the operating parameters as described in Section 7.6.3.3. Don't try to correct the calibrant retention times. Library listings for all target compounds should appear if the Photovac has been calibrated for them (7.4.2).

e. Press CHART. Press ENTER. Press DOWN ARROW until the LCD says; "CHART RECORDER ON WITH SETUP".

f. Press START STOP P. Press ENTER. The Photovac will analyze the air in the trailer. It will print a chromatogram, some analysis information, and set up information. See example in Figure 7-3. If a peak appears on the chromatogram, obtain an analytical zero (Section 7.4.3). Change the operating parameters as described in Section 7.6.3.4.

g. Press CHART. Press DOWN ARROW until the LCD says; "CHART RECORDER ON WITH BASELINE".

7.6.3.2 Changing Status Report Settings

To correct the date or time:

a. Press USE.

b. Press 1 to select Library #1. Press ENTER

c. Enter the day of the month (e.g. 24). Press ENTER.

d. Enter the number of the month (e.g. 04). Press ENTER.

e. Enter the year (e.g. 1989). Press ENTER.

f. Enter the current hour (e.g. 14). Press ENTER.

g. Enter the current minute (e.g. 24). Press ENTER.

h. If you mis-enter a number, press CLEAR and enter the right one.

To correct an event on or off time:

a. Press EVENT. Enter the number of the event that needs change. Press ENTER.

b. If the On Time for the event is right, press ENTER. If it is not right, enter the correct On Time and press ENTER.

c. If the Off Time for the event is right, press ENTER. If is is not right, enter the correct Off Time shown for the event and press ENTER.

d. Repeat steps a. - c. for each event that has on or off times that do are not correct.

7.6.3.3 Changing Library List Settings

a. If the library number (in the upper left hand corner) is not 1, Press USE, CLEAR, 1, and ENTER, in that order.

b. Any other differences can be modified by following the calibration procedure (Section 7.4.2)

7.6.3.4 Changing Analysis and Set-up Settings

a. Reset the Analysis Number to 1 after each day's analysis by turning the instrument off and then on.

b. Don't try to change the Internal Temperature.

c. If the Gain is not 2, then Press GAIN, CLEAR, 2, and ENTER.

d. To change User Identification (see Exhibit 7-3), Press INFO. Enter the name of the site. Press ENTER. Enter a description of the samples. Press ENTER.

e. Don't try to change the Offset.

f. If the Chart Speed is not 1, Press CHART. Press DOWN ARROW until the LCD says; "CHART SPEED: 1".

g. If Slope Sensitivity is not 16 16 6 mV/Sec, Press SENS. Enter 16. Press ENTER. Enter 16. Press ENTER. Enter 6. Press ENTER.

h. If Window +/- is not 10 Percent, Press WINDO. Enter 10. Press ENTER.

i. If Minimum Area is not 5 mVSec, Press AREA. Enter 5. Press ENTER.

j. If Timer Delay is not 0.0 Sec, Press CYCLE. If the LCD does not say: "TIMER DELAY?" at all, press CLEAR and CYCLE again.

k. When LCD says: "TIMER DELAY?", press CLEAR, 0, and ENTER.

l. The LCD should now say "ANALYSIS TIME? 120". If it shows another analysis time, press CLEAR, 1, 2, 0, and ENTER.

m. The LCD should say "CYCLE TIME? Min", press CLEAR, 0, and ENTER.

n. Press ENTER 5 times. The LCD should say: "READY ENTER COMMAND".

7.7 PREVENTIVE MAINTENANCE, TROUBLE-SHOOTING AND SERVICING

Section 7.7.1 lists potential causes of some equipment problems and corrective actions to take. Sections 7.7.2 to 7.7.6 describe some of these corrective actions.

7.7.1 Indicators of Instrument Malfunction

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
LCD indicated LAMP NOT READY more than 3 min after switch-on.	Source needs tuning.	Tune Source (Section 7.7.3).
Printer doesn't function	Printer disabled	Press FEED key
Plotter starts, then stops immediately.	"ANALYSIS TIME" is 0	Set proper analysis time, use CYCLE key. (Section 7.6.3.4)
No peaks appear.	Improper valve setting.	Check event settings (Section 7.6.3.2).
	Leaky gas fittings.	Tighten all fittings using fingers only. DO NOT over-tighten fittings.
	Septum in injection port needs changing or tightening.	Change or tighten (Section 7.7.4)
	Valve failure	Photovac authorized service only.
Early peaks appear but later peaks missing.	Backflush too early.	Increase EVENT 3 OFF time (Section 7.6.3.2).
Unwanted late peaks appear, possibly during next analysis.	Backflush too late.	Decrease EVENT 3 OFF time (Section 7.6.3.2).
	"ANALYSIS TIME" too short	Increase ANALYSIS TIME to 10 times the series flow time (Section 7.6.3.4).
Peaks appear during air run.	Contaminated column	Perform analytical zero (Section 7.4.3).
		Flush column (Section 7.7.2)
Valve remains ON indicated on LCD.	ON time greater than OFF time.	Check LIST or EVENT status on LCD (Section 7.6.3.1).

Sensitivity too low.	Calibrant is wrong.	Check cylinder label.
	Leak in system.	Finger tighten all suspect fittings.
		Check column attachment and injection port. DO NOT OVER-TIGHTEN fittings.
	High "Offset"	Perform analytical zero (Section 7.4.3).
	Contaminated column	Flush column (Section 7.7.2).
	Valve timing is wrong	Reset event settings (Section 7.6.3.2).
	Lamp is failing.	Replace lamp (Section 7.7.3.2).
The peak appears, but it is identified as "unknown"	Peak not calibrated.	Calibrate (Section 7.4.2).
		Calibrate more frequently.
		Check plotter and ID #s of peak (Section 7.4.2)
Battery life too short.	Lamp power too high.	Get status report (Section 7.6.3.1). If SOURCE POWER > 50, re-tune lamp (Section 7.7.3.1).
Printer/valve cycle is too frequent.	Operating on CYCLE	Set cycle time to 0 (Section 7.6.3.4)
Peaks appear too slowly.	Flow rate too low.	Re-set flow rates [Section 7.3 (e)].
Peaks appear too quickly.	Flow rate too high.	Re-set flow rates [Section 7.3 (e)].

Instrument uses air carrier too fast.	Flow rate too high.	Re-set flow rates [Section 7.3 (e)].
	Carrier gas leak.	Tighten all fittings. (especially on column) DO NOT OVER-TIGHTEN VALVE FITTINGS.

7.7.2 Flushing Contaminated Columns

a. Turn the Red Flow Valve to set the flow through the flowmeter to 10 ml/min or more.

b. Allow the columns to flush overnight.

c. If background contamination remains, take the instrument to a Photovac authorized service location for column decontamination.

7.7.3 Source Lamp Maintenance

7.7.3.1 Source Lamp Tuning

a. With the instrument on, swing the computer module up on its hinge to reveal the Photovac lamp housing, which is a black box marked PHOTOVAC.

b. Remove the special tuning tool, (a plastic screwdriver) from the clip on the front face of the black box. DO NOT USE A METAL TOOL for this adjustment as you will surely cause an electrical short circuit.

c. Engage the tool in the slot of the small screw beneath the hole in the box lid. Observe the LCD while you rotate the screw slowly in a clockwise direction. You may have to make several slow rotations. Stop when the the message changes to "READY ENTER COMMAND".

d. Press TEST. Enter "7853". Press ENTER. The message "LAMP POWER" followed by a number, between 20 and 50, will appear.

e. Tune the lamp to yield a LAMP POWER level of 30 to 35 that also produces a "READY" message.

f. If the "READY" message does not appear at all, take the instrument to a Photovac authorized service location for lamp replacement.

g. Turn the instrument off ("OFF" + "ENTER") and then "ON" again. Within 3 minutes, the "READY" message should return.

h. If The "READY" does not appear on re-start, repeat the procedure.

i. Tune the lamp to the lowest LAMP POWER level that yields reliable start-ups. Reliable start-up is more important for instrument function than lamp power.

7.7.3.2 Source Lamp Replacement

a. Turn the instrument off.

b. Swing the computer module up on its hinge to reveal the Photovac lamp housing, which is a black box marked PHOTOVAC.

c. Remove the 4 securing screws from the lid of the lamp housing. Inside you will see a white Teflon® cylinder screwed into the right wall of the box. This cylinder is the lamp holder and has a silver wire wound around it in a spiral.

d. Gently remove the connecting wire from its socket in the free end of the lamp holder.

e. Gently unscrew the lamp holder and withdraw it. You will see the lamp inside the holder as you pull it away from the wall. Be careful not to drop the lamp.

f. Withdraw the old lamp from the holder with a clean laboratory tissue.

g. Place the lamp O-ring (use the O-ring from the old lamp, if necessary) on the new lamp, about 5 mm from the end face of the window. Handle the new lamp with a clean laboratory tissue. Be very careful not to touch the window end with your fingers.

h. Insert the new lamp into the holder

i. Screw the holder back into place. MAKE SURE IT GOES IN STRAIGHT AND IS NOT CROSS THREADED.

j. Tighten until you begin to feel the resistance from the O-ring.

k. Replace the connecting wire into its socket.

l. Replace the lid and make sure all 4 screws are returned and are tight.

m. Press Power ON. Tune the lamp (Section 7.7.3.1).

7.7.4 Leaking Septum

While you will rarely inject samples through MANUAL INJECTION ports, you must change the septum if the column appears to leak. Leakage may appear as poor replication and an unstable baseline.

a. Insert a spare GC syringe needle into the MANUAL INJECTION port so that it spears the septum.

b. Leaving the needle in place, unscrew the retainer and withdraw it, with the septum impaled on the needle.

c. Discard the old septum.

d. Ensuring that the new septum is handled as little as possible between the fingers, position the new septum, Teflon® face down, on the end of the retainer and spear it with needle through the injection channel to hold the septum in exactly the correct alignment.

e. Carefully screw the retainer back into position with the needle maintaining the septum in the correct position until it is seated.

f. Watch the flow through the flow-meter for the outlet port as the retainer is tightened.

g. A steady flow rate, which does not increase as the retainer is further tightened, indicates the retainer is in the correct position.

h. DO NOT OVER-TIGHTEN THE septum retainer. This can cause needle blockage.

7.7.5 Printer/Plotter Paper Replacement

Keep at least one spare roll of plotter paper (#SA-303) in stock so replacement can be made as soon as the one in use is finished.

a. Remove the paper roll cover. The paper will come out with the cover.

b. Slip the paper roll spindle out of the cover and drop the paper roll.

c. Place a new roll between the plotter cover clips in the same direction as the old roll.

d. Insert the spindle through the cover clips and the paper roll.

e. Unroll approximately 12" of paper.

f. While holding onto the cover and paper, feed the end of paper through the paper feed slit behind the plotter roller.

g. Feed the paper through the slit on the plotter cover.

h. Snap the plotter cover back into place.

i. Press the "FEED" key to verify that the paper roll feeds properly.

7.7.6 Changing Plotter Pens

a. Remove the plotter cover and keep it away from the pen carriage.

b. Press "PEN" until you the pen you want to change is in position.

c. Press the white lever at the front right of the plotter cutout. The pen will pop up.

d. Remove the pen with a plastic letter opener hook.

e. Insert a pen of the corresponding color.

f. Gently push the pen into place. Make sure the tip is resting in the ring or it will not write properly.

7.8 Other Types of Service

All other types of repair may be performed only by the CDM regional equipment warehouse. Meters must return to the warehouse for a preventive maintenance check at least once a month.

EXCERPTS FROM:

ENVIRONMENTAL COMPLIANCE BRANCH

STANDARD OPERATING PROCEDURES

AND

QUALITY ASSURANCE MANUAL

FEBRUARY 1, 1991

Section 6.0 Field Analytical Procedures

Section D.4 Method D.4 Dissolved Oxygen
(Membrane Electrode)

U. S. Environmental Protection Agency
Region IV
Environmental Services Division
College Station Road
Athens, Georgia 30613

6.0 FIELD ANALYTICAL PROCEDURES

6.1 GENERAL

Field analytical equipment used by Branch personnel should be suitable for the analysis to be accomplished and properly calibrated. In addition to being accurate, field analyses must be conducted on a sample which is representative of the source from which it was collected. Therefore, the type of sample and location of the sampling site are critical. A detailed discussion of sample type and sample site selection is given in Section 4 for the various media investigated by Branch personnel.

The objectives of this section are to:

- list the specific field analytical techniques that shall be used by Branch personnel;
- list the specific quality control procedures and calibration techniques for each piece of field analytical equipment used by Branch personnel;
- list the source of all reagents and standards used to perform field analyses and/or calibrate field analytical equipment; and
- specify the training required of Branch personnel to perform the listed field analyses.

Specific field analytical methodology for each parameter is given in Appendix D.

6.2 SPECIFIC ANALYTICAL TECHNIQUES

The specific field analytical techniques used by Branch personnel are listed below and the specific procedures for each analytical technique and field test are presented in Appendix D.

Analytical Parameter	Method	Reference	Equipment
Temperature	Calibrated glass (mercury), dial (mechanical), or electrometric thermometer	1	Mercury filled glass, mechanical dial type thermometer, or thermistor with electronic readout
pH	Electrometrically using a glass electrode in combination with a reference potential or a combination electrode	1	Portable field pH meter
Dissolved Oxygen (DO)	Modified Winkler or membrane electrode	1	Standard DO kit with fresh sodium thiosulfate, or membrane electrode and electronic readout
Specific Conductance	Wheatstone bridge type or equivalent meter corrected to 25_oC	1	Self-contained - conductivity meter, Wheatstone bridge type, or equivalent with automatic temperature compensation to 25_oC or "dial in" temperature compensation
Total Chlorine Residual	Back titration, iodometric with starch or amperometric end-point or DPD colorimetric	1	Iodometric backtitration kit with fresh reagents, or amperometric titrator with fresh reagents, or DPD kit with color standards
Tracer-Fluorescence	Analysis of fluorescent dyes using a fluorometer	2	Rhodamine WT dye and Turner fluorometer
Salinity	Electrodeless Inductive Conductivity Cell Salinometer	3	Beckman RS5-3 Portable Salinometer and Hydrolab Surveyor II Meter

6.3 SPECIFIC QUALITY CONTROL PROCEDURES

Quality assurance procedures for field analysis, and field analytical and test instrumentation calibration are an essential part of these standard operating procedures. All field analytical procedures shall be conducted in duplicate at least 10 percent of the time. A record of these duplicate analyses shall be kept in field logbooks. A significant difference in the replicate analyses (greater than specified in the following sections) shall result in recalibration of the instruments used, re-examination of the analytical methodology being used, or re-examination of the sampling location.

All field analyses must be traceable to the specific individual performing the analyses. Time records shall be kept in local time using the military 2400 hour format and shall be recorded to the minute. This information shall be entered into the field logbooks for all field analyses performed by Branch personnel.

A specific calibration and/or standardization plan for all field analytical equipment is presented in this subsection. Included in this plan are: calibration and maintenance intervals; listing of required calibration standards and conditions requiring recalibration.

6.3.1 Temperature

6.3.1.1 Initial Calibration -- All thermometers shall be initially calibrated against a National Bureau of Standards (NBS) certified thermometer or one traceable to NBS certification.

6.3.1.2 Inspection and Calibration -- Each glass mercury filled thermometer shall be inspected before each field trip to see that it is not cracked and has no air space in the mercury column. If a mechanical dial-type thermometer is used, it should not have a broken face cover or otherwise show damage. A cross-check with a calibrated NBS certified thermometer shall be made at least semi-annually. Thermistors and electronic readout units should be calibrated in the same manner. Recording thermometers shall be checked for recording accuracy before each use. The recorder time scale accuracy shall be checked semi-annually. Before using a thermometer in the field, a visual observation shall be made to assure that it has not been damaged. If a thermistor is used, the instrument shall be checked against a thermometer before field use. Cross-checks and duplicate field analyses should agree within $\pm 0.5^{\circ}C$.

6.3.1.3 Calibration Records -- A logbook shall be maintained with each thermometer number and/or equipment property number recorded. All calibration information including individuals making the calibrations and dates of calibration shall be recorded.

6.3.1.4 Reporting Units -- Report all temperature data to the nearest $0.5^{\circ}C$.

6.3.2 pH

6.3.2.1 Equipment -- Only electronic (portable) pH meters with automatic

temperature compensation (ATC) should be used. Temperature resistant, combination electrodes should be employed in conjunction with the meters. pH test paper will be used only for determining pH ranges, for determining approximate pH values, or for concentrated hazardous waste samples which would damage the instrument.

6.3.2.2 Equipment Inspection and Calibration -- The pH meter shall be checked before each field trip for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes. The slope of the meter shall also be checked initially with three fresh standard buffer solutions (e.g., 4, 7, and 10). All pH recorders shall be checked for recording accuracy and time scale accuracy. While in the field, the meter shall be calibrated daily before use with two buffers bracketing the expected sample pH. Thereafter, the meter shall be checked against two buffers when moving to a new sample location. Fresh buffer solutions shall be used for each field trip. In case of an apparent pH violation, the electrode shall be checked with pH 7.0 buffer and recalibrated to the closest reference buffer. Then the sample shall be retested. Duplicate tests should agree within 0.1 standard unit.

6.3.2.3 Reporting Units -- Report pH to the nearest 0.1 standard unit.

6.3.3 Dissolved Oxygen (DO)

6.3.3.1 Equipment -- Modified Winkler kits and membrane electrode DO meters should be used.

6.3.3.2 Equipment Inspection and Calibration -- DO meters shall be checked before each field trip by inspecting the membrane for air bubbles and holes. If the membrane is dry, it shall be replaced and soaked in water before calibrating. Calibration should be made against the modified Winkler test.

DO kits shall be refilled with new standardized sodium thiosulfate before each field trip. Each solution shall be checked for clarity and volume.

Before using the DO meter each day, duplicate deionized or known clean water samples shall be collected by siphoning water from a bucket into two DO bottles. These duplicate samples shall be analyzed by the modified Winkler test for DO content. The DO meter shall be calibrated against the DO content measured by the Winkler test by placing the DO probe in the bucket containing the water used for the Winkler test.

While using the DO meter, the instrument shall be recalibrated at least twice per day or if a change in water quality is noted. If the sample temperature is $5^{0}C$ greater than the calibration temperature, the meter shall also be recalibrated.

Duplicate analyses should agree with $\pm$ 0.1 mg/l.

6.3.3.3 Reporting Units -- Results for the DO test should be reported to the nearest 0.1 mg/l.

6.3.4 Specific Conductance

6.3.4.1 Equipment -- A portable specific conductance meter, Wheatstone bridge type or equivalent should be used.

6.3.4.2 Inspection and Calibration -- Each conductivity meter shall be checked before each field trip. Batteries shall be checked, and conductivity cells shall be cleaned and checked against known conductivity standards (KCl).

6.3.4.3 Field Calibration -- Before using in the field, check instrument daily with known standards. Refer to the instrument instructions for temperature conductance calculations. Duplicate field analyses should agree within ± 10 percent.

6.3.4.4 Reporting Units -- Results should be expressed in micromhos/centimeter (umhos/cm) corrected to 25°C. Results should be reported to the nearest ten units for readings under 1,000 umhos/cm and the nearest 100 units for readings over 1,000 umhos/cm.

6.3.5 Total Chlorine Residual

6.3.5.1 Equipment -- The iodimetric back titration method with a starch-iodide end point or amperometric end point or a Hach DR 100 colorimetric (DPD) kit may be used.

6.3.5.2 Inspection and Calibration -- Each titration kit or meter shall be checked before each field trip by inspecting the meter for battery strength and fresh reagents. The normality of the iodate should be checked with a distilled water blank to establish a correction factor for the titrant. This will also serve to check the response of the amperometric titrator. Duplicate chlorine residual analyses should agree within ± 0.01 mg/l.

If the Hach DR 100 colorimeter (DPD) kit is used, the method must agree with the requirements of Method 408E, "Standard Methods," 16th Edition, or Method 330.5 "Methods for Chemical Analysis of Water and Wastes," and calibration scales must be calibrated on site at a minimum of three points (blank and two standards) that bracket the expected sample concentration.

6.3.5.3 Reporting Units -- Results should be reported to the nearest 0.01 mg/l residual chlorine.

6.3.6 Fluorescent Tracing

6.3.6.1 Tracer -- Rhodamine WT dye is the standard tracer used by Branch personnel.

6.3.6.2 Fluorometer -- A filter fluorometer (fluorometer) is the instrument used to determine intensity of emitted light or concentration of dye in the sample.

6.3.6.3 Fluorometer Calibration and Calibration Standards -- Before a fluorometer is used in the field, it shall be checked against a set of standard

dye solutions. All standard concentrations shall be made relative to the stated concentration of the manufacturer's solution.

All standard solutions shall be made with distilled water. Sufficient solution volumes shall be made to permit calibration checks. Calibration checks shall be conducted whenever the fluorometer has been turned off for an extended period of time.

The fluorometer and all associated equipment shall be thoroughly cleaned between uses.

6.3.6.4 Reporting Units -- Turner Design fluorometer results shall be reported as ± 1 percent of full scale concentration.

6.3.7 Salinity

6.3.7.1 Equipment -- A portable salinometer, electrical conductivity type shall be used.

6.3.7.2 Inspection and Calibration -- Each salinometer shall be checked before every field trip. Batteries shall be checked and the cell inspected to determine if it is free of marine growth and salt. The meter shall be checked against the resistor loop supplied with the meter.

6.3.7.3 Reporting Units -- Results should be reported to the nearest 0.1 part per thousand of salinity.

6.4 SEMI-ANNUAL MAINTENANCE

All analytical and test instruments and kits shall be inspected on a semi-annual basis, whether used during the intervening period or not. The purpose of the semi-annual inspection is to maintain the equipment in a ready-to-use condition. This inspection shall consist of a general examination of the electrical system (including batteries) and a calibration against standards. Any expired reagents, broken glassware, or parts shall be replaced.

6.5 SOURCES OF CHEMICALS AND STANDARDS

All chemicals used in test kits and with field analytical instruments as reagents and standards shall be supplied and standardized by the Analytical Support Branch (ASB). Certified pH buffer solutions shall be purchased from chemical supply houses. All reagents and solutions shall have expiration dates attached to the containers. All out-of-date reagents, buffers, and chemical solutions shall be properly disposed of at their expiration date. All field reagent containers shall be identified with the chemical name, concentration, and date prepared.

Tracer-fluorescence standards will be prepared for each study using the actual tracer as outlined in Appendix D.9.

6.6 TRAINING

Each member of the Branch involved in field studies shall undergo an initial review of field analytical and test procedures and equipment. After the initial review, subsequent reviews shall take place annually. The Branch Quality Assurance Officer, in conjunction with personnel from the ASB, shall conduct the instruction. Any new instrumentation adopted by the Branch will be introduced to Branch personnel in a training session before it will be authorized for routine use.

6.7 REFERENCES

1. "Guidelines for Establishing Test Procedures for the Analysis of Pollutants," Federal Register, Volume 49, No. 209, 40 CFR 136, October 26, 1984, and any subsequent revisions.

2. Wilson, J. F., Fluorometric Procedures for Dye Tracing: USGS Techniques of Water-Resources Investigations, Book 3, Chapter A12, United States Department of Interior, Geological Survey, 1968.

3. Standard Methods for the Examination of Water and Wastewater, 1985, 16th Edition.

4. Methods for Chemical Analysis of Water and Wastes, EPA, 600/4-79-020, and all current revisions.

METHOD D.4 DISSOLVED OXYGEN (MEMBRANE ELECTRODE)

D.4.1 Scope and Application

The membrane electrode (ME) probe method for DO measurements is recommended for those samples containing materials which interfere with the modified Winkler procedure as listed in Section D.3.1 of Method D.3.

The ME probe method may be used as a substitute for the modified Winkler procedure provided that the meter itself is standardized against the Winkler method on samples free of interferences.

D.4.2 Summary of Method

The most common ME instruments for determination of DO in water are dependent upon electrochemical reactions. Under steady-state conditions, the current or potential can be correlated with DO concentration. Interfacial dynamics at the ME-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.

Refer to the manufacturer's instructions for calibrating and operating each specific DO meter.

D.4.3 Interferences

- Dissolved organic materials are not known to interfere in the output from DO probes.
- Dissolved inorganic salts are a factor in the performance of DO probes
- Reactive gases which pass through the ME probes may interfere. For example, chlorine will depolarize the cathode and cause a high probe output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Hydrogen sulfide will interfere with ME probes if the applied potential is greater than the half-wave potential of the sulfide ion.
- Dissolved oxygen ME probes are temperature sensitive, and temperature compensation is normally provided by the manufacturer.

D.4.4 Apparatus

- YSI Model 57 DO Meter
- YSI 5700 Series DO Probe
- Hydrolab Surveyor II

D.4.5 Sample Handling

Refer to Appendix D.3.4 (Method D.3).

D.4.6 Calibration

1. Fill a clean bucket with uncontaminated or deionized water and place the ME probe into the bucket. Using the siphon method described in Section D.3.4.4 of Method D.3, fill duplicate BOD bottles and determine the DO by the Winkler method.

2. Adjust the meter according to manufacturer's instructions. Be sure to adjust the meter to the temperature of the water in the bucket, then calibrate the DO indicator dial to read the average DO concentration of the two samples determined by the Winkler test.

D.4.7 Test Procedure

1. When making measurements be sure that the ME stirring apparatus is working, adjust the temperature compensator, and read the DO dial to the nearest 0.1 mg/l.

2. Keep the probe in water when not in use to prevent the membrane from drying out.

3. If the sample temperature is 5°C greater than the calibration temperature, the meter should be recalibrated to the temperature of the sample.

4. Recalibrate against the Winkler test when the DO readings show a distinct change in DO levels, or when the probe has been in waters high in sulfide.

D.4.8 Precision and Accuracy

Manufacturer's specification claims 0.1 mg/l repeatability with ± 1 percent accuracy.

D.4.9 References

Standard Methods for the Examination of Water and Wastewater, 16th Edition p. 395, Method 421 F (1985).

Methods for Chemical Analysis of Water and Wastes, US-EPA, 360.1 (1983).

Instruction Manual YSI Model 57, Dissolved Oxygen Meter, Science Division, Yellow Springs Instrument Company.

Surveyor II Operating Manual, Hydrolab Corporation.

METHOD D.5 SPECIFIC CONDUCTANCE

D.5.1 Scope and Application

This method is applicable to ground, surface, and saline waters, as well as domestic and industrial wastes.

D.5.2 Summary of Method

- The specific conductance of a sample is measured by use of a self-contained conductivity meter, Whetstone bridge-type, or equivalent.
- Samples are preferably analyzed at 25°C. If not, temperature corrections are made and results reported at 25°C.

D.5.3 Test Procedure

1. Follow instructions manual for specific field conductivity meter used.
2. Check the meter with two standard solutions of approximate specific conductances of 100 and 1,000 umhos/cm, or standards that bracket the expected sample conductance. If the meter does not read within one percent of the standards, determine what the problem is and correct it before proceeding. Most field instruments read conductivity directly; with those instruments, follow the manufacturer's instructions. Report the results to the nearest ten units for readings under 1,000 umhos/cm and the nearest 100 units for readings over 1,000 umhos/cm.
3. Record the actual sample temperature when the measurement is made. The meter reading should be converted to specific conductance at 25°C using the information in the manufacturer's instruction manual.

5.4 Apparatus Section

- Beckman SoluBridge® Model RB-5/RB-6
- YSI Model 3530 Flow Through Cell
- Hydrolab Corporation Surveyor II

D.5.5 Precision and Accuracy

The conductivity meters listed above have an accuracy of ± 2 percent of reading. With satisfactory equipment, results within 1 percent of the true value should be obtained.

D.5.6 References

Standard Methods for the Examination of Water and Wastewater, 16th Edition, p. 76, Method 205 (1985).

Annual Book of ASTM Standards, Part 31, "Water," Standard D1125-64, P. 120.

Methods for Chemical Analysis of Water and Wastes, US-EPA, 120.1 (1983).

Instruction Manual, SoluBridge® RB-5/RB-6, Beckman Instruments, Inc., Rev. January 1982.

Surveyor II Operating Manual, Hydrolab Corporation, Rev. A February 1985.

YSI Model 3560 Water Quality Monitoring System Instructions, July, 1988.

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PROTOCOLS FOR SHORT TERM TOXICITY SCREENING OF HAZARDOUS WASTE SITES

by

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bands around the petri dishes to reduce evaporation loss of the medium. Fresh (liquid) stock cultures may be started at four-week intervals by transfer of cells from a single clone in a petri dish to an appropriate volume of liquid medium.

A.5.5.3 Culture Medium

The culture medium is used to maintain the stock cultures of the test organisms. Culture medium is used as a control in each test and as the diluent in each test. Steps for preparing the culture medium follow:

1. Prepare five stock nutrient solutions using reagent-grade chemicals as described in Table A-2.

2. Add 1 mL of each stock solution, in the order listed in Table A-2, to approximately 900 mL of distilled or deionized water. Mix well after the addition of each solution.

3. Dilute to 1 L, mix well, and adjust the pH to 7.0 ± 0.1, using 0.1 N sodium hydroxide or hydrochloric acid, as appropriate. The final concentration of macronutrients and micronutrients in the culture medium is given in Table A-3.

4. Sterilize the filtration apparatus, including 0.2-µm pore diameter membranes. Membranes may be constructed of Teflon, glass fiber, or cellulose triacetate. Membranes must be autoclaved to ensure an aseptic system.

5. Immediately filter the pH-adjusted medium through a 0.2-µm pore diameter membrane at a vacuum of not more than 380 mm (15 in) mercury, or at a pressure of not more than one-half atmosphere (8 psi).

6. Place the filtered medium immediately into sterile culture flasks. No further sterilization steps are required before the inoculation of the medium.

Unused sterile medium should stored at 4°C in the dark for not more than one month before use. Storage may result in substantial loss of water by evaporation.

A.5.6 CULTURE METHODS FOR THE EARTHWORMS (EISENIA FOETIDA)

A.5.6.1 Introduction

Large numbers of E. foetida of known age and size can be easily cultured. Considerable information has been accumulated concerning their growth (Neuhauser et al. 1980), reproduction (Hartenstein et al. 1979), and physical requirements (Kaplan et al. 1980). This information and the ease of culturing makes E. foetida an appropriate earthworm for testing the toxicity of solid hazardous wastes.

A.5.6.2 Distribution

E. foetida can be found worldwide in its specific habitat, which includes manure and soils with a high proportion of organic matter (Fender 1985).

A.5.6.3 Life Cycle

E. foetida reaches maturity in seven to eight weeks at 22 ± 2°C. It is very prolific; a single worm produces two to five cocoons per week, each with several worms.

A.5.6.4 Morphology and Taxonomy

Classification of the earthworm Eisenia foetida is controversial. Some authorities recognize two subspecies, foetida and andrei (Edwards 1984), while others recognize the subspecies as distinct species (Fender, 1985). Identification with the naked eye is not 100% accurate. There are no studies which indicate a sensitivity difference between andrei and foetida; conventional toxicological literature does not differentiate between the two. For these reasons, this manual simply refer to E. foetida as the designated name of the species used in the test. CERL has used andrei as its test organism for the last two years. In any case, results of the tests should include an identification of the organism used.

A.5.6.5 Culture Methods

A.5.6.5.1 Sources of Organisms--

Starter cultures of E. foetida can be obtained from Mr. Julian Stewart, Vittor & Associates, 8100 Cottage Hill Road, Mobile, AL 36695.

A.5.6.5.2 Culture Vessels--

The earthworms can be grown in any number of suitable containers including glass, polyethylene, and wood. The size of the container affects the ability to handle and move the earthworms as required by the laboratory protocol. Excessive container weight may make moving, feeding, and harvesting procedures difficult. The containers should be covered with a glass lid containing air holes.

A.5.6.5.3 Culture Media--

The earthworms are grown in peat moss bedding. The bedding pH is adjusted between 5 and 8 by adding up to three percent by weight of $CaCO_3$. When using peat, care must be taken to avoid overwatering. Peat tends to become water logged with time and anaerobic conditions develop. Indications of anaerobic conditions occur after two to three months and include (1) a change in color between the bottom bedding material and the upper one to two inches of material, and (2) development of a strong odor.

A.5.6.5.4 Culture Conditions--

E. foetida stock cultures are maintained in a growth chamber in the dark at the same temperature as used for testing. The chambers must be capable of maintaining a temperature of $22 \pm 2°C$.

A.5.6.5.5 Feeding--

A mixture of alfalfa pellets is used as the maintenance organic food substrate for the earthworms. The mixture is saturated with water and aged for two weeks in a sealed container. The aged food is sprinkled on the surface of the culture tray. Alfalfa pellets can be obtained from agricultural feed and supply stores.

A.5.6.5.6 Culture Maintenance--

Crowding of adult worms in the growth container must be avoided. Crowding decreases the growth rate and reproduction efficiency. Splitting the bedding material in half every three to four months with pH-adjusted peat moss will prevent overcrowding (Neuhauser et al. 1980).

When the bedding appears dry on the surface, water should be added. However, saturation can cause the earthworms to crawl out of the rearing container. Therefore, water should be added at a rate that keeps the material wet, but avoids standing water in the bottom of the rearing pan. Water use will depend on the ambient temperature and relative humidity. Watering additions can, however, easily be adjusted to the particular conditions of the rearing room.

A pH range of 5 to 8 is best for optimum growing conditions. Earthworms subjected to moisture and pH conditions outside the optimum range will leave the container or die.

A.5.6.5.7 Production Level--

At least four culture containers should be maintained to ensure a sufficient number of earthworms on a continuing basis.

A.5.6.6 Test Organisms

Adult E. foetida (at least two months old with a clitellum) are used for the toxicity test. The earthworms should weigh 300 to 500 mg and be from the same culture container. From 150 to 300 earthworms may be required for each test.

A.8.5 EARTHWORM SURVIVAL (EISENIA FOETIDA)

A.8.5.1 Scope and Application

This method (modified from the methods described by Edwards [1984] and Goats and Edwards [1982]) estimates the acute toxicity of solid hazardous wastes to the earthworm (E. foetida) in a 14-d static test. The responses measured include the synergistic, antagonistic, and additive effects of all the chemical, physical, and biological components that adversely affect the physiological and biochemical functions of the test organisms. The method uses soil as the exposure medium because the exposure conditions closely resemble natural conditions. The method could also be used to test aqueous samples by using 100% artificial soil and by using the aqueous samples in place of distilled or deionized water to hydrate the test soils. This method should be performed by, or under the supervision of, professionals experienced in environmental toxicity testing.

Detection limits of the toxicity of an hazardous waste solution or pure substance are organism dependent.

A.8.5.2 Summary of Method

Earthworms (E. foetida) are exposed in a static system for 14 days to different concentrations of solid hazardous wastes mixed with artificial soil. Test results are based on survival of the worms.

A.8.5.3 Definitions

For definitions of key terms, refer to the Glossary.

A.8.5.4 Interferences

Toxic substances may be introduced by contaminants in water, glassware, sample hardware, artificial soil, and testing equipment (see Section A.4, Facilities and Equipment). Low dissolved oxygen (DO) concentrations or saturation of soils with water may mask the presence of toxic substances.

Pathogenic organisms in test materials may also affect test organism survival, and confound test results.

Improper hazardous waste sampling and handling may adversely affect test results (see Section A.7, Hazardous Waste Sampling and Handling).

A.8.5.5 Safety

For a discussion on safety, see Section A.2, Health and Safety.

A.8.5.6 Apparatus and Equipment

1. Earthworm culture units -- see Section A.5.6. This test requires 150-300 earthworms >60 days old weighing 300 to 500 mg. It is preferable to obtain the earthworms from an in-house culture unit.

2. Sample containers -- for sample shipment and storage (see Section A.7, Hazardous Waste Sampling and Handling).

3. Environmental chamber or equivalent facility with temperature control (22 ± 2°C).

4. Water purification system -- Millipore Milli-Q or equivalent.

5. Balance, analytical -- capable of accurately weighing earthworms to 0.001 g.

6. Balance, top-loading -- capable of weighing soil samples to 1.0 g.

7. Reference weights, Class S -- for checking performance of balance. Weights should bracket the expected weights of the weighing pans and the expected weights of the pans plus worms or soil.

8. Test chambers -- standard 1-pint canning jars with screw-top lids and rings.

9. Volumetric flasks and graduated cylinders -- Class A, borosilicate glass or non-toxic plastic labware, 10- to 1000-mL.

10. Volumetric pipets -- Class A, 1- to 100-mL.

11. Serological pipets -- 1- to 10-mL, graduated.

12. Pipet bulbs and fillers -- Propipet^{R} or equivalent.

13. Bulb-thermograph or electronic-chart type thermometers--for continuously recording temperature.

14. National Bureau of Standards certified thermometer (see EPA Method 170.1, EPA 1979b).

A.8.5.7 Reagents and Consumable Materials

1. Reagent water -- defined as activated-carbon-filtered, distilled or deionized water that does not contain substances toxic to the test organisms. A water purification system may be used to generate reagent water (see number 4 above).

2. Solid hazardous waste sample -- see Section A.7, Hazardous Waste Sampling and Handling.

3. Artificial soil consisting of (by weight) 10% 2.36-mm-screened sphagnum peat, 20% colloidal kaolinite clay, and 70% grade 70 silica sand. The artificial soil must be well mixed after it is prepared. Peat, sand, and clay can be obtained from local suppliers.

4. pH buffers 4, 7, and 10 (or as per instructions of instrument manufacturer) for standards and calibration check (see EPA Method 150.1, EPA 1979b).

5. Laboratory quality assurance samples and standards for the above methods.

6. Reference toxicant (see Section A.3, Quality Assurance).

7. Test organisms -- earthworms (E. foetida); see Section A.5.6 for culture methods for earthworms. The species taxonomy should be verified using appropriate systematic keys (Fender 1985). Adult E. foetida (at least two months old with a clitellum) used for each test should weigh 300 to 500 mg and be from the same culture container.

A.8.5.8 Sample Collection, Preservation, and Storage

For a discussion on collecting, preserving, and storing samples, see Section A.7, Hazard Waste Sampling and Handling.

A.8.5.9 Calibration and Standardization

For a discussion on calibration and standardization, see Section A.3, Quality Assurance.

A.8.5.10 Quality Control

For a discussion on quality control, see Section A.3, Quality Assurance.

A.8.5.11 Procedures

A.8.5.11.1 Test Soils--

One of two dilution factors, 0.3 or 0.5, is commonly used. A dilution factor of approximately 0.3 allows testing between 100% and 1%, using only five concentrations (100%, 30%, 10%, 3%, and 1%). This series of dilutions minimizes the level of effort, but, because of the wide interval between test concentrations, provides poor test precision (±300%). A dilution factor of 0.5 provides greater precision (±100%), but requires several additional dilutions to span the same range of concentrations. Improvements in precision decline rapidly as the dilution factor is increased beyond 0.5. A dilution factor of 0.5 is generally preferred.

If the hazardous waste is known or suspected to be highly toxic, a lower range of concentrations should be used (such as 10%, 5%, 2.5%, 1.25%, and 0.63%). If a high rate of mortality is observed during the first 1 to 2 h of the test, additional dilutions at the lower range of concentrations should be added.

The volume of hazardous waste required for three replicates per concentration, each containing 200 g of test soil, is approximately 1200 g. Prepare enough test soil at each concentration to provide sufficient soil for chemical analyses.

A.8.5.11.2 Glassware Preparation--

Drill or punch a 1/16-in. hole into the center of each canning jar lid. Clean all jars using the procedures outlined in Section A.4, Facilities and Equipment. The rinse cycle in some dishwashers is colder than the wash cycle; this creates a thermal shock, which may crack the soft glass jars. The cleaned jars should be dried at 50°C in a forced air oven and stored with lids (without holes) on in a dust-free environment until needed. The lids should be examined after each use because the seal may deteriorate during repeated washing. Replace the lids and screw rings as needed.

A.8.5.11.3 Start of the test--

Tests should begin as soon as possible, preferably within 24 h of test soil collection. If the persistence of sample toxicity is not known, the maximum holding time should not exceed 36 h. In no case should the test be started more than 72 h after test soil collection. Just prior to testing, the temperature of the test soils should be adjusted to 20 ± 2°C.

Homogenize the solid waste material using a blender. Mix the homogenized solid waste material with artificial soil to prepare 700 g each of a geometric series of test soil concentrations, e.g., 100, 50, 25, 12.5, 6.25, 3.13% dry weight/dry weight, plus controls (100% artificial soil). To ensure even distribution of the test soil mixture, the total amount for each concentration is mixed together in a blender before dividing into replicates.

After mixing, test soils need to be hydrated with deionized water to create a moist, but not saturated, testing environment. The earthworm test soils are to be hydrated to 75% of water holding capacity. Hydration water required to achieve the desired hydration is calculated as follows:

Hydration Water to be added (mL/100g) = THW_{ts} - EHW_{ts}

THW_{ts} (total test soil hydration water desired, mL/100 g) =
PHYD x [(PAS X WHC_{as}) + (PWS x WHC_{ws})],

EHW_{ts} (existing test soil hydration water, mL/100 g) =
[(PAS x MF_{as}) + (PWS x MF_{ws})] x 100,

where PHYD = proportion of hydration required (e.g., 0.75);
PAS = proportion of artificial soil in test soil (e.g., 0.50);
WHC_{as} = water holding capacity of the artificial soil in mL/100 g;
PWS = proportion of waste sample in the test soil;
WHC_{ws} = the water holding capacity of the waste sample in mL/100 g;
MF_{as} = moisture fraction of the artificial soil; and
MF_{ws} = moisture fraction of the waste sample.

Ten earthworms are placed into each of the three replicate jars each containing 200 g (dry weight) of test soil. (Randomize the position of test chambers at the beginning of the test.) Adult earthworms should be handled with a spatula.

The earthworms should be placed on the surface of the test soil in a pint jar, capped, and secured. The tests are incubated to give a soil temperature of 20 ± 2°C under continuous light. The test jars must not be shaded.

A.8.5.11.4 Light, Photoperiod, and Temperature--

Lighting should be at continuous ambient laboratory levels, which is approximately (540 to 1080 lux), with no shading.

A.8.5.11.5 Feeding--

To avoid further interferences, the worms are not fed during the test.

A.8.5.11.6 Routine Chemical and Physical Analyses--

At a minimum, the following measurements are made:

- The pH of the test soils should be measured at the beginning and end of the test.
- The temperature of the environmental control chamber should be continuously monitored.
- The TOC of the test soils should be measured in one test jar at all test concentrations and in the control.

A.8.5.11.7 Observations During the Test--

Mortality is assessed by emptying the test soil onto a tray and sorting the worms from the soil. Dead worms are discarded. (E. foetida are considered dead when they do not respond to a gentle touch to their anterior.) Live worms are placed back into their test jars and placed on the surface of the soil. The numbers of live and dead worms in each test chamber are recorded at 14 days and the dead worms are discarded.

Decay of dead worms can be rapid and, if all 10 worms per container are not found, it can be assumed that the worms decayed beyond recognition.

A.8.5.11.8 Termination of the Test--

The test is terminated after 14 days of exposure. At termination, the number of live and dead worms in each test chamber are counted.

A.8.5.11.9 Acceptability of Test Results--

For the test results to be acceptable, mean survival in the controls must be at least 90%.

A.8.5.11.10 Summary of Test Conditions--

A summary of test conditions is listed in Table A-9.

A.8.5.12 Calculations

The effect measured during the toxicity tests using E. foetida is death.

See Section 2 in the main text for a description of data analysis methods. Both 7-d and 14-d LC50s and 95% confidence intervals should be calculated.

A.8.5.13 Precision and Accuracy

Section A.3, Quality Assurance, describes test precision; the accuracy of toxicity tests cannot be determined.

TABLE A-9. SUMMARY OF RECOMMENDED TEST CONDITIONS FOR E. FOETIDA SURVIVAL TEST

1. Test type:	Static
2. Soil temperature (°C):	20 ± 2°C
3. Light quality:	Ambient laboratory light
4. Light intensity:	540-1080 lux
5. Photoperiod:	Continuous illumination
6. Test vessel type and size:	1-pint glass canning jars with rings and lids 1/8 inch air hole
7. Test soil mass:	200 g
8. Test soil pH*	$\geq$ 4 but $\leq$ 10
9. Artificial soil (% weight):	10% 2.36 mm-screened sphagnum peat, 20% colloidal kaolinite clay, and 70%-grade 70 silica sand
10. Test soil moisture content:	75% of water holding capacity
11. Renewal of test materials:	None
12. Age of test organisms:	>60 days
13. Number of test organisms per chamber:	10
14. Number of replicate chambers per dilution:	3
15. Feeding regime:	Do not feed
16. Dilution factor:	0.5
17. Test duration:	14 days
18. Effect measured:	Death

* If pH is outside this range, results may reflect ph toxicity. Adjustments of ph to 4.0 or 10.0 may result in altered toxicity of other constituents. See Sec 1.4. and A 7.7.

A.8.6 LETTUCE SEED GERMINATION (LACTUCA SATIVA)

A.8.6.1 Scope and Application

This method (modified from the method described by Thomas and Cline [1985]) estimates the acute toxicity of solid hazardous wastes to lettuce (L. sativa) in a 120-h static test. The responses measured include the synergistic, antagonistic, and additive effects of all the chemical, physical, and biological components that adversely affect the physiological and biochemical functions of the test organisms. The method uses soil as the exposure medium because the exposure conditions closely resemble natural conditions. The method could also be used to test aqueous samples by using 100% artificial soil and using the aqueous samples in place of distilled or deionized water to hydrate the test soils. This method should be performed by, or under the supervision of, professionals experienced in environmental toxicity testing.

Detection limits of the toxicity of a hazardous waste solution or pure substance are organism dependent.

A.8.6.2 Summary of Method

Lettuce seeds (L. sativa) are exposed in a static system for 120 h to different concentrations of solid hazardous wastes mixed with artificial soil. Test results are based on the successful germination of the seeds.

A.8.6.3 Definitions

For definitions of key terms, refer to the Glossary.

A.8.6.4 Interferences

Toxic substances may be introduced by contaminants in water, glassware, sample hardware, artificial soil, and testing equipment (see Section A.4, Facilities and Equipment).

Improper hazardous waste sampling and handling may adversely affect test results.

Pathogenic organisms in test materials may affect test organism survival, and also confound test results.

A.8.6.5 Safety

For a discussion on safety, see Section A.2, Health and Safety.

A.8.6.6 Apparatus and Equipment

1. Wire mesh screens for sizing seeds (fractions of an inch): 1/6 x 1/28, 1/6 x 1/30, 1/6 x 1/32, 1/6 x 1/3, A.T. Ferrell and Company, Saginaw, MI 48601 or Seedburo Equipment Company, Chicago, IL 60607.

2. Forceps

3. pH meter

4. Storage bottles

5. 12" x 12" polyethylene resealable bags (e.g., Ziploc^{R})

6. An illuminated magnifier

7. Sample containers -- for sample shipment and storage (see Section A.7, Hazardous Waste Sampling and Handling).

8. Controlled environmental chamber capable of maintaining a uniform temperature of 24 ± 2°C and 4300 ± 430 lux of light operating on a clock timer to control diurnal cycling.

9. Water purification system -- Millipore Milli-Q or equivalent.

10. Balance, top loading - capable of weighing soil samples to 0.1 g.

11. Reference weights, Class S -- for checking performance of balance. Weights should bracket the expected weights of the weighing pans and the expected weights of the pans plus samples.

12. Test chambers -- the bottom halves of plastic petri dishes, 150-mm wide by 15-mm high placed in 12" x 12" polyethylene reseal'able bags.

13. Volumetric flasks and graduated cylinders -- Class A, borosilicate glass or non-toxic plastic labware, 10- to 1000-mL.

14. Volumetric pipets -- Class A, 1- to 100-mL.

15. Serological pipets -- 1- to 10-mL, graduated.

16. Pipet bulbs and fillers -- Propipet^{R} or equivalent.

17. Bulb-thermograph or electronic-chart type thermometers -- for continuously recording temperature.

18. National Bureau of Standards certified thermometer (see EPA Method 170.1, EPA 1979b).

A.8.6.7 <u>Reagents and Consumable Materials</u>

1. Reagent water -- defined as activated-carbon-filtered, distilled or deionized water that does not contain substances toxic to the test organisms. A water purification system may be used to generate reagent water (see number 9 above).

2. Solid hazardous waste sample

3. Artificial soil -- the artificial soil used in the lettuce seed germination test is commercially available, 20-mesh, washed silica sand.

4. Cover sand -- commercially available 16-mesh sand, which has been passed through a 20-mesh sieve to remove fines.

5. pH buffers 4, 7, and 10 (or as per instructions of instrument manufacturer) for standards and calibration check (see EPA Method 150.1, EPA 1979b).

6. Laboratory quality assurance samples and standards for the above methods.

7. Reference toxicant (see Section A.3, Quality Assurance).

8. Test organisms -- lettuce (butter crunch variety), Lactuca sativa L. The seeds used in this test are available from commercial seed companies. Seed from one lot should be purchased in amounts adequate for one year's testing. Information on seed lot, year, or growing season in which they were collected and germination percentage should be provided by the seed source. Only untreated (not treated with fungicide, repellents, etc.) seeds are acceptable for use in this toxicity test.

A.8.6.8 Sample Collection, Preservation, and Storage

For a discussion on collecting, preserving, and storing samples, see Section A.7, Hazardous Waste Sampling and Handling.

A.8.6.9 Calibration and Standardization

For a discussion on calibration and standardization, see Section A.3, Quality Assurance.

A.8.6.10 Quality Control

For a discussion on quality control, see Section A.3, Quality Assurance.

A.8.6.11 Procedures

A.8.6.11.1 Test Soils--

One of two dilution factors, 0.3 or 0.5, is commonly used. A dilution factor of approximately 0.3 allows testing between 100% and 1%, using only five concentrations (100%, 30%, 10%, 3%, and 1%). This series of dilutions minimizes the level of effort, but, because of the wide interval between test concentrations, provides poor test precision (± 300%). A dilution factor of 0.5 provides greater precision (± 100%), but requires several additional dilutions to span the same range of concentrations. Improvements in precision decline rapidly as the dilution factor is increased beyond 0.5. A dilution factor of 0.5 is generally preferred.

A.8.6.11.2 Glassware Preparation--

All glassware used in preparing the soil samples must be thoroughly washed as described in Section A.4, Facilities and Equipment.

A.8.6.11.3 Start of the Test--

Sample preparation should begin as soon as possible, preferably within 24 h of sample collection. If the persistence of sample toxicity is not known, the maximum holding time should not exceed 36 h. Just prior to testing, the temperature of the test soils should be adjusted to 24 ± 2°C.

Homogenize the solid waste material using a blender. Mix the homogenized solid waste material with artificial soil to prepare 400 g each of a geometric series of test soil concentrations, i.e., 100, 50, 25, 12.5, 6.25, 3.13% dry weight hazardous waste/dry weight artificial soil, plus controls (100% artificial soil). To ensure even distribution of the test soil mixture, the total amount for each concentration is mixed together in a blender before dividing into replicates.

After purchase, size grading of seeds is carried out on the entire seed lot. Small samples, 100-150, are sized at a time.

In addition, the seed lot must be inspected. Trash, empty hulls, and damaged seed are removed.

Nest the four wire mesh sizing screens, with the one containing the largest holes on top and those with successively smaller holes in sequence below. A blank or bottom pan is used to collect the fraction that passes through all screens.

Pour the seeds onto the top screen, then shake the whole set of nested screens (by hand or with a vibrator) until all the seed remains on one screen or reaches the bottom pan. The separated fractions are set aside and retained. This procedure is repeated until all the seed in the lot is sized. The size class containing the most seed is selected and used for the duration of the tests. The seeds in each size class are divided into small lots, placed in separate envelopes or sacks, and stored in airtight, waterproof containers in a refrigerator at 4°C.

Place 100 g of each concentration of air-dried control or test soil in each of three replicate 150-mm plastic petri dishes. Randomize the position of the test containers. Place 40 seeds in each dish. Space the seeds at least 0.5 inch from the edge of the petri dish to ensure that they will be covered with test soil. Press the seeds into the test soil with the bottom of a clean beaker. Pour 90 g of cover sand on top of the hydrated test soil. . Level the cover sand with a ruler or small piece of cardboard. Place petri dish cover over the bottom to prevent water loss and spillage prior to incubation.

Hydrate the test soils with deionized water to create a moist, but not saturated, testing environment. The lettuce seed germination test soils are to be hydrated to 85% of water holding capacity. Hydration water required to achieve the desired hydration is calculated as follows.

Hydration Water to be added (mL/100g) = $THW_{ts} - EHW_{ts}$

THW_{ts} (total test soil hydration water desired, mL/100 g) =
$PHYD \times [(PAS \times WHC_{as}) + (PWS \times WHC_{ws})]$,

EHW_{ts} (existing test soil hydration water, mL/100 g) =
$[(PAS \times MF_{as}) + (PWS \times MF_{ws})] \times 100$,

where PHYD = proportion of hydration required (e.g., 0.85);
PAS = proportion of artificial soil in test soil (e.g., 0.50);
WHC_{as} = water holding capacity of the artificial soil in mL/100 g;
PWS = proportion of waste sample in the test soil;
WHC_{ws} = the water holding capacity of the waste sample in mL/100 g;
MF_{as} = moisture fraction of the artificial soil; and
MF_{ws} = moisture fraction of the waste sample.

If $MF_{as} = 0$, which would be the case if the artificial soils are prepared from dry ingredients, then $EHW_{ts} = PWS \times MF_{ws} \times 100$.

Place each covered petri dish into a resealable polyethylene bag, centered over the bottom of the bag. Raise the sides of the bag into a vertical position over the dish. Remove the dish cover and seal (airtight) the bag, leaving as much air space as possible. Randomly distribute the bags in an environmental chamber.

A.8.6.11.4 Light, Photoperiod, and Temperature--

Incubate at 24 ± 2°C in the dark for 48 h, followed by 16 h of light and 8 h dark until termination of the test at the end of 120 h. Light intensity should be 4300 ± 430 lux.

A.8.6.11.5 Routine Chemical and Physical Analyses--

At a minimum, the following measurements are made:

- The pH of the test soils should be measured at the beginning and end of the test (Black 1965, 1982).
- Soil temperature is measured at the beginning of each 24-h exposure period in one replicate of each test concentration and in the control.

A.8.6.11.6 Observations During the Test--

No observations are made during the test.

A.8.6.11.7 Termination of the Test--

After 120 h, the number of germinated seeds in each dish is determined by counting each seedling that protrudes above the soil surface.

A.8.6.11.8 Acceptability of Test Results--

For the test results to be acceptable, mean germination in the controls must be at least 90%.

A.8.6.11.9 Summary of Test Conditions--

A summary of test conditions is listed in Table A-10.

A.8.6.12 Calculations

The effect measured during the toxicity tests using lettuce (L. sativa) seeds is germination.

See Section 2 in the main text for a description of data analysis methods.

Report the LC50 and its 95% confidence limits. The LC50 is an estimate of the median lethal concentration.

A.8.6.13 Precision and Accuracy

Section A.3, Quality Assurance, describes test precision; the accuracy of toxicity tests cannot be determined.

TABLE A-10. SUMMARY OF RECOMMENDED TEST CONDITIONS FOR LETTUCE SEED (L. SATIVA) GERMINATION TEST

1.	Test type:	Static
2.	Temperature (°C):	24 ± 2°C
3.	Light quality:	Fluorescent
4.	Light intensity:	4300 ± 430 lux
5.	Photoperiod:	Initial 48 h dark, followed by 16 h of light and 8 h of dark until termination of the test.
6.	Test vessel type and size:	The bottom halves of plastic petri dishes, 150-mm wide by 15-mm high, placed in 12" x 12" polyethylene resealable bags.
7.	Test soil mass:	100 g
8.	Test soil moisture content:	85% of water holding capacity
9.	Artificial soil:	20-mesh, washed silica sand
10.	Test soil pH:	$\geq$4 but $\leq$10
11.	Renewal of test materials:	None
12.	Age of test organisms:	seeds
13.	Number of test organisms per chamber:	40
14.	Number of replicate chambers per dilution:	3
15.	Dilution factor:	0.5
16.	Test duration:	120 h
17.	Effect measured:	Germination

* If pH is outside this range, results may reflect pH toxicity. Adjustment of pH to 4.0 or 10.0 may result in altered toxicity to other constituents. See Sec 1.4 and A.7.7.

ENVIRONMENTAL SCIENCES DIVISION

TOXICOLOGY LABORATORY

QUALITY ASSURANCE PROGRAM

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ENVIRONMENTAL SCIENCES DIVISION

TOXICOLOGY LABORATORY

QUALITY ASSURANCE PROGRAM

QAP-X-89-ES-0002

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SUBJECT: PREFACE

This manual contains the quality assurance plan and the standard operating procedures used by the Environmental Sciences Division Toxicology Laboratory. The plan was developed from the requirements outlined in the *Martin Marietta Energy Systems Quality Procedures Manual* and the *Oak Ridge National Laboratory Quality Assurance Manual.*

The plan, which spells out specific requirements mandated by sponsors and the management of Oak Ridge National Laboratory, is designed to be easily read by all staff associated with the Toxicology Laboratory.

Elements of the QA plan and the standard operating procedures of the Toxicology Laboratory are contained in white-tabbed sections (labeled QAP and SOP, respectively) of this manual. A separate white-tabbed section (REF) is devoted to the national testing procedures upon which the standard operating procedures are based.

An index has been included at the back of the manual to facilitate access to many important topics. Additions to the index can be made at any time to maximize the usefulness of the document. Such additions will not be regarded as plan revisions.

I would like to thank G. M. Logsdon for her editorial expertise in designing and reviewing this document; her painstaking efforts to clarify the text have been much appreciated. I also thank K. N. Gibson for her many useful suggestions about design and her long hours of work in adapting the document to WordPerfect 5.0.

L. E. Roberson

ESD TOXICOLOGY LABORATORY

QUALITY ASSURANCE PROGRAM

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DATE	03-01-89

SUBJECT: REVISION RECORD

All changes, additions, and deletions to the QA plan or procedures of the ESD Toxicology Laboratory are to be recorded on the following chart.

Revised section	Nature of revision	Revision date	Signature	Insertion date
QAP-6, SOP-14 SOP-15	Temp. Control Modules, New Reference Toxicant (SLS)	9/20/89	Kyra J. Kuyper	11/7/89
QAP-2	New Version	9/13/90	Kyra J. Kuyper	9/26/90
QAP-3				
Title Pg. Assignment Pg	New Version	1/23/91	Belinda K. Boone	7/9/91
Contents. Intro.	"	"	Belinda K Boone	"
QAP 1, 5, 7, 9 SOP 1-11, 14 & 15	"	"	Belinda K Boone	"
Contents, Ref. 1 - Ref. 8	References updated to reflect changes in EPA manual	10-01-91	Belinda Boone	12/5/91
Contents, SOP-Contents	Revised to include new SOPs 17 & 18	4-13-92	Terry Phipps	6/22/92
SOP 17, SOP 18	New procedures	4-13-92	Terry Phipps	6/22/92
Title Pg., Contents, QAP-contents, QAPs 1 3 4 5 8	New Versions	7/1/92	Terry Phipps	9/10/92
SOP-Contents, SOPs 1, 2, 4-11, 14-17	Revised versions	7/1/92	Terry Phipps	9/10/92
SOPs 3, 7-11, 15-18 REF-9, Contents REF-Contents	New Version New Reference; Revised New Version	2/1/93	Terry Phipps	2/9/93
SOP-Contents QAPs 6 & 10	Revised Version Revised Version	2/1/93	Terry Phipps	2/9/93
SOP-20	New Procedure	6/1/93	Terry Phipps	6/15/93
SOPs 19-27	New Procedures	7/1/93	Terry Phipps	7/19/93
QAP-8	New Version	9/3/93	Terry Phipps	9/3/93
Contents, QAPs 1, 4, 5, 8, 9	Revised Version	10/1/93	Terry Phipps	9/30/93
SOP-Contents SOPs 1, 2, 4, 6, 8-11, 14, 15, 17, 18, 22-23, 25-28	Revised Version	10/1/93	Terry Phipps	9/30/93
SOP-28	New Version	10/15/93	Terry Phipps	10/15/93

ESD TOXICOLOGY LABORATORY

QUALITY ASSURANCE MANUAL

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SUBJECT: REVISION RECORD

All changes, additions, and deletions to the QA plan or procedures of the ESD Toxicology Laboratory are to be recorded on the following chart.

Revised Section	Nature of revision	Revision date	Signature	Insertion date
Contents, QAP-2 SOPs 7, 21, 26, 28, 3	New Versions	11-1-93	Terry L. Lipps	11/1/93
Refer to Transmittal 15 attached	New and revised Sections	2-1-94	Terry L. Lipps	2/7/94

SUBJECT: INTRODUCTION

Origin of the QA Program

In 1979, the American Society of Mechanical Engineers (ASME), under mandate of the American National Standards Institute (ANSI), developed and issued a national standard entitled *Quality Assurance Program Requirements for Nuclear Facilities*, otherwise known as ANSI/ASME NQA-1. This standard was subsequently expanded and revised.

Martin Marietta Energy Systems, Inc., requires that the quality assurance (QA) programs at its facilities be in accordance with ANSI/ASME NQA-1. Thus, Oak Ridge National Laboratory (ORNL) has established a program based on the national standard. The ESD Toxicology Laboratory QA plan incorporates laboratory-wide procedures with division procedures and program procedures related to quality. As part of ORNL, the Toxicology Laboratory in the Environmental Sciences Division (ESD) has developed a set of project-specific standard operating procedures to complement the Toxicology Laboratory QA plan.

Required Elements of the QA Plan

The ORNL version of NQA-1 contains 19 QA elements, each of which should be addressed by a QA program. However, 4 of the 19 elements ("Design Control"; "Inspection"; "Test Control"; and "Inspection, Test, and Operating Status") either are not applicable to work conducted in the ESD Toxicology Laboratory or overlap with QA elements addressed in other sections. These four elements are therefore not included as separate items in this plan. Table 1 lists the ORNL QA elements and their location in the QA plan of the ESD Toxicology Laboratory. The rationale for the exclusion of nonapplicable elements follows.

Rational for the Exclusion of Elements

Four elements in the ORNL QA plan are considered nonapplicable to the Toxicology Laboratory for the following reasons.

1. NQA-1 Element 4--"Design Control":

   The design of the ESD Toxicology Laboratory is controlled through applicable documentation procedures as specified in "Instructions and Procedures" (Sect. QAP-5) and in the standard operating procedures (Sect. SOP). Reports generated by the operation of the laboratory will not be subject to external review processes before being submitted to the customer for appraisal.

2. NQA-1 Element 10--"Inspection":

   Processes and product inspections, as normally defined for manufactured items, are not applicable for work done in the laboratory.

3. NQA-1 Element 11--"Test Control":

   Tests performed by the Toxicology Laboratory are of a clinical nature and are not designed to confirm the acceptability of manufactured items. The control of procedures is specified in "Instructions and Procedures" (Sect. QAP-5), and the control of equipment is described in "Measuring and Test Equipment" (Sect. QAP-6).

4. NQA-1 Element 14--"Inspection, Test, and Operating Status":

   Calibration and control equipment is specified in "Measuring and Test Equipment" (Sect. QAP-6) and in the individual standard operating procedures (Sect. SOP).

Table 1. Location of ORNL QA elements in the QA plan of the ESD Toxicology Laboratory

NQA-1 BASIC ELEMENT	TO BE APPLIED (Y/N)	APPLICABLE ORNL QA PROCEDURE(S)	DIVISION SPECIFIC PROCEDURES	ADDITIONS/ CLARIFICATIONS
1. *Organization*	Y	QA-L-1-100	QAP-2	
2. *Quality Assurance Program*	Y	QA-L-2-100 QA-L-2-101 QA-L-2-102 QA-L-2-103 QA-L-2-104 QA-L-2-105 QA-L-2-106	QAP-1	
3. *Design Control*	N	QA-L-3-100 QA-L-3-101 QA-L-3-102		See Rationale
4. *Procurement Document Control*	Y	QA-L-4-100 QA-L-4-101	QAP-3	
5. *Instructions, Procedures, and Drawings*	Y	QA-L-5-100	QAP-5	
6. *Document Control*	Y	QA-L-6-100	QAP-4	
7. *Control of Purchased Items and Services*	Y	QA-L-7-100 QA-L-7-101 QA-L-7-102	QAP-3	
8. *Identification and Control of Items*	Y	QA-L-8-100	QAP-3	
9. *Control of Processes*	Y	QA-L-9-100	QAP-5	
10. *Inspection*	N	QA-L-10-100		See Rationale
11. *Test Control*	N	QA-L-11-100		See Rationale

SUBJECT: INTRODUCTION

NQA-1 BASIC ELEMENT	TO BE APPLIED (Y/N)	APPLICABLE ORNL QA PROCEDURE(S)	DIVISION SPECIFIC PROCEDURES	ADDITIONS/ CLARIFICATIONS
12. *Control of Measuring and Test Equipment*	Y	QA-L-12-100	QAP-6	
13. *Handling, Storage, and Shipping*	Y	QA-L-13-100	QAP-3	
14. *Inspection, Test, and Operating Status*	N	QA-L-14-100 QA-L-14-101		See Rationale
15. *Control of Nonconforming*	Y	QA-L-15-100	QAP-7	
16. *Corrective Action*	Y	QA-L-16-100 QA-L-16-101 QA-L-16-102 QA-L-16-103	QAP-7	
17. *Quality Assurance Records*	Y	QA-L-17-100	QAP-4	
18. *Audits and Surveillances*	Y	QA-L-18-100 QA-L-18-101 QA-L-18-102	QAP-8	
19. *Software*	Y	QA-L-19-100	QAP-9	

SUBJECT: ABBREVIATIONS AND CODES

ANSI	American National Standards Institute
ANOVA	analysis of variance
ASME	American Society of Mechanical Engineers
BMPAP	Biological Monitoring Plan and Abatement Program
CONC	Test concentration
CONT	control
D.F.	degrees of freedom
D.O.	dissolved oxygen
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESD	Environmental Sciences Division
ESQIS	Energy Systems Quality Information System
FC	free chlorine
FHM	fathead minnow
GLM	general linear models
ICP	Inductively Coupled Plasma Spectrophotometry
LSD	least significant difference
MSE	mean square error
NCR	nonconformance report
NEIC	National Enforcement Investigation Center
NPDES	National Pollutant Discharge and Elimination System
NQA-1	National Quality Assurance Standard 1

SUBJECT: **ABBREVIATIONS AND CODES**

ORNL	Oak Ridge National Laboratory
ORGDP	Oak Ridge Gaseous Diffusion Plant
QA	quality assurance
QAP	quality assurance plan
QC	quality control
QER	quality event report
QIR	quality investigation report
REF	reference procedure
REP	replicate
REV	revision sheet
SAS	Statistical Analysis System, registered trademark of the SAS Institute, Inc., Cary, North Carolina
SOP	standard operating procedure
SOR	siphoned out and returned
TCA	trout chow and Cerophyl mixture supplemented with algae
TCMP	Toxicity Control and Monitoring Plan
TCO	trout chow and Cerophyl mixture
TDHE	Tennessee Department of Health and Environment
TRC	total residual chlorine
S	standard deviation

SUBJECT: QUALITY ASSURANCE PLAN–CONTENTS

QAP-1: QUALITY ASSURANCE PROGRAM AND LABORATORY ACTIVITIES

QAP-2: ORGANIZATIONAL RESPONSIBILITIES

QAP-3: PROCUREMENT DOCUMENT CONTROL AND CONTROL OF PURCHASED/USED ITEMS AND SERVICES

QAP-4: DOCUMENT CONTROL AND QUALITY ASSURANCE RECORDS

QAP-5: INSTRUCTIONS AND PROCEDURES

QAP-6: MEASURING AND TEST EQUIPMENT

QAP-7: NONCONFORMANCE AND CORRECTIVE ACTIONS

QAP-8: AUDITS AND SURVEILLANCES

QAP-9: SOFTWARE QUALITY ASSURANCE

QAP-10: CUSTODY

SUBJECT: QUALITY ASSURANCE PROGRAM AND LABORATORY ACTIVITIES

Purpose of the QA Plan

If consistently implemented, a properly designed quality assurance/quality control (QA/QC) plan provides both the means to produce data of prescribed quality and the documentation necessary to demonstrate that quality. Because QA/QC lapses can result from uncertainties about responsible parties, a project QA/QC plan should detail not only the technical procedures that are used to obtain data but also the types of administrative controls that are in place to ensure that the technical procedures are used properly and consistently.

This plan is developed to conform to requirements specified by sponsors and by Martin Marietta Energy Systems, Inc., in Policy Procedure GP-5, "Quality Assurance Program." GP-5 requires that QA plans be prepared, organized, and implemented in accordance with ANSI/ASME NQA-1.

This plan is designed to ensure that all reportable data generated by the ESD Toxicology Laboratory are valid, traceable, and in accordance with the laboratory's requirements. Such conformity is to be achieved through use of the QA plan, standard operating procedures, laboratory logbooks, and reports.

QA Activities

The following QA activities will be reported to the ESD QAS.

1. changes in the scope of this plan;
2. changes in surveillance plans;
3. results of surveillance activities; and
4. occurrence reports, reports of significant corrective actions, and surveillance findings.

Management Assessment

The effectiveness and adequacy of the plan will be periodically and independently assessed by the Group Leader and the section head through discussions, staff meetings, and investigation of any potential problem areas.

Quality Improvement

The ESD Toxicology Laboratory continually strives to improve the quality of its operations and services. In order to assess quality improvement, ESD Toxicology Laboratory management and staff routinely conduct internal surveillances in an effort to identify problem areas that may require improvement. Surveillance documentation includes the identification of the problem as well as a plan for its resolution. When applicable, meetings with laboratory staff are held to discuss problems

identified and to solicit suggestions for improvements and prevention. Additionally, follow-up surveillances are conducted to ensure that quality improvements are being made.

Internal surveillances will be reviewed yearly to track quality improvement efforts made by the Toxicology Laboratory and to apprise laboratory management and staff of the status of corrective actions.

Purpose of the Laboratory

The ESD Toxicology Laboratory conducts chronic and acute tests with *Ceriodaphnia dubia* and fathead minnow larvae to estimate toxicity of ambient water and effluent samples from wastewater treatment operations. Toxicity tests (biomonitoring) are required in Part III (Other Requirements) of the National Pollutant Discharge and Elimination System permits (or the state equivalent) and in biological monitoring and abatement programs. Toxicity test results are ultimately reported to the appropriate state regulatory authority.

The results of the Part III toxicity tests are reported on a test-by-test basis, whereas the results of the biological monitoring and abatement program tests are reported separately in reports drafted for each facility. Tests to identify toxicants and to evaluate changes in wastewater treatment operations are initiated on a case-by-case basis under the guidelines established in Part III of the facility's permit.

Laboratory Procedures

The standard operating procedures presented in this plan were derived from documents published by the U.S. Environmental Protection Agency (EPA): EPA/600/4-85/013, *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-85/014, *Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, and EPA/600/4-89/001, *Short Term Methods for Estimating Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Second Edition*. These documents, together with this QA plan, provide specific guidance in the fulfillment of NPDES permit requirements and the QA requirements of Martin Marietta Energy Systems, Inc.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD QA Specialist.

Approved by Lynn A. Kszos — Group Leader — 9/13/93 — Date

Approved by L. C. Paulson — ESD QA Specialist — 9/13/93 — Date

Effective Date 10/1/93

SUBJECT: ORGANIZATIONAL RESPONSIBILITIES

This section applies to all projects and experiments of the ESD Toxicology Laboratory. It identifies and describes the administrative and technical organization used to ensure project quality.

General Responsibilities

Figure QAP-2.1 shows the organizational structure and the lines of communication between the ORNL administration (—) and the QA administration (----) aspects of the Toxicology Laboratory. Figure QAP-2.2 shows the scheme of NPDES permit negotiations between state and federal government organizations and Martin Marietta Energy Systems, Inc., in relationship to testing requirements fulfilled by the Toxicology Laboratory. Figure QAP-2.3 shows the pathways by which toxicity test results are reported (the dashed line indicates that EPA is not reported to on a regular basis but may be called in for consultation).

Section Head

The section head is responsible for overall QA policy and the development of a QA program for the Toxicology Laboratory. He will assess the adequacy of the laboratory QA plan every two years. So that any necessary revisions will be incorporated at the two year deadline, the Section Head will meet with the Group Leader to assess the adequacy of the plan and make the appropriate changes to the plan 6 months prior to the two year deadline. In addition, the section head will participate in the investigation of problems or potential problems regarding laboratory management or the administration of quality assurance.

Group Leader

The Group Leader is responsible for the quality and technical adequacy of projects in the Toxicology Laboratory and will oversee operations in the laboratory. The Group Leader's responsibilities include

1. assigning duties to the laboratory staff and orienting the staff to the needs and requirements of the laboratory;

2. reviewing laboratory-specific sponsor-related procedures and internally prepared plans and reports;

3. ensuring that all activities related to the technical and quality aspects of the laboratory are in compliance with sponsor requirements;

4. serving as a liaison between the laboratory and other organizations, such as laboratories, the Quality Department and the Health and Safety Division;

5. determining the effect of nonconformances, the appropriateness of reporting nonconformances to management, and the provisions for documenting such reporting;

6. notifying QA personnel of nonconformances and their effects upon the work of the laboratory;

7. reviewing and coordinating corrective action reports;

8. reviewing and incorporating applicable policy and regulatory requirements that affect the laboratory;

9. taking the lead in planning assessments of the laboratory's technical activities as far as they may affect quality and providing control over such activities to an extent consistent with sponsor and divisional requirements;

10. ensuring the implementation of all surveillances, audits, and quality-related corrective actions;

11. ensuring the adequate implementation of sponsor requirements and laboratory task requirements through the use of standard operating procedures;

12. ensuring and documenting the training of personnel performing activities that affect quality;

13. ensuring that protection and control of all log books and designated QA records are consistent with sponsor requirements and ORNL requirements; and

14. ensuring the traceability of all samples and data within the confines of the laboratory.

QA Administration

The manager of the ORNL QA program is ultimately responsible for the administration and coordination of the ESD QA program. The ESD QA Specialist has the specific responsibility of administering the QA program of the Toxicology Laboratory. The QA Specialist is independent from cost and schedule considerations and has access to all work areas. The QA organization has the authority, access, and organizational freedom as designated in QA-L-100, paragraph 100.4. The work covered by this plan is subject to audits and surveillances.

QA Specialist

The QA Specialist will

1. lead efforts to establish QA programs that are responsive both to requirements set by the ORNL QA program and to sponsor requirements,

2. periodically examine and document compliance with QA requirements,

3. conduct periodic surveillance and audits of laboratory activities that affect quality, and

4. provide verification of all corrective actions that may be required.

QA Coordinator

The QA Coordinator will act as a liaison between the Group Leader and the ESD QA specialist to keep the Toxicology Laboratory staff informed of changes in QA procedures and plans. The QA Coordinator is responsible for evaluating the QA plan for adequacy and effectiveness and for implementing the Toxicology Laboratory's quality assurance plan and standard operating procedures. The QA Coordinator will conduct or assist in the performance of internal surveillances to assess the implemention of standard operating procedures. The QA Coordinator will distribute revisions to the QA plan and will maintain QA records. The QA coordinator will develop corrective action plans that may be required.

Technical Staff and Students

Quality in the Toxicology Laboratory depends on the conscientiousness of individuals in adhering to well-defined procedures. The cooperation and abilities of the technical staff in maintaining high QA and their assistance in reporting any lapses in QA are paramount to the overall objective of the laboratory QA plan.

The technical staff are responsible for conducting laboratory activities in a manner that will ensure the highest possible quality of the test data. In this regard, it is the responsibility of each technical staff member or student to conduct the toxicity tests and their associated procedures according to the standard operating procedures described in this manual.

The technical staff are responsible for preparing toxicity test reports derived from test results data. The technical staff are also responsible for verifying the accuracy of data calculations and data entries that are used in performing statistical analyses of the test data.

Other Support and Service Personnel

The Group Leader ensures that support and services provided by other personnel and facilities meet the requirements specified in this plan. In the case of samples provided by others, the Group Leader ensures that the appropriate quality control measures and the steps in the chain of custody are properly documented.

SUBJECT: ORGANIZATIONAL RESPONSIBILITIES

Approvals

This QA plan must first meet the approval of ESD management and the management of the Toxicology Laboratory. The plan must then be approved by the manager of the ORNL QA program.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD QA Specialist.

Approved by Lynn A. Kszos — Group Leader — 10/31/93 — Date

Approved by L. C. Roberson — ESD QA Specialist — 10/29/93 — Date

Effective Date 11/1/93

ORNL-DWG 88M-9567A

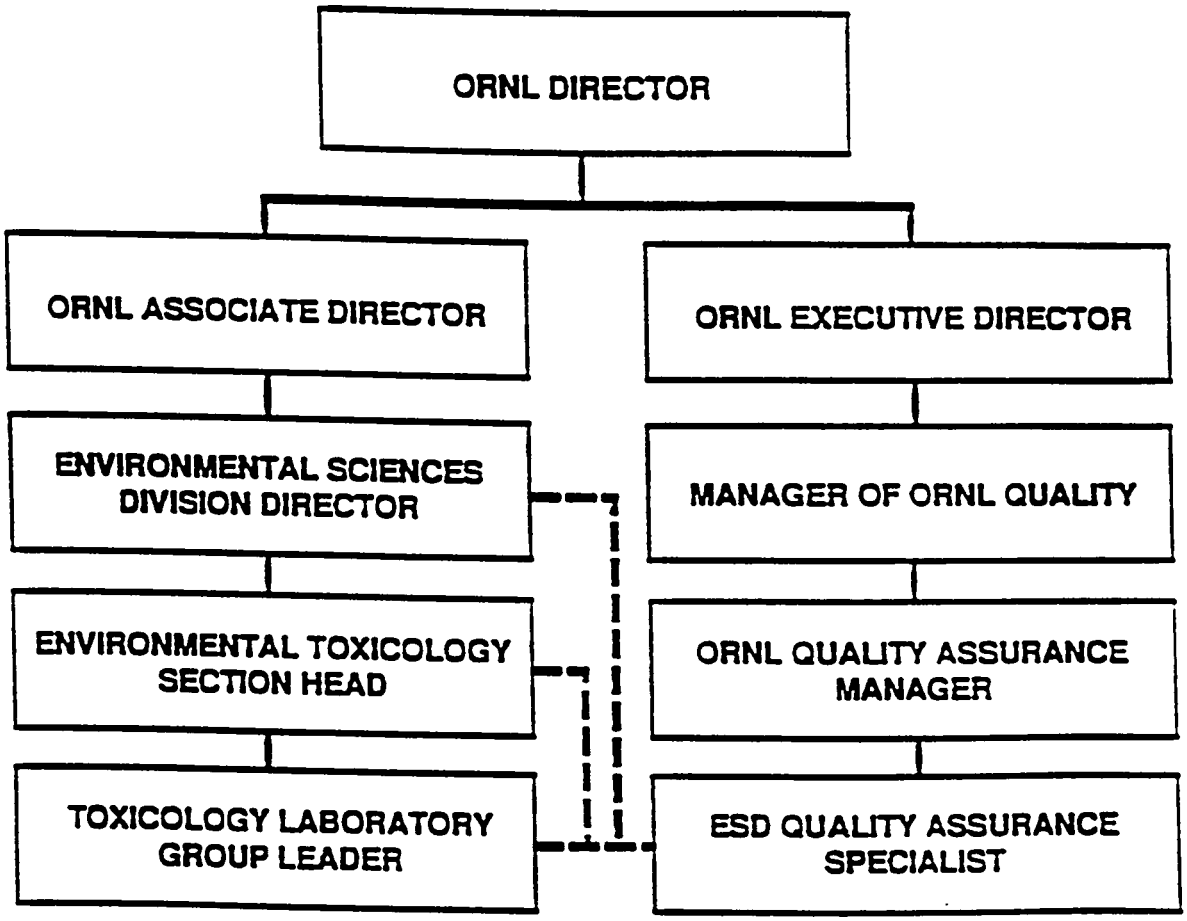


Fig. QAP-2.1 Organizational structure and lines of communication.

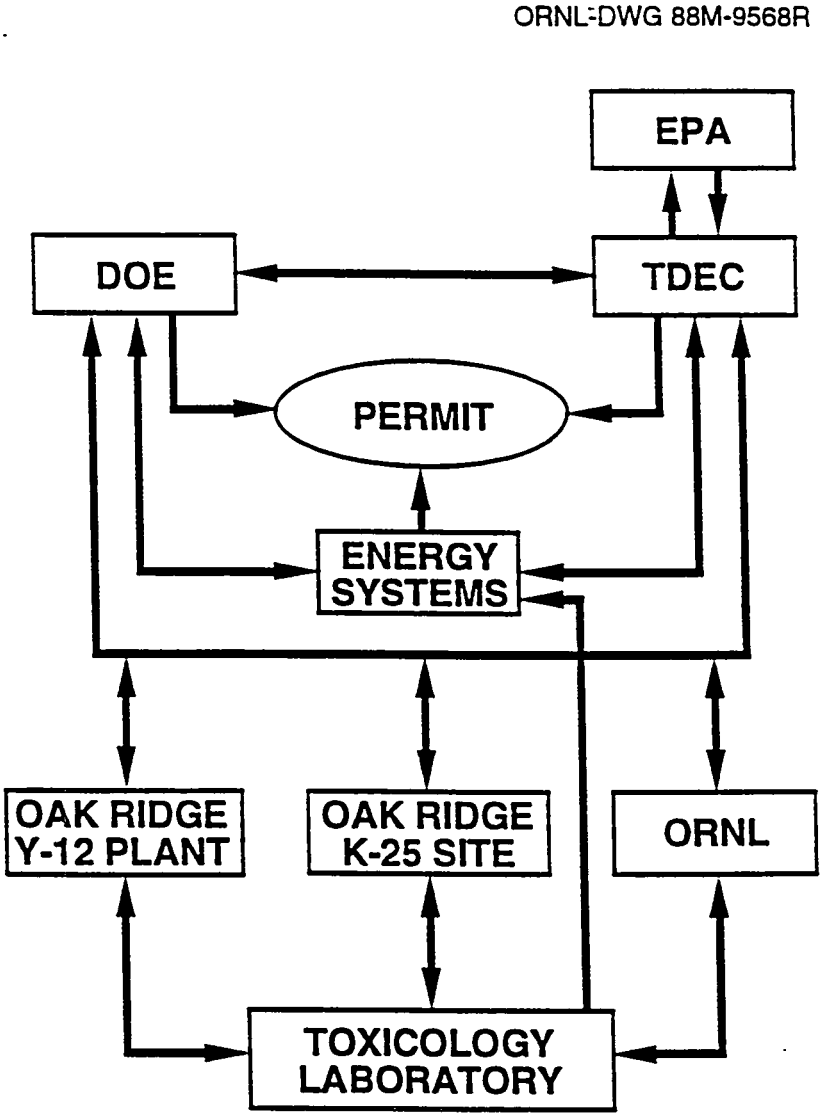


Fig. QAP-2.2 Flow of information from toxicity testing and negotiation scheme for NPDES permits.

ORNL-DWG 88M-9569R

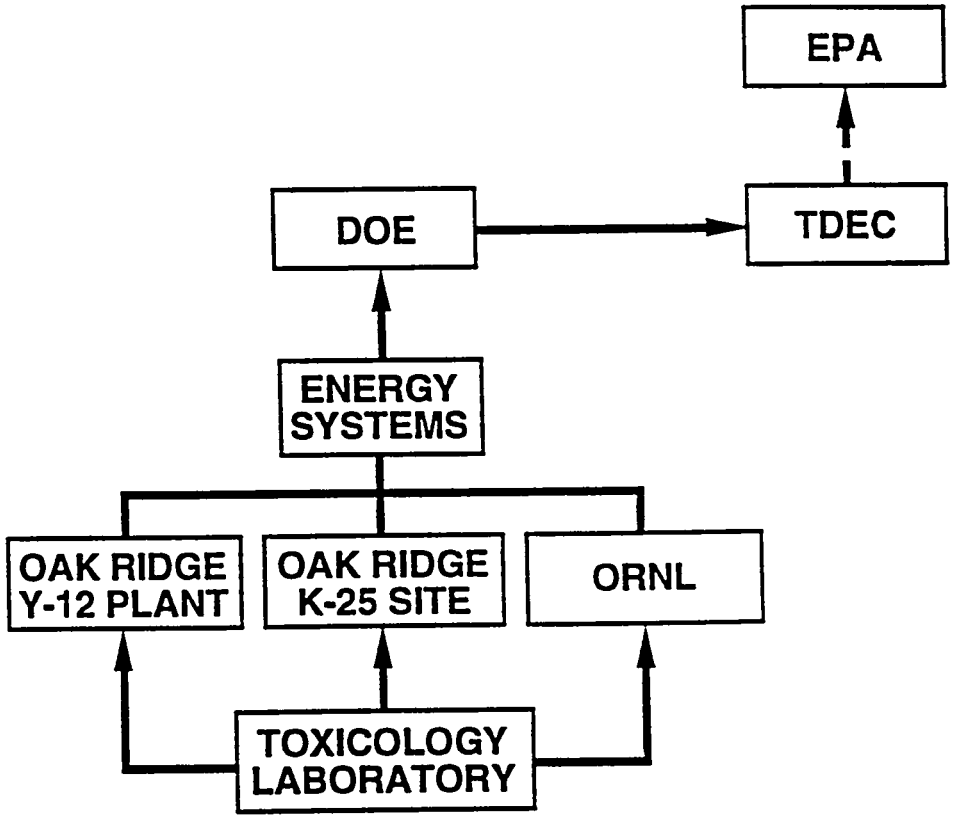


Fig. QAP-2.3 Pathways for reporting results of toxicity tests.

SUBJECT: PROCUREMENT DOCUMENT CONTROL AND CONTROL OF PURCHASED/USED ITEMS AND SERVICES

This section describes the procedures used to ensure that the correct items and services are purchased or used and that items and services conform to specified requirements.

Purchases from Company Stores

When items stocked by Energy Systems Stores are necessary for work in the Toxicology Laboratory and fulfill quality requirements, they are to be purchased from Stores rather than from an outside vendor.

Purchases from Vendors

When Stores cannot supply finished items that are necessary in generating data in the Toxicology Laboratory, such items may be purchased from outside vendors. Purchases will consist of standard catalog items and standard models of off-the-shelf items.

Requisitions

Purchase requisitions are routinely available and are to be used to obtain necessary items. The purchase orders should contain specific identification of the manufacturer's catalog/model number, as applicable. Purchase requisitions are to be prepared and reviewed for conformance to the required technical and quality specifications. Group Leaders can approve purchase requisitions up to $100,000, with certain exemptions (e.g., furniture, computer supplies, calendars, business cards). All other purchase requisitions, including exempted requests, shall be initialed by the Group Leader and signed by the Section Head before being transmitted to the Procurement Division. Changes to purchase requisitions are to be reviewed and approved by those persons who approved the original purchase requisition.

Procurement of Services

The procurement of services (such as sample analyses) must be requested by the Group Leader or designee. The Group Leader is to specify the scope of the analysis, as well as the QA and technical requirements of the analysis.

Project-Specific Needs

The principal non-personnel service purchased by the Toxicology Laboratory consists of water analyses. The Group Leader will ensure that the submission of samples and the documentation of their test results are consistent with criteria set for quality in the laboratory.

If any special items or services are identified as requiring more extensive QA documentation or control, this QA plan will be revised by the Group Leader and by the appropriate QA Specialist for those items and services.

SUBJECT: PROCUREMENT DOCUMENT CONTROL AND CONTROL OF PURCHASED/USED ITEMS AND SERVICES

Identification, Storage, Handling, and Control of Items

Only correct and accepted items that are traceable to their source may be used. If stock materials and laboratory equipment are adequately labeled by the supplier and if they are stored in such a manner that their identity and status are maintained, they do not require additional identification, controls, or markings.

Equipment used in the laboratory procedures is described in the individual standard operating procedures (Sect. SOP). The person performing a procedure is responsible for ensuring that only equipment identified in the laboratory test procedures is used.

The Group Leader or the Sample Custodian (or alternate) will witness and initial the identification of each new sample or sample lot upon its arrival at the laboratory. Individuals performing tests are responsible for ensuring the correct use of each sample as identified. Unused portions of samples containing hazardous waste at toxic concentrations will be returned to the point of origin for disposal.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Project Manager, Group Leader, and ESD QA Specialist.

Approved by	Lynn A. Kszos Project Manager	7/1/92 Date
Approved by	A. Stewart Group Leader	7/2/92 Date
Approved by	L. C. Johnson ESD QA Specialist	7/1/92 Date
Effective Date	7/2/92	

SUBJECT: DOCUMENT CONTROL AND QUALITY ASSURANCE RECORDS

Revisions

Copies of the most recent revisions of this QA plan and the standard operating procedures are to be maintained and controlled by the Group Leader and the ESD QA Specialist. The Group Leader has the responsibility of ensuring the distribution and implementation of all revisions.

Obsolete portions of these documents should be removed when revised portions are inserted. A revision sheet (Sect. REV) is to be maintained by the person to whom the manual is assigned.

Maintenance of Records

Table QAP-4.1 lists those documents that are designated as QA records. All QA records generated by the Toxicology Laboratory will be retained for at least 5 years.

Laboratory Logbooks

Permanently bound, serially numbered logbooks are used for recording all original data, calculations, notes, comments, calibration results, chemical analyses, culture maintenance, toxicity test data and results thereof, as well as other information pertinent to functions performed within the Toxicology Laboratory. An identification number is assigned to each logbook by the Laboratory Records Department.

The Project Manager or designee is responsible for ensuring that requirements, procedures, and responsibilities are established and documented for the transmittal, protection, maintenance, and retention of laboratory notebooks.

Transmittal

The Toxicology Laboratory Steward shall obtain blank laboratory logbooks from Energy Systems Stores, Building 7001. The Laboratory Steward will take the logbook to the Records Department, Building 4500-N, and have a registered number assigned to the logbook prior to use in the Toxicology Laboratory. The Laboratory Steward shall assign the purpose of the logbook for recording data obtained in the Toxicology Laboratory. Each logbook shall be clearly and appropriately labeled with the purpose of the logbook.

Protection

Laboratory logbooks, while in use in the Toxicology Laboratory, shall be stored in a fire-proof, lockable file cabinet located in the ESD Toxicology Laboratory, Room 12, Building 1504.

Toxicology Laboratory personnel shall make Xerox® copies of the laboratory logbooks upon completion of toxicity tests. Copies shall be stored in a backup looseleaf notebook located in a lockable file cabinet outside Room 12 in Building 1504.

SUBJECT: DOCUMENT CONTROL AND QUALITY ASSURANCE RECORDS

Maintenance

Toxicology Laboratory personnel shall maintain laboratory logbooks in accordance with the Standard Operating Procedure (Refer to SOP-16).

Retention

Registered laboratory logbooks shall be retained in the Toxicology Laboratory until complete. The Toxicology Laboratory Steward shall return completed registered logbooks to Laboratory Records, Building 4500-N, for storage.

Backup laboratory notebooks shall be retained in a lockable file cabinet located in Building 1504.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD QA Specialist.

Approved by Lynn A. Kuyper — Group Leader — 9/13/93 — Date

Approved by L. E. Peterson — ESD QA Specialist — 9/13/93 — Date

Effective Date 10/1/93

Table QAP-4.1. QA records to be maintained

Type of record	Maintenance[a]
Laboratory logbooks	**
Backup laboratory notebooks	~
Sponsor requirements Instructions Procedures QA requirements	*
QA plan	*
NCRs[b]	*
Surveillance reports	*
Software programs	++
Documentation of software validation review	++
Risk assessment	*
Training records	++
Chain-of-custody documentation	++
Documentation of instrument calibration	++
Documentation of analyses	++
Audit reports	*

[a]The symbol ** signifies that Laboratory Records will keep the completed original document in a location that is secure, protected, and accessible. The symbol ~ signifies that the Group Leader or designee will keep the backup laboratory notebooks in a location that is secure, protected, and accessible. The symbol * signifies that both the Group Leader or designee and the ESD QA Specialist will keep a copy in locations that are secure, protected, separate, and accessible. The symbol ++ signifies that the Group Leader or designee will keep the original document in a location that is secure, protected, and accessible. .

[b]NCR = nonconformance report.

SUBJECT: INSTRUCTIONS AND PROCEDURES

Project Activities, Procedures, and Control of Processes

Activities in the Toxicology Laboratory are to be performed in accordance with requirements set by sponsors and with divisional QA/QC requirements. Standard operating procedures specified by the sponsor, as well as the control of processes for testing and maintaining test organisms, are described in a separate section (Sect. SOP).

Listing of Procedures

The sampling procedures described in Sect. SOP are used for collecting samples. Procedures for testing and analysis are selected in this order: (1) EPA procedures; (2) analytical procedures prescribed by Martin Marietta Energy Systems, Inc.; (3) procedures prescribed by the ORNL Analytical Chemistry Division; and (4) project-specific procedures developed for the particular needs of the Toxicology Laboratory.

Description of Procedures

Descriptions of all technical procedures relevant to the Toxicology Laboratory are contained in the standard operating procedures of this manual (Sect. SOP).

EPA procedures upon which the standard operating procedures are based can be found in a separate section entitled "Reference Procedures" (Sect. REF).

Training

Training of laboratory personnel is provided to ensure competence in performing laboratory tasks.

The Project Manager, Group Leader, or designee shall oversee the preparation, issuance, maintenance, review, and revision of project-specific instructions, practices, and procedures. The Project Manager, Group Leader, or designee shall ensure that activities affecting quality shall be performed in accordance with documented procedures and instructions prior to beginning work.

Laboratory personnel involved in toxicity assessment and research are trained in accordance with established Standard Operating Procedures (Sect. SOP). Technical expertise and personnel compliance with these procedures will be evaluated by periodic surveillance, reviews, inspections, and blind tests.

Laboratory personnel are required to read, understand, and demonstrate an acceptable level of proficiency in performing the tasks and procedures outlined in the SOPs applicable to the maintenance of the Toxicology Laboratory and the accomplishment of toxicity assessment. In addition, personnel are required to read the "Reference Procedures" section included in QAP-X-89-ES-002.

SUBJECT: INSTRUCTIONS AND PROCEDURES

The Group Leader or approved trainer will train laboratory personnel on the procedures detailed in the Standard Operating Procedures. The trainer will observe the trainee on their ability to satisfactorily performed these procedures.

This level of training is documented on the "Training Checklist" (Exhibit QAP-5.1) and will be retained by the Group Leader or designee.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD QA Specialist.

Approved by _____ Group Leader — 9/13/93 Date

Approved by _____ ESD QA Specialist — 9/13/93 Date

Effective Date 10/1/93

SUBJECT: INSTRUCTIONS AND PROCEDURES

I, _____, have read the ESD Toxicology Laboratory Quality Assurance Program manual.

The trainee will initial the **READ** and **TRAINED** columns for the referenced SOP after (1) each applicable Standard Operating Procedure has been read, and (2) after training has been received by the Project Manager or approved trainer.

The Project Manager or approved trainer will initial the **PROFICIENT** column after the calibrations, procedures, and calculations (if applicable) have been satisfactorily performed by the trainee.

After the **READ**, **TRAINED**, and **PROFICIENT** columns have been initialed, the trainee will sign and date the **TRAINEE SIGNATURE AND DATE** column.

SOP Section	Read	Trained	Proficient	Trainer (name)	Trainee (signature and date)
SOP-1 Preparation of Dilute Mineral Water					
SOP-2 Washing of Glassware					
SOP-3 Preparation of *Ceriodaphnia* Food					
SOP-4 Maintenance of *Ceriodaphnia* Cultures					
SOP-5 Preparation of Newly Hatched Brine Shrimp					
SOP-6 Culture of Fathead Minnows					
SOP-7 Collection, Handling, and Storage of Samples					

(continued)

Exhibit QAP-5.1. Training Checklist.

SUBJECT: MEASURING AND TEST EQUIPMENT

This section describes the policies ensuring that instruments and other measuring and test equipment used for activities affecting the quality of data are calibrated and adjusted at specified intervals so that they maintain the required degree of accuracy.

Calibration

Measuring and test equipment used to obtain reportable data must be calibrated in accordance with sponsor requirements and the manufacturer's instructions. The frequency of calibration will be determined by sponsor requirements and/or the best professional judgment of the Group Leader.

Measuring and test equipment that has been calibrated by the manufacturer may be used. Standards are to be used to verify that measuring and test equipment will yield acceptable data. The descriptions of the applicable procedures will state the standards to be used, the frequency of standardization, and the acceptable criteria (maximum and minimum range), along with the directions for evaluating the standard. Results of the analyses of standards must be recorded in the registered log books specified in the individual standard operating procedures (Sect. SOP). The appropriate laboratory personnel will initial and date each analysis of a standard to signify that the measuring and test equipment has been calibrated and that it will yield results meeting acceptable criteria.

Labeling

Whenever possible, measuring and test equipment should be labeled to indicate their calibration status. When direct labeling is not practical, the calibration status of an item should be noted in the registered log books specified in the individual standard operating procedures (Sect. SOP).

Suspect Equipment

When measuring or test equipment is suspect, it should be removed immediately from service and repaired and/or recalibrated. If it is found to be out of calibration, an immediate investigation is to be initiated (if applicable) to determine the validity of measurements taken since the last acceptable standardization. Reportable data obtained with the suspect equipment during this interval will be noted in appropriate laboratory notebooks and in a quality investigation report, if deemed necessary by the Group Leader (see "Nonconformance and Corrective Actions," Sect. QAP-7).

Maintenance

Preventative maintenance of field and laboratory instruments should be conducted in accordance with schedules recommended by the appropriate vendors or manufacturers.

The Analytical Chemistry Division is responsible for the calibration and maintenance of all equipment that is required to perform analyses of samples for the Toxicology Laboratory.

SUBJECT: MEASURING AND TEST EQUIPMENT

Project-Specific Requirements

Table QAP-6.1 lists equipment requiring calibration for use in the Toxicology Laboratory.

Table QAP-6.1. Equipment requiring calibration in accordance with procedures in the manufacturer's manual

Item	Category[a]	Frequency of calibration or calibration check	Calibrator[b]
pH meter	C	Before each use	Individual user
Conductivity meter	C	Weekly	Designated user
Dissolved oxygen meter	C	Before each use	Individual user
Thermometer (digital)	C	Quarterly	Designated user
Cahn microbalance	B	Every 6 months	I&C
Mettler balance	B	Every 6 months	I&C
Temperature control (module)	B	Yearly	I&C
Automatic pipettes	C	Weekly	Designated user

[a]Category B - "Routine" devices and systems that are to be included in a calibration recall program on a regular cycle.

Category C - "Experimental" or "other" devices and systems that are to be calibrated by, or at the direction of, the user as deemed necessary.

[b]I&C = Instrumentation and Controls Division.

ESD TOXICOLOGY LABORATORY

QUALITY ASSURANCE PROGRAM

SECTION QAP-6
PAGE 3 of 3
DATE 02-01-93

SUBJECT: MEASURING AND TEST EQUIPMENT

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Project Manager, Group Leader, and ESD QA Specialist.

Approved by	Lynn A. Kosas Project Manager	2/1/93 Date
Approved by	A. Stewart Group Leader	1/27/93 Date
Approved by	L.C. Peterson ESD QA Specialist	1/27/93 Date
Effective Date	2/9/93	

SUBJECT: NONCONFORMANCE AND CORRECTIVE ACTIONS

This section identifies methods and policies for the documentation, evaluation, corrective action, and close-out activities that are necessary when an unplanned deviation from the standard operating procedures is detected or when errors are noted in reportable data. Further, it identifies the requirements for the documentation and implementation of corrective actions.

Unplanned Deviations

All unplanned deviations will be evaluated with respect to their possible impact on reportable data. All deviations from standard operating procedures, equipment calibrations, or any aspect of the QA plan will be evaluated and documented. Nonconforming items will be controlled to prevent their inadvertent use.

Responsibilities of Project Participants

Persons participating in the work of the Toxicology Laboratory will ensure the prompt identification, control, and disposition of nonconforming items. Each laboratory participant will submit records of all nonconformances to the Group Leader and/or the Division QA Specialist within a reasonable period of time following the initial identification and documentation of the nonconformance. The nonconformance will then be evaluated by the Group Leader. The evaluation will determine if the nonconformance has adversely affected the results of the data.

Reporting of Problems

The Group Leader and the QA Specialist or an appropriate member of division management will determine if the event justifies the issuance of a nonconformance report. The appropriate report will document the event, the findings of the evaluation, and the required corrective actions. Exhibits QAP-7.1 and QAP-7.2 show the various forms used for documenting deficiencies in quality.

All occurrences related to this project will be identified, categorized, reported, corrected, and documented in accordance with the ORNL QA Manual, procedure QA-L-16-100, Occurrence Reporting.

Corrective Action

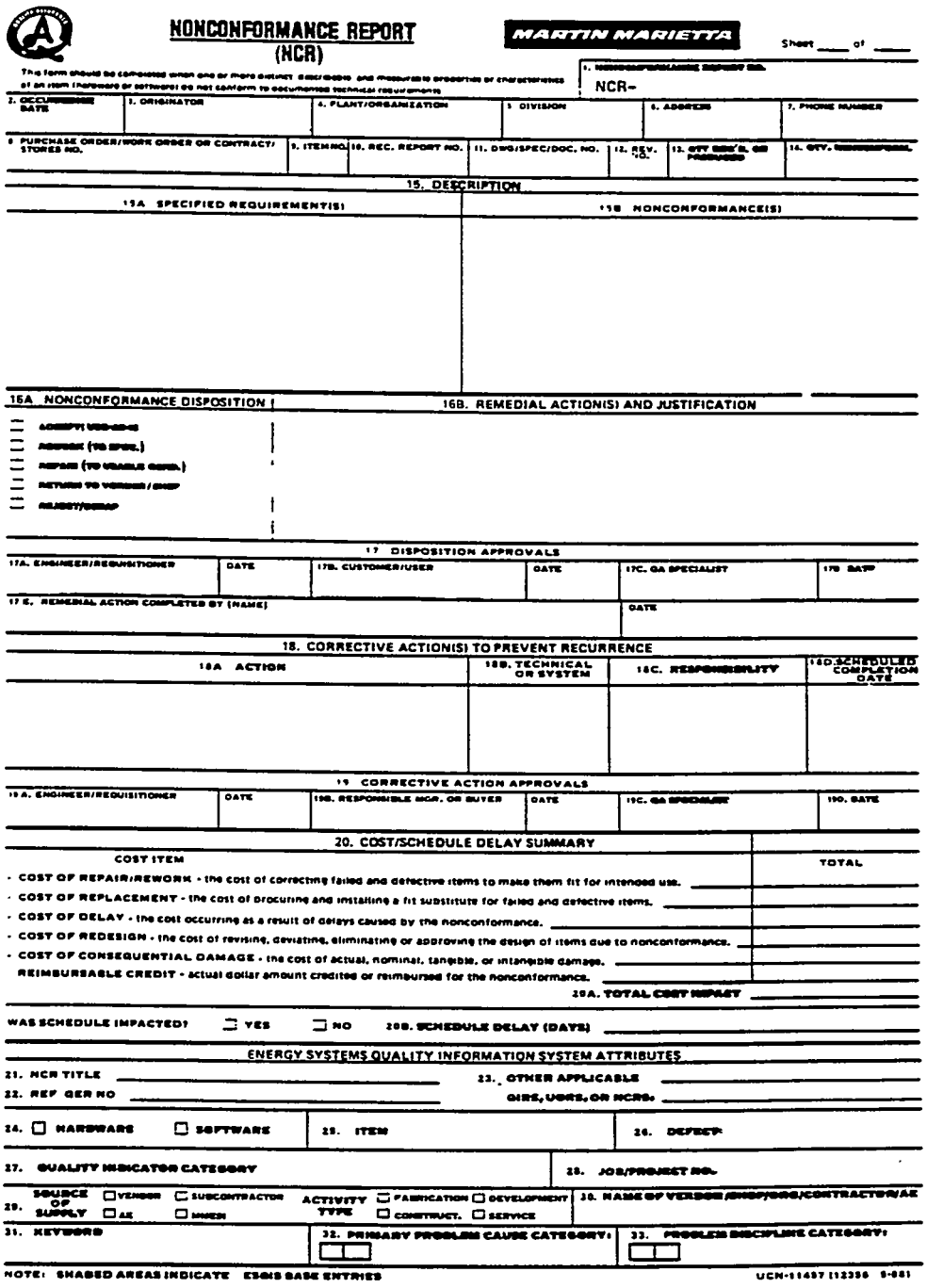
The Group Leader will prepare the corrective action plan and assign responsibility for implementing corrective actions. The corrective actions will be documented on a standard corrective action report and status (CARS) form, available from the ORNL Quality Department. All CARS forms must be attached to the appropriate deficiency form. Exhibit QAP-7.2 shows the form used for documenting corrective actions. The QA Specialist will monitor the action plan to ensure that the corrective action(s) are implemented and completed.

SUBJECT: NONCONFORMANCE AND CORRECTIVE ACTIONS

The status of corrective actions will be periodically evaluated by the ESD QAS. Corrective actions that are incomplete after their scheduled completion date are to be escalated to the next higher level of management.

Additional information regarding nonconformances and corrective actions may be found in Sects. 15 and 16 of the *ORNL Quality Assurance Manual.*

SUBJECT: NONCONFORMANCE AND CORRECTIVE ACTIONS



NONCONFORMANCE REPORT
(NCR)

MARTIN MARIETTA

Sheet ____ of ____

This form should be completed when one or more defined characteristics of an item (hardware or software) do not conform to documented technical requirements

1. NCR-

2. OCCURRENCE DATE | 3. ORIGINATOR | 4. PLANT/ORGANIZATION | 5. DIVISION | 6. ADDRESS | 7. PHONE NUMBER

8. PURCHASE ORDER/WORK ORDER OR CONTRACT/STORES NO. | 9. ITEM NO. | 10. REC. REPORT NO. | 11. DWG/SPEC/DOC. NO. | 12. REV. NO. | 13. QTY REC'D, QTY REJECTED | 14. QTY.

15. DESCRIPTION

15A SPECIFIED REQUIREMENT(S) | 15B NONCONFORMANCE(S)

16A NONCONFORMANCE DISPOSITION

- ☐ ACCEPT AS-IS
- ☐ REWORK (TO SPEC.)
- ☐ REPAIR (TO VIABLE COND.)
- ☐ RETURN TO VENDOR / SHOP
- ☐ REJECT/SCRAP

16B. REMEDIAL ACTION(S) AND JUSTIFICATION

17 DISPOSITION APPROVALS

17A. ENGINEER/REQUISITIONER | DATE | 17B. CUSTOMER/USER | DATE | 17C. QA SPECIALIST | 17D. DATE

17E. REMEDIAL ACTION COMPLETED BY (NAME) | DATE

18. CORRECTIVE ACTION(S) TO PREVENT RECURRENCE

18A ACTION | 18B. TECHNICAL OR SYSTEM | 18C. RESPONSIBILITY | 18D. SCHEDULED COMPLETION DATE

19 CORRECTIVE ACTION APPROVALS

19A. ENGINEER/REQUISITIONER | DATE | 19B. RESPONSIBLE MGR. OR BUYER | DATE | 19C. QA SPECIALIST | 19D. DATE

20. COST/SCHEDULE DELAY SUMMARY

COST ITEM	TOTAL
• COST OF REPAIR/REWORK - the cost of correcting failed and defective items to make them fit for intended use.	
• COST OF REPLACEMENT - the cost of procuring and installing a fit substitute for failed and defective items.	
• COST OF DELAY - the cost occurring as a result of delays caused by the nonconformance.	
• COST OF REDESIGN - the cost of revising, deviating, eliminating or approving the design of items due to nonconformance.	
• COST OF CONSEQUENTIAL DAMAGE - the cost of actual, nominal, tangible, or intangible damage.	
REIMBURSABLE CREDIT - actual dollar amount credited or reimbursed for the nonconformance.	
	20A. TOTAL COST IMPACT

WAS SCHEDULE IMPACTED? ☐ YES ☐ NO 20B. SCHEDULE DELAY (DAYS)

ENERGY SYSTEMS QUALITY INFORMATION SYSTEM ATTRIBUTES

21. NCR TITLE

22. REF GER NO

23. OTHER APPLICABLE GIRS, UORS, OR NCRs

24. ☐ HARDWARE ☐ SOFTWARE | 25. ITEM | 26. DEFECT

27. QUALITY INDICATOR CATEGORY | 28. JOB/PROJECT NO.

29. SOURCE OF SUPPLY ☐ VENDOR ☐ SUBCONTRACTOR ☐ AE ☐ MMES
ACTIVITY TYPE ☐ FABRICATION ☐ DEVELOPMENT ☐ CONSTRUCT. ☐ SERVICE

30. NAME OF VENDOR/SHOP/DRG/CONTRACTOR/AE

31. KEYWORD | 32. PRIMARY PROBLEM CAUSE CATEGORY: ☐☐ | 33. PROBLEM DISCIPLINE CATEGORY: ☐☐

NOTE: SHADED AREAS INDICATE ESMIS BASE ENTRIES

UCN-11497 (12396 9-88)

Exhibit QAP-7.1. Nonconformance report (NCR) form.

SUBJECT: NONCONFORMANCE AND CORRECTIVE ACTIONS

CORRECTIVE ACTION REPORT AND STATUS

CORRECTIVE ACTION SOURCE: Initiation Date:_____

AUDIT#_____ UOR#_____

NCR#_____ QIR#_____

FINDING AND/OR RECOMMENDATION:

CORRECTIVE ACTION:

RESPONSIBLE PERSON: _____

SCHED. COMPLETION DATE: _____ *REVISED COMPLETION DATE:* _____

Commit to Corrective Action:_____ _____
Division/Program Manager/Director Date

Accept and Understand Task:_____ _____
Responsible Person Date

Reviewed for Adequacy:_____ _____
Division/Program QAS ESQIS Entry Date

STATUS:

CORRECTIVE ACTION COMPLETION:

_____ _____
Responsible Person Date Completed

QAS:_____

Date Verified Completion and Effectiveness:_____

Date Entered in ESQIS:_____

Exhibit QAP-7.2. Corrective action report and status (CARS) form.

SUBJECT: AUDITS AND SURVEILLANCES

This section identifies the requirements for planning, performing, and reporting audits and surveillances to verify compliance with all aspects of the QA program of the ESD Toxicology Laboratory and to determine the program's effectiveness.

Audits

The Toxicology Laboratory is subject to audits by sponsors, TDEC, EPA, ORNL, and the ESD QA Specialist.

Surveillances

In compliance with requirements specified in the *ORNL Quality Assurance Manual*, laboratory activities will be under surveillance by the ESD QA Specialist and the laboratory's Group Leader (or designee). Surveillance activities are listed in Tables QAP-8.1 and QAP-8-2. The frequency of surveillance and the activities to be examined will be determined by the Group Leader and/or the ESD QA Specialist.

Reporting

Surveillance activities conducted by the Group Leader (or designee) and the ESD QA Specialist will be documented and copies sent to the manager of the ORNL QA program.

Table QAP-8.1. Surveillance activities for water toxicity tests performed by the Group Leader or designee

Activity	Frequency
Tracking water samples through sampling, testing, water chemistry, and report preparation phases of a toxicity test.	Twice yearly
Validating ambient sampling sites.	Twice yearly
Submitting blind samples for toxicity testing and/or water quality measurements.	Quarterly
Verifying *Ceriodaphnia* fecundity by repeat counts.	Quarterly
Verifying statistical computations on final reports (i.e., means and standard deviations).	Monthly
Verifying fathead minnow growth by repeat weights.	Quarterly
Verifying cleanliness of laboratory-washed glassware.	Designated as a control for each toxicity test conducted.

Table QAP-8.2. Surveillance activities for sediment toxicity tests performed by the Group Leader or designee

Activity	Frequency
Tracking sediments samples through sampling, testing, water chemistry, and report preparation phases of a toxicity test.	One sample per test period.
Verifying *Daphnia magna* survival and fecundity by by repeat counts.	Random 5% of total number of replicates on test termination day counted by technician; once per test period.
Verifying initial *Hyalella* count by repeat counts.	Random 5% of total number of replicates on test initiation day counted by a second technician; once per test period.
Verifying final *Hyalella* count by repeat counts.	Random 5% of total number of replicates on test termination day counted by a second technician; once per test period.
Verifying initial *Anodonta imbecillis* count by repeat counts.	Random 5% of total number of replicates counted by a second technician on test initiation day; once per test period.
Verifying *Anodonta imbecillis* condition and count by repeat counts.	Random 5% of total number of replicates counted by a different technician on alternating days; once per test period.
Verifying statistical computations on final reports (i.e., means and standard deviations).	One test per test period.

Table QAP-8.2. Surveillance activities for sediment toxicity tests performed by the Group Leader or designee (continued)

Activity	Frequency
Checking test variability by running a duplicate treatment of one sample.	One random sample to be run as a side-by-side duplicate by a second technician; one site per test period for any one at the following tests: *Hyalella*, *Daphnia magna*, *Anodontia imbecillis*, Microtox®, or *Ceriodaphnia dubia* acute tests.
Verifying cleanliness of laboratory-washed glassware.	Designated as a control for each toxicity test conducted.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD COO Specialist.

Approved by Lynn A. Kszos — Group Leader — 1/31/94 — Date

Approved by L. C. Johnson — ESD QA Specialist — 1/31/94 — Date

Effective Date 2/15/94

ESD TOXICOLOGY LABORATORY

QUALITY ASSURANCE MANUAL

SECTION QAP-9
PAGE 1 of 1
DATE 10-01-93

SUBJECT: SOFTWARE QUALITY ASSURANCE

The software used in the analysis of data obtained in the Toxicology Laboratory is classified as Category 3 defined in MMES Standard ESS-QA-19.0.

Category 3 includes software developed by scientists and engineers in the course of their research and development activities. This software consists of procedures, programs, and analysis techniques that are designed and developed as a part of theoretical or experimental research in the physical, biological, mathematical, and engineering sciences. The documentation of such software, including design standards, developmental methodology, program verification, and instructions for use, is carried out in the manner usual for scientific and engineering research and development. Such documentation may include entry of appropriate material in research notebooks and/or the publication of material in refereed literature.

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader and ESD QA Specialist.

Approved by Lynn A. Kszos — Group Leader — 9/13/93 — Date

Approved by L. E. Eberson — ESD QA Specialist — 9/13/93 — Date

Effective Date 10/1/93

SUBJECT: CUSTODY

This section identifies the policies and procedures that are used for ensuring sample integrity and for maintaining sample custody.

Sample Custody

To establish the integrity of samples, it may be necessary in litigation to demonstrate that the samples were maintained under custody from the time they were collected in the field to the time they were analyzed in the laboratory. The field sampler is personally responsible for the care and custody of the collected samples until they are properly transferred or disposed of.

The National Enforcement Investigation Center (NEIC) defines custody in the following way:

> A sample is under custody if:
> 1. It is in your possession, or
> 2. It is in your view, after being in your possession, or
> 3. It was in your possession and you locked it up, or
> 4. It is in a designated secure area.

Sample Custodian

The Sample Custodian is any person who is authorized to collect or take possession of samples, at any time. The Toxicology Laboratory Sample Custodian is responsible for the following:

1. collecting and identifying field samples,
2. receiving and logging in samples to the laboratory from the site of collection so that neither the identity nor the integrity of samples is in doubt,
3. notifying the analysis personnel of sample arrival,
4. coordinating intralaboratory delivery of samples with appropriate custody records, and
5. disposing of samples and test waters in accordance with approved procedures.

Chain of Custody

Figure QAP-10.1 shows the steps in the chain-of-custody scheme that are to be followed for sampling and testing (the dashed line indicates that samples may be sent to a water quality analysis laboratory if necessary). The Sample Custodian will check the completeness of the entries on the chain-of-custody form. The form will be copied, and the Xerox® copy will be placed in the backup chain-of-custody notebook.

Chain-of-Custody Form

Exhibit QAP-10.2 shows a sample chain-of-custody form which is used to document the transfer of the possession and custody of samples. The form attests that, between sample collection and laboratory analysis, the sample was constantly under custody. Toxicology Laboratory personnel shall complete the chain-of-custody form in accordance with the Standard Operating Procedure (Sect. SOP).

Custody Seals and Shipping Procedures

Occasionally, samples to be tested are sent to the laboratory by outside vendors. In such cases shipping containers will be locked or sealed for shipment. While being shipped to the laboratory, samples sometimes may be handled by postal clerks, couriers, or others. However, the samples are effectively in a secured area: the NEIC procedure requires that a custody seal be affixed to the shipping container in such a way that, if the shipping container is properly secured and arrives at the laboratory with the custody seals intact and with adequate documentation, the integrity of the samples can be demonstrated. Therefore, signatures from these intermediary clerks and couriers are not required.

All shipments will be accompanied by the chain-of-custody form identifying its contents. The original form will accompany the shipment, and a copy will be retained in the Toxicology Laboratory's backup chain-of-custody notebook. If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, a government bill of lading will be used. The Toxicology Laboratory will retain freight bills, post office receipts, bills of lading, packing slips or shipping orders as part of the sample's permanent documentation.

Laboratory Custody Procedures

For the purposes of the Toxicology Laboratory, Building 1504 is considered a secure area: the outside doors are locked after work hours, and only authorized (badged) personnel or those who are escorted by badged personnel, are permitted in the building. The laboratory areas in Building 1504 shall be maintained as secured areas and shall be restricted to authorized personnel.

Samples should be handled by a minimum number of persons.

Incoming samples shall be received only by the Sample Custodian, who will indicate receipt by signing the chain-of-custody form accompanying the samples and retain the form as a permanent record. Couriers picking up samples at the airport or post office shall sign jointly with the Sample Custodian.

Laboratory personnel are responsible for the care and custody of a sample and should be prepared to testify that the sample was in their possession and in view or secured in the laboratory at all times from the moment it was received from the Sample Custodian to the time the tests were run.

SUBJECT: CUSTODY

Disposal of Samples and Test Waters

Once the analyses of the samples are completed, the unused portions of the samples, together with test water collected during change-out, must be disposed of in accordance with procedures approved by the Environmental Compliance Division (Sect. SOP).

Approval

All Quality Assurance Plans generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Project Manager, Group Leader, and ESD QA Specialist.

Approved by	Lynn A. Kozos Project Manager	2/1/93 Date
Approved by	A Stewart Group Leader	1/27/93 Date
Approved by	L.C. Peterson ESD QA Specialist	1/27/93 Date
Effective Date	2/9/93	

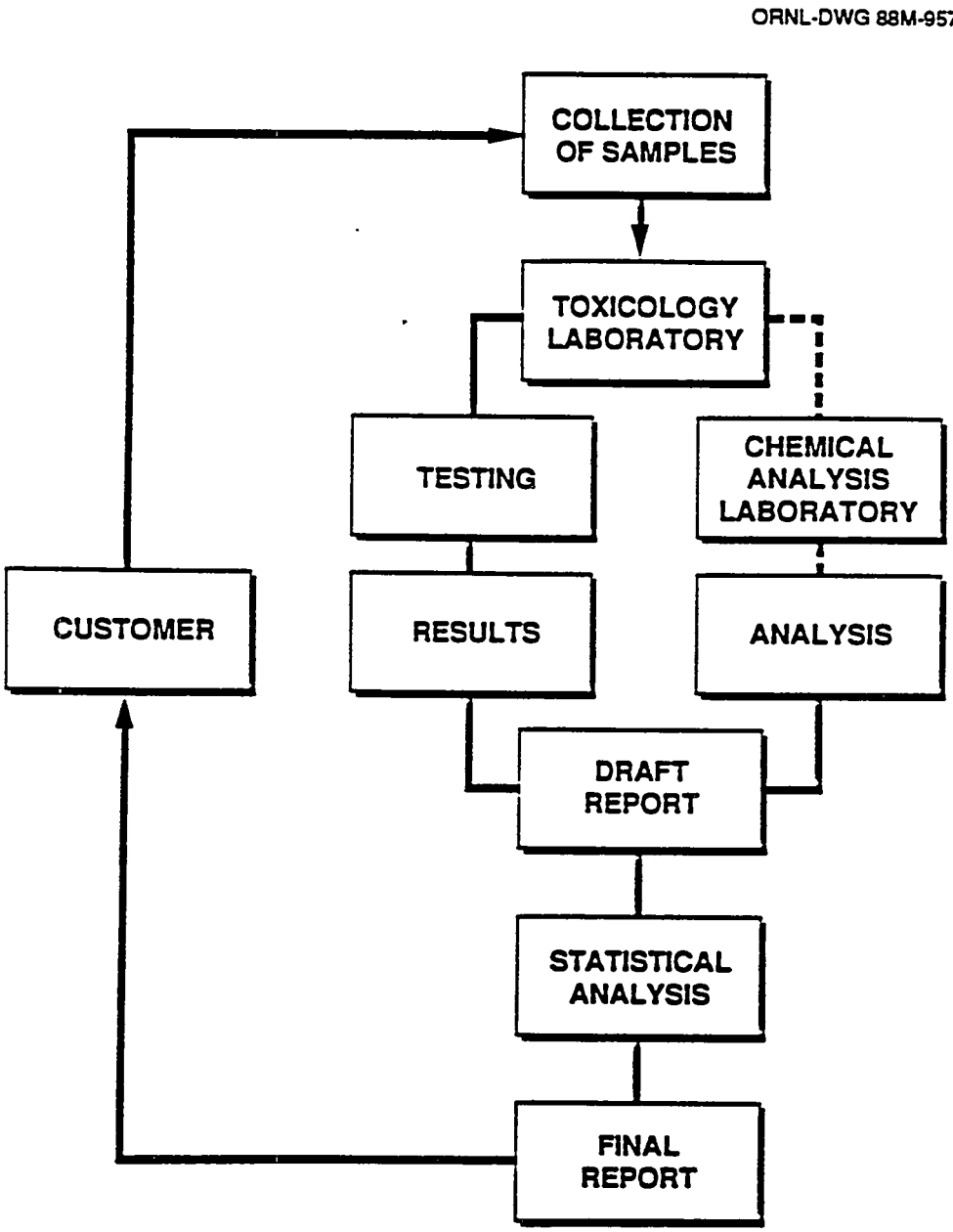


Fig. QAP-10.1 Chain-of-custody steps for sampling, testing, and reporting.

SUBJECT: CUSTODY

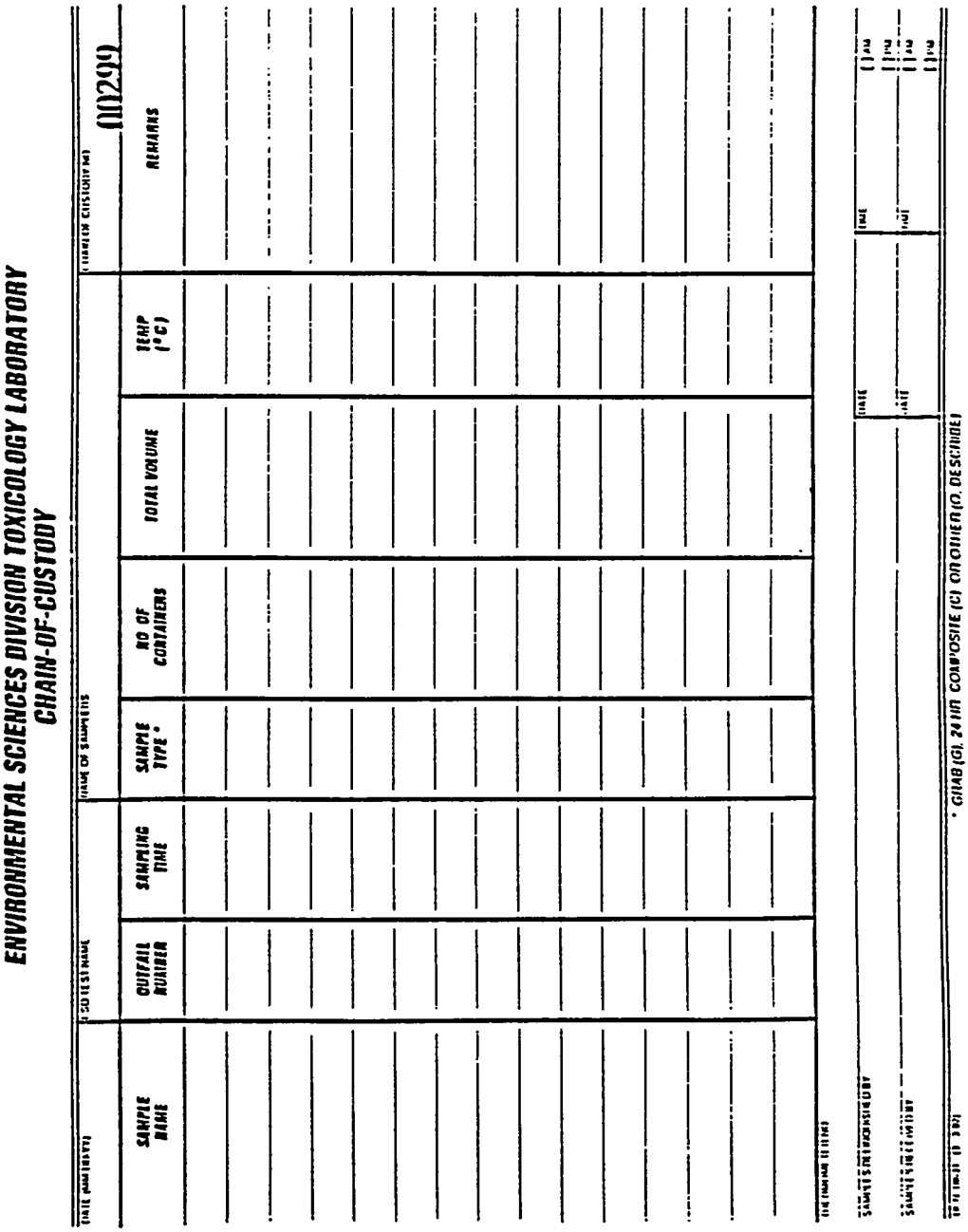


Exhibit QAP-10.2 Sample Chain-of-Custody Form.

SUBJECT: STANDARD OPERATING PROCEDURES–CONTENTS

The following standard operating procedures were designed specifically for the Toxicology Laboratory. Full descriptions of the individual procedures are contained in this section of the manual.

SOP-1: PREPARATION OF DILUTE MINERAL WATER

SOP-2: WASHING OF GLASSWARE

SOP-3: PREPARATION OF *CERIODAPHNIA* FOOD

SOP-4: MAINTENANCE OF *CERIODAPHNIA* CULTURES

SOP-5: PREPARATION OF NEWLY HATCHED BRINE SHRIMP

SOP-6: CULTURE OF FATHEAD MINNOWS

SOP-7: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

SOP-8: PREPARATION OF SAMPLES

SOP-9: FATHEAD MINNOW CHRONIC TOXICITY TEST

SOP-10: *CERIODAPHNIA* CHRONIC TOXICITY TEST

SOP-11: PERFORMANCE OF CHEMICAL ANALYSES

SOP-12: STATISTICAL ANALYSES OF DATA FROM THE FATHEAD MINNOW TOXICITY TEST

SOP-13: STATISTICAL ANALYSES OF DATA FROM THE *CERIODAPHNIA* TOXICITY TEST

SOP-14: FATHEAD MINNOW REFERENCE TEST

SOP-15: *CERIODAPHNIA* REFERENCE TEST

SOP-16: DATA LOGGING AND CARE OF LABORATORY LOGBOOKS

SOP-17: FATHEAD MINNOW ACUTE TOXICITY TEST

SOP-18: *CERIODAPHNIA* ACUTE TOXICITY TEST

SUBJECT: **STANDARD OPERATING PROCEDURES--CONTENTS**

SOP-19: MICROTOX® TOXICITY TEST

SOP-20: FRESHWATER MUSSEL ACUTE SEDIMENT TOXICITY TEST

SOP-21: *HYALELLA AZTECA* WHOLE SEDIMENT TOXICITY TEST

SOP-22: *DAPHNIA MAGNA* CHRONIC WHOLE SEDIMENT TOXICITY TEST

SOP-23: LABORATORY CULTURING OF *DAPHNIA MAGNA*

SOP-24: PREPARATION OF *HYALELLA* FOOD

SOP-25: LABORATORY CULTURING OF *HYALELLA AZTECA*

SOP-26: HANDLING AND STORAGE OF SEDIMENT SAMPLES IN THE LABORATORY

SOP-27: LABORATORY SPIKING OF SEDIMENT SAMPLES

SOP-28: SEDIMENT POREWATER EXTRACTION, HANDLING, AND STORAGE

SOP-29: COLLECTION OF SURFACE SEDIMENT SAMPLES

SOP-30: *HYALELLA AZTECA* WATER-ONLY REFERENCE TOXICITY TEST

SOP-31: *DAPHNIA MAGNA* WATER-ONLY REFERENCE TOXICITY TEST

SOP-32: *CHIRONOMUS TENTANS* WATER-ONLY REFERENCE TOXICITY TEST

SOP-33: PREPARATION OF *CHIRONOMUS TENTANS* FOOD

SOP-34: LABORATORY CULTURING OF *CHIRONOMUS TENTANS*

SOP-35: *CHIRONOMUS TENTANS* WHOLE SEDIMENT TOXICITY TEST

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

Purpose

To ensure proper collection, handling, and storage of ambient samples for toxicity tests.

Equipment

1- and/or 2-gal Nalgene bottles
Rubber boots and gloves
1-L Nalgene bottle
2½-gal bucket and nylon or polypropylene rope
Hand-held electronic thermistor (±0.1°C)
Serialized waterproof chain-of-custody forms (exhibit SOP-7.1)
"Rite in the Rain" or equivalent all-weather pen

Procedure

1. Collection and handling of samples involve the following steps.

   a. Label a clean 1- or 2-gal Nalgene bottle with sampling site identification.

   b. Put on rubber boots and gloves to do the sampling.

   c. At each sampling site, rinse the bottle with several hundred milliliters of water from the site before filling it.

   d. Fill the bottle by gently submersing the bottle in the stream or effluent. Be careful to stand downstream from the bottle during this procedure to avoid sampling water that contains sediments inadvertently suspended by the immersion of the bottle or by your movements.

   e. In sites where the depth of the water precludes obtaining a sample by immersing the bottle, use a smaller container (e.g., a 1-L Nalgene bottle) to dip the water from the site, and then pour it into the 2-gal bottle.

   f. Fill the sample bottle completely before capping it to reduce the exchange of gases between dissolved and gaseous phases.

   g. Samples that are difficult to obtain because of the terrain may be sampled with a 2½-gal bucket tied to the end of a nylon or polypropylene rope. Rinse the bucket with water from the site before using it.

h. When collecting samples in a contaminated or regulated area, follow the procedures described in the Biological Monitoring and Abatement Program Procedure (BMAP) QA-BMAP-19-200 (Exhibit SOP-7.2).

2. Completing the chain-of-custody form involves the following steps.

a. Use a "Rite in the Rain" all-weather pen or equivalent for all entries. Complete Steps b-n, except step c, immediately after collecting the sample.

b. DATE (MM/DD/YY) - Enter the sample collection date (e.g., 02/11/92).

c. ESD TEST NAME - This section to be completed by ESD Toxicology Laboratory personnel. Enter the appropriate test name. A list of approved test names is maintained in the Laboratory Operations Manual, Building 1504, Room 12, and is revised as necessary by the Laboratory Steward.

d. NAME OF SAMPLERS - Enter the name of each person collecting the sample(s).

e. CHAIN-OF-CUSTODY NO. - This blank must contain a pre-printed number. Contact the ESD Toxicology Laboratory for serialized forms, if the form lacks a number.

f. SAMPLE NAME - Enter the name of the sample collected. Typically this is the name of the facility releasing the effluent (e.g., K-25 K-1407-J, X-10 Non Rad, Y-12 WETF) or the stream, lake or pond from which the sample was taken. If a chemical sample is submitted for analysis, this column should identify the chemical.

g. OUTFALL NUMBER - Enter the outfall number of the sample collected (e.g., 011, X13, 502). Place a line through the box if no outfall number is designated or does not exist.

h. SAMPLING TIME - Enter the four-digit, military time number for the time the sample was collected (e.g., 0850, 1345).

i. SAMPLE TYPE - Enter the type of sample collected (i.e., Grab (G), 24 hr. composite (C), or Other (O; Describe)).

j. NO. OF CONTAINERS - Enter the total number of containers used for the sample.

k. TOTAL VOLUME - Enter the total volume of sample collected.

l. **TEMP (°C)** - Record the temperature of the sample at the time of collection. Measure the water temperature with a hand-held electronic thermistor (e.g., Cole-Palmer Model 85230-00; ± 0.1°C).

m. **REMARKS** - Enter information that may be of value later (e.g., high/low flow, turbid, raining hard, etc.). Toxicology Laboratory personnel are to measure the temperature of the sample when the sample is received in the laboratory for analysis if collected by persons other than Toxicology Laboratory personnel. Record the temperature and thermometer number in this column.

n. **THERMOMETER NO.** - Enter the number of the thermometer used for sample collection, if appropriate. If thermometer is not identified, enter "NA" (not applicable) or "None."

3. For samples that are delivered to the Toxicology Laboratory from ORNL, the K-25 site, the Y-12 Plant, etc., the following should be completed.

a. When samples are delivered to the laboratory, a Toxicology Laboratory staff member will review the chain-of-custody form for completeness of information (i.e., all pertinent blanks on the form are completed). If any information is missing, have the person(s) delivering the sample(s) complete the chain-of-custody form before accepting the sample(s).

b. In the presence of a staff member of the Toxicology Laboratory, the **SAMPLES RELINQUISHED BY** blank is signed by the person delivering the sample.

c. Enter the corresponding date and time, and check the appropriate AM or PM box. The Toxicology Laboratory staff member will sign their name in the **SAMPLES RECEIVED BY** blank and will enter the date and time sample was received. Check the appropriate AM or PM box.

d. A staff member of the Toxicology Laboratory will measure the temperature of the sample(s). Record the temperature, the thermometer number, and initials in the **REMARKS** blank on the chain-of-custody form.

e. The Toxicology Laboratory staff member will make a Xerox® copy of the chain-of-custody form for the person delivering the sample(s) before they leave Building 1504. The Toxicology Laboratory staff member will make a Xerox® copy of the completed chain-of-custody form to be placed in the backup chain-of-custody notebook.

4. For samples shipped to the Toxicology Laboratory, Building 1504, Room 12, Oak Ridge, TN 37831, the following should be completed.

a. All shipments are to be accompanied by an original chain-of-custody form identifying its contents. Toxicology Laboratory personnel will retain all freight bills, bills of lading, post

office receipts, packing slips, or shipping orders that accompany the shipment as part of the sample's permanent documentation and are filed with the original chain-of-custody form. The original form and accompanying documentation are filed in the Toxicology Laboratory chain-of-custody notebook located in Room 12, Building 1504.

b. The Toxicology Laboratory staff member accepting the sample will sign their name in the **SAMPLES RECEIVED BY** blank. Enter the date and time sample(s) was received and check the appropriate AM or PM box in the corresponding blanks.

c. The Toxicology Laboratory staff member accepting delivery of the sample(s) will take the temperature of the sample(s). Record the temperature, the thermometer number, and initials in the **REMARKS** blank on the chain-of-custody form.

d. The staff member accepting the sample will make a Xerox® copy of the chain-of-custody form and return to the sender by mail. The Toxicology Laboratory staff member will make a Xerox® copy of the completed chain-of-custody form to be placed in the backup chain-of-custody notebook.

5. For samples collected by ESD Toxicology Laboratory personnel, complete the chain-of-custody form as described in step 2.

   a. There may be occasion (e.g., weekends) where the person relinquishing the sample and the person receiving the sample are the same. Sign your name and enter the data in the corresponding blanks on both the **SAMPLES RELINQUISHED BY** and **SAMPLES RECEIVED BY** lines.

   b. Make a Xerox® copy of the chain-of-custody form for the backup chain-of-custody notebook.

6. For samples sent to other laboratories within ORNL by the Toxicology Laboratory, the following should be completed.

   a. Complete the chain-of-custody form as outlined in 2a through 2n.

   b. Enter the name of the laboratory the sample(s) is being sent to and the date the sample(s) is sent in the **REMARKS** section.

   c. The Toxicology Laboratory staff member delivering the sample(s) will sign their name in the **SAMPLES RELINQUISHED BY** block and complete the corresponding **DATE** and **TIME** sections.

   d. A staff member of the receiving laboratory will sign their name in the **SAMPLES RECEIVED BY** block and will complete the **DATE** and **TIME** sections.

e. The Toxicology Laboratory staff member will obtain two Xerox® copies of the signed chain-of-custody form before leaving the receiving laboratory. One copy will be placed in the chain-of-custody notebook located in Room 12, Building 1504, and the remaining copy will be filed in the backup chain-of-custody notebook.

7. For samples shipped to laboratories outside ORNL by the Toxicology Laboratory, the following should be completed.

a. Complete the chain-of-custody form as described in step 2.

b. Enter the name and address of the laboratory the sample(s) is being shipped to and the method of shipment or courier name (e.g., Federal Express) in the **REMARKS** section.

c. The Toxicology Laboratory staff member responsible for shipping the sample(s) will sign their name in the **SAMPLES RELINQUISHED BY** block and complete the corresponding **DATE** and **TIME** sections.

d. The staff member will include a letter with the chain-of-custody form to the receiving laboratory requesting a copy of the signed chain-of-custody form be returned to the Toxicology Laboratory documenting the transfer of sample(s) custody.

e. The staff member will make two Xerox® copies of the chain-of-custody form and the accompanying letter. One copy will be filed in the chain-of-custody notebook located in Room 12, Building 1504. The remaining copy will be filed in the backup chain-of-custody notebook. These copies will be replaced by the completed copy of the chain-of-custody form returned to the Toxicology Laboratory by the receiving laboratory.

f. Prior to shipping, the staff member will contact Health Physics to request the shipment be green tagged.

g. The staff member will have the Group Secretary type a shipping order, if a blanket shipping order does not exist, that will accompany the sample(s). The Group Secretary will make a copy of the shipping order for the files.

h. The staff member will take the sample container(s) and documentation to Shipping, Building 7001.

8. All chain-of-custody forms must be accounted for. If a form in the series is damaged, mark the form void and return it to the ESD Toxicology Laboratory.

a. All completed and voided forms are retained in the chain-of-custody notebook located in the ESD Toxicology Laboratory, Building 1504, Room 12, Oak Ridge, TN 37831. Blank chain-of-custody forms can be obtained from the ESD Toxicology Laboratory.

b. Exhibit SOP-7.1 shows a sample chain-of-custody form that is to be used to document the sample handling process.

9. Storage of samples involves the following steps.

a. Analysis for Total Residual Chlorine (TRC) and Free Chlorine (FC) must be performed immediately upon arrival at the Toxicology Laboratory (Refer to SOP-11). Other prescribed chemical analyses must be performed within 36 hours of sample arrival in the laboratory.

b. Tests should be initiated within 24 h, but not later than 36 h, of sample collection.

c. If samples are not to be analyzed upon receipt by ESD Toxicology Laboratory personnel, they must be stored under refrigeration at 4 $\pm$ 2°C.

10. Disposal of sample and test waters involves the following.

a. Dispose of all excess sample water and test water to the process drain in Room 3 or to the sample collection system in Room 12 with the following exception.

1. Water collected from the Y-12 Plating Rinse Water Treatment Facility will be collected and stored for return to the facility.

b. Other exceptions to this disposal method are to be included in the test write-up prepared by the Laboratory Steward or designee and distributed to all Toxicology Laboratory personnel. Exceptions are to be approved by Environmental Compliance.

Approval

All Standard Operating Procedures generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader.

Approved by Lynn A. Kszos — Group Leader — 10/15/93 — Date

Effective Date 11/1/93

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

ENVIRONMENTAL SCIENCES DIVISION TOXICOLOGY LABORATORY
CHAIN-OF-CUSTODY

DATE (MM/DD/YY)	ESD TEST NAME		NAME OF SAMPLERS				CHAIN-OF-CUSTODY NO 00750
SAMPLE NAME	OUTFALL NUMBER	SAMPLING TIME	SAMPLE TYPE *	NO. OF CONTAINERS	TOTAL VOLUME	TEMP (°C)	REMARKS

THERMOMETER NO.

SAMPLES RELINQUISHED BY	DATE	TIME	☐ AM ☐ PM
SAMPLES RECEIVED BY	DATE	TIME	☐ AM ☐ PM

UCN-10831 (3 3/92)

* GRAB (G), 24 HR COMPOSITE (C), OR OTHER (O, DESCRIBE)

Exhibit SOP-7.1. Sample chain-of-custody form.

OAK RIDGE NATIONAL LABORATORY

QUALITY ASSURANCE PROGRAM

BIOLOGICAL MONITORING AND ABATEMENT PROGRAM

QUALITY ASSURANCE PROCEDURE

PROCEDURE NO. QA-BMAP-19-200

DATE 05-29-92

PAGE 1 OF 10

SUPERSEDES ISSUE DATED

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

1.0 Purpose

Many Biological Monitoring and Abatement Program (BMAP) field sites are located in areas where the environment is contaminated with low concentrations of radionuclides. BMAP contamination control procedures are established to minimize the possibility of persons working in contaminated areas becoming contaminated, to establish methods for handling contaminated equipment and supplies, and to avoid transporting contaminated material to noncontaminated areas. Methods described in this procedure meet the requirements of Oak Ridge National Laboratory (ORNL) Health Physics Procedures and the Radiation Protection and Radiation Monitoring Standard Operating Procedures.

2.0 Scope

This BMAP procedure applies to all persons engaged in field activities related to the BMAP.

3.0 References

ORNL Health Physics Manual
DOE Order 5480.11
Radiation Protection and Radiation Monitoring Standard Operating Procedure Manual

4.0 Definitions

Contamination Area (formerly called Contamination Zone): An area within a Controlled Area where surface contamination in excess of 10 times the guides specified in Attachment 2 to DOE Order 5480.11 is present. See Exhibit A.

Contaminated Items: An item is considered contaminated when the count rate produced by a radiation survey meter is greater than normal background when the meter probe is held 0.5 inch from the surface of the item being surveyed.

Exhibit SOP-7.2. BMAP Procedures for Staff Working in Field Sites Contaminated with Radionuclides.

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

Contamination Area Clothing: Wearing apparel, also known as C-area clothing, provided by the Laboratory for use in Regulated Areas and Contamination Areas and worn by individuals to prevent the contamination of their bodies and personal clothing. C-area clothing may include:

Surgeons caps	Cotton gloves
Canvas hoods	Magenta rubber gloves
C-area shoes	Neoprene-dipped gloves
Plastic/tyvek suits	Rubber overshoes
Yellow socks	Plastic shoe covers
Respirators	Rubber boots (magenta toe and heel)
Yellow laboratory coats	Yellow coveralls

Controlled Area: Any area to which access is controlled in order to protect individuals from exposure to radiation or radioactive materials.

Radiological Area: Any area within a Controlled Area where an individual can receive a dose equivalent greater than 3 mrem in 1 hour at 30 cm from the radiation source or any surface through which the radiation penetrates, or when airborne radioactivity concentrations greater than 10 percent of the derived air concentration (DAC) are present (or are likely to be), or where surface contamination in excess of the guides specified in Attachment 2 to DOE Order 5480.11 is present (See Exhibit A). For the purpose of contamination control, radiological areas include Regulated Areas, Contamination Areas, Airborne Radioactivity Areas, and Respirator Areas. Note: For the purpose of radiation control, radiological areas include Radiation Areas, High Radiation Areas and Very High Radiation Areas.

Regulated Area: Any area within a Controlled Area where surface contamination in excess of the guides specified in Attachment 2 to DOE Order 5480.11 is present (or is likely to be). See Exhibit A.

Transferable Contamination: Loose surface contamination that can be easily rubbed from the surface on which it exists or can be otherwise easily removed and transferred to personnel or to other locations.

5.0 BMAP Sites Considered to be Contaminated with Radionuclides

The BMAP Program Manager, together with the BMAP Principal Investigators, the ESD Radiation Control Officer, and the ORNL Radiation Protection Department, is responsible for identifying sampling sites that for the purpose of BMAP activities shall be considered Radiological Areas, i.e., areas where precautions are taken to protect individuals from exposure to radioactive materials. The level of radioactivity in the media (biota, water, and sediment) at most BMAP sampling sites is sufficiently low that most contaminated sites are classified as Regulated Areas. BMAP sampling sites and their radiological classification are described in Table 1 and are shown in Fig. 1. Sites along Bear Creek and

UCN-9938A

Exhibit SOP-7.2. (Continued)

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

East Fork Poplar Creek are contaminated by releases of radioactive material from the Y-12 Plant; sites associated with White Oak Creek, its tributaries, and White Oak Lake are contaminated by releases from ORNL; and sites along Mitchell Branch are contaminated by releases from the K-25 Site.

6.0 Procedures

6.1 General Requirements for Working in Regulated Areas or Contamination Areas

Only those persons authorized by the Principal Investigator or his/her designee shall be permitted to work in Regulated Areas or Contaminated Areas. Successful completion of Radiation Workers Training and SARA/OSHA Training for Hazardous Waste Site Activities is required for unescorted entrance into Regulated Areas or Contaminated Areas. Two or more persons shall work together in Regulated Areas or Contaminated Areas and at least one person shall have completed the training courses mentioned above. Eating, drinking, smoking, and chewing are prohibited in Regulated Areas and Contaminated Areas and nonessential personal items shall not be taken into these areas. No personal clothing other than undergarments shall be worn in Regulated Areas or Contaminated Areas. Personal shoes shall not be worn into Regulated Areas or Contaminated Areas even when the shoes are covered by shoe covers, overshoes or boots. Discovery of contaminated personal items necessitates the filing of an Off-Normal (Category III) Occurrence report which goes to DOE and the Radiation Protection Department shall confiscate the contaminated items. Consequently, BMAP workers must not only understand the procedures for working in Regulated Areas and Contaminated Areas, they must also follow them.

The highest concentrations of radionuclides at BMAP sampling sites are found in the sediments of a stream or lake and the adjacent floodplain. Personnel shall take special care to avoid coming in direct contact with the sediment and to avoid inadvertently transferring contaminated sediment to noncontaminated areas.

6.2 Apparel for Working in a Contamination Area

Persons who enter a Contamination Area shall wear the following apparel:

C-area outer clothing (yellow coveralls)
Removable footware or protective covers for company-issue shoes
Rubber gloves taped to clothing at wrist

Personnel shall wear company-issue clothing and shoes beneath the C-area apparel so that the C-area apparel can be removed when leaving the Contamination Area.

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Exhibit SOP-7.2. (Continued)

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

6.3 Apparel for Working in a Regulated Area

No personal clothing or shoes shall be worn in a Regulated Area; however, the type of company-issue clothing required shall depend on the type of activity to be performed. If there is a likelihood that clothing or shoes shall become contaminated, white or yellow coveralls shall be worn over company-issued clothing; and, shoe covers, rubber overshoes or boots shall be worn to protect shoes and/or feet. Rubber gloves shall always be worn when handling contaminated material.

6.4 Additional Items for Working in Regulated Areas and Contamination Areas

Personnel working in Regulated Areas or Contamination Areas shall have at their disposal the following items:

Portable radiation survey meter (alpha and/or beta-gamma) capable of detecting surface contamination that exceeds the levels (fixed and removable) listed in Attachment A
Plastic bags for contaminated items
Tape for taping gloves, bags, etc.
Radioactive material labels

6.5 Departure from Regulated Areas or Contamination Areas

A radiation survey meter is used to check for contamination on personnel and all items that have been used in a Regulated Area or a Contamination Area before exiting the site or entering a vehicle. Section 8.0 provides instructions for using a portable survey meter to frisk personnel and equipment for contamination. Equipment and protective gear should be rinsed in stream or lake water to remove as much sediment as possible before they are monitored for contamination. If the survey meter reading is not above normal background when checking items such as waders, boots, clothing, or equipment then the items are not considered to be contaminated. (Note: Because alpha radiation is readily attenuated by a thin film of water, wet items that may be contaminated with alpha emitters must be scanned when dry to verify they are clean.)

Shoes and clothing found to be contaminated must be removed, if possible, and placed in a plastic bag marked "radioactive material" before leaving a Regulated Area or Contamination Area. If contaminated apparel can not be removed, the contaminated area must be covered with an outer uncontaminated garment, tape, plastic and/or shoe cover to contain the contamination until the individual reaches an area where the contaminated item(s) can be removed. Anytime an outer layer of clothing is contaminated, the underlying skin or clothing must be checked for contamination.

Exhibit SOP-7.2. (Continued)

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

Contaminated disposable items (shoe covers, disposable gloves, etc.) are placed in a separate plastic bag labeled "radioactive material" and returned to the laboratory for disposal according to Health Physics Procedure RP-5.1.

Contaminated reusable items (e.g., fish nets, electrofisher probes, sampling equipment) are placed in plastic bags or special containers that are clearly marked "radioactive material" and tagged to indicate the level of contamination and handling precautions. Contaminated items must be decontaminated prior to use in uncontaminated areas. Large or heavy items that may compromise the integrity of an ordinary plastic bag must be double bagged or wrapped in heavy gauge material. Sharp items must be placed in protective containers. All items must be appropriately labeled and tagged.

Samples collected from contaminated sites should be individually bagged and then placed in containers (e.g., buckets, plastic bags, ice chests) conspicuously marked to indicate radioactive material is present inside. The exterior of the outer container should be checked for surface contamination by wiping the exterior surface with a masslinn smear and checking the smear with a survey meter. If the meter reads above background, the container should be placed in a clean plastic "radioactive material" bag before being removed from the area.

6.6 Monitoring Items for Radioactivity

All bags and containers holding samples, equipment, or protective gear from Regulated Areas or Contamination Areas are checked in the field for external contamination as described in Sect. 8.3 and 8.5 before being placed in a vehicle. Upon arrival at the laboratory, items from Radiological Areas shall be left in the vehicle until they can be checked by a HP surveyor. The surveyor will smear the outside of the containers to determine if transferrable radioactive material is present. If so, the container must be placed in a clean plastic bag before being carried into a building and the vehicle and personnel must be checked for contamination. Contaminated items shall be clearly labelled "radioactive material" and should be kept in designated Radiological Areas. If stored outside a Radiological Area, contaminated items shall be clearly labelled "radioactive material" and wrapped in protective material to prevent spread of contamination.

Bags containing contaminated clothing must be checked by a HP surveyor before being sent to the laundry. The surveyor must attach a "Radiation Hazards Tag" (UCN 2785) to the bag to indicate the contamination level of the clothing before it can be taken to the laundry.

Exhibit SOP-7.2. (Continued)

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

6.7 Disposal of Waste

All solid rad waste is disposed of in accordance with the procedures described in the Health Physics Procedure RP-5.1.

6.8 Equipment Repairs and/or Calibration

Contaminated equipment in need of repair is decontaminated in a Radiological Area as thoroughly as possible by the user. The equipment must be checked by a HP surveyor prior to being submitted for repair. If no contamination is present, the surveyor attaches a "green tag" to the item to indicate that the level of radioactivity is insignificant. The green tag allows the item to be transferred to a repair shop within the confines of ORNL.

Special precautions shall be taken during laboratory operation or calibration of equipment that has been used at contaminated field sites to be certain that contamination is not transferred to work spaces, equipment, or supplies accessible to persons who may be unaware that contamination may be present. Precautions include proper labeling of contaminated items, prompt disposal of rad waste, cleaning work areas and equipment after use, and having work areas surveyed by a HP technician.

7.0 Employee Training

7.1 On-the-Job Training

The Principal Investigator or his/her designee is responsible for assuring that all persons (employees, guests, students, etc.) who work in Radiological Areas are familiar with the BMAP procedures for working in contaminated field sites. BMAP training procedures are outlined in QA-BMAP-19-100. After personnel have been trained, the Principal Investigator or his/her designee decides who is qualified to work in a Radiological Area and keeps a list of approved individuals in the appropriate Project QA Plan. Persons who have been approved to work in Radiological Areas by one Principal Investigator are eligible to perform the same type work for other BMAP projects.

7.2 Additional Training

Classes and seminars that provide information for staff who work in Radiological Areas concerning regulations, handling and disposing of radioactive material, etc. are offered by ORNL and ESD personnel. The BMAP Program Manager and/or Principal Investigators keep personnel informed as to the availability of these courses and encourage staff members to attend.

Exhibit SOP-7.2. (Continued)

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

8.0 BMAP Procedures for using Portable Radiation Detection Meters

8.1 Introduction

A survey meter shall be used to monitor personnel and material when leaving a contaminated site and/or before entering a vehicle at a contaminated site. Two types of portable survey meters are available--one has an alpha detector, the other a beta-gamma detector. The alpha ("beer mug") detector has a foil-covered end window for measuring alpha emissions. The beta-gamma detector is a Geiger-Muller counter with a pancake-shaped probe. Both types of meters can be set to produce an audible count signal in addition to a meter reading. Each meter should have a small plastic dish taped to its side. The dish contains a radioactive material (a lantern mantle which contains radioactive thorium) that is used to test the operation of the meter.

Procedures for operating alpha and beta-gamma meters are basically the same but the appropriate meter must be used. An alpha detector should be used to check for contamination while working Bear Creek sites and a beta-gamma detector used at White Oak Creek and White Oak Lake sites. Survey meters are available in Room 169 of Building 1505 and should be signed out according to posted instructions. The ORNL Radiation Protection Department schedules all portable survey meters for recalibration every 90 days. Do not use a survey meter that is overdue for recalibration, but return it to the ESD HP technician. The following sections provide procedures for using survey meters; however, the ESD HP technician should verify each individual's understanding and ability to properly use the portable survey meters before the individual uses one in his/her work.

8.2 Acquiring a Survey Meter

8.2.1 Determine if the correct type of survey meter is available for the BMAP site to be visited. Make sure the meter is not overdue for calibration. If a meter assigned to the BMAP is not available, obtain one from the HP technician.

8.2.2 Check to see if the battery is charged by turning knob to "battery check" position and observing whether the meter reading is within the acceptable range. If the battery is "weak", return the meter to the HP technician for return to the calibration facility. Do not use the meter or attempt to replace the batteries.

8.2.3 Turn the meter knob to the scale indicated on a calibration sticker on the side of the instrument which shows the count rate that should be produced by the test source. Turn on the audio switch. Hold the probe in contact with the test source. The audio rate should increase and the count rate should be within the counts per minute (CPM) range given on the sticker.

Exhibit SOP-7.2. (Continued)

TITLE: BHAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

8.2.4 If the rate meter and audio respond satisfactorily, it can be taken to the field. If the meter is obtained from the ESD HP technician, sign it out by entering the requested information in the logbook.

8.3 **Using a GM Survey Meter with Pancake Probe in the Field**

8.3.1 Do not allow instrument to contact water or be exposed during inclement weather. Make sure the survey meter is not handled with contaminated gloves or comes in direct contact with contaminated material. Survey meters must be adequately secured during transport to prevent damage.

8.3.2 When ready to use meter; check the status of the battery and turn on the audio.

8.3.3 Use the test source to check the meter and audio as described in Sect. 8.2.3.

8.3.4 Set the meter on the 1X scale and check the background count rate. If the background is > 300 cpm, try to find a location in the area where the count rate does not exceed 300 cpm.

8.3.5 Continue with the monitoring procedures, even if the background is > 300 cpm, and if no contamination is indicated on the items being monitored, proceed immediately to a nearby location where the background is < 300 cpm and repeat the monitoring procedures.

8.3.6 Observe the ratemeter and audible background count rate and then position the detector so that the window is not > 0.5 inch away from the material being monitored.

8.3.7 Slowly scan the entire surface of the material being surveyed. Maintain the ≤ 0.5 inch distance and do not move the probe faster than 2 inches per second. Periodically recheck the response of the instrument to the test source during extended field use.

8.3.8 If the count rate (audible or ratemeter) increases above observed background, pause with the detector ≤ 0.5 inch from the "hot" spot and monitor it carefully to determine the count rate and the extent of the contaminated area.

8.3.9 If the count rate is above the background rate, the item is considered contaminated and should be handled accordingly (see Sect. 6.5).

8.3.10 If the meter goes off scale, turn the knob to the next higher scale, press the reset button, and measure the count rate again.

Exhibit SOP-7.2. (Continued)

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

8.3.11 Care must be taken to ensure that the detectors do not become contaminated or damaged. If a meter becomes contaminated, damaged or does not function properly, this information should be noted in the logbook and the instrument must be returned to the ESD HP technician for return to the calibration facility for maintenance and recalibration.

8.3.12 When you have finished using a survey meter, turn it off to prevent draining the battery. Return the meter to Room 169, Building 1505 or its proper storage location.

8.4 **Distinguishing Beta from Gamma Radiation**

At times it may be desirable to determine whether the radiation detected with the beta-gamma detector is due to the presence of beta- or gamma-emitting radionuclides. With a pancake type probe, this distinction can be made by taking a reading with the probe held in the normal position (window facing the material) and then taking another reading with the probe turned over (window facing away from material). In the normal operating position, both beta and gamma emitters are measured. When the probe is turned over, beta radiation is shielded out and only gamma radiation is measured. If the count rate is about the same for both procedures, primarily gamma radiation is present. If the rates are different, the difference may be due to beta radiation. This is not a quantitative procedure because lower energy gamma radiation may also be attenuated significantly by the back of the pancake probe.

8.5 **Using an Alpha Survey Meter in the Field**

8.5.1 Adequately secure survey meters during transport to prevent damage. Do not allow instrument to contact water or to be unprotected during inclement weather. Do not handle instrument with contaminated gloves or allow it to contact contaminated surfaces.

8.5.2 Check the status of the battery and turn on the audio. Inspect the instrument for damage. Even a tiny hole in the probe "foil" makes the instrument inoperable and it must be returned to HP for repair.

8.5.3 Use the test source to check the ratemeter and audio response as described in Sect. 8.2.3. Periodically recheck for proper response to the test source after extended use in the field.

Exhibit SOP-7.2. (Continued)

SUBJECT: COLLECTION, HANDLING, AND STORAGE OF SAMPLES

TITLE: BMAP PROCEDURES FOR STAFF WORKING IN FIELD SITES CONTAMINATED WITH RADIONUCLIDES

8.5.4 Select the X1 range. Audible and ratemeter background counts should be essentially zero (< 10 cpm). High background counts may indicate a light leak. A light leak is also indicated if the response to the test source is low or null when exposed to light but is within the acceptable range when shaded from light. In either case, do no use the instrument but return it to HP for repair.

8.5.5 Hold the window of the detector not > 0.25 inch from the surface to be checked and move the probe over the entire surface at a rate not exceeding about 1.5 inches per second. Listen and watch for an increase in the audible and ratemeter response (any positive response may indicate significant alpha contamination).

8.5.6 If a positive response is observed, pause over that spot to see if the positive response persists. A persistent count rate of ≥ 30 cpm (about one "beep" every two seconds) indicates the surface is contaminated and appropriate measures should be taken as indicated in Sect. 6.5.

8.5.7 To check for alpha contamination on a masslin smear from the exterior of bags, sample containers, etc., place the smear (dirty side up) on a clean flat surface and set the probe on the smear with the probe window in contact with the smear. Any persistent positive response indicates significant contamination on the smear and appropriate measures should be taken as indicated in Sect. 6.5.

8.5.8 When you have finished using the survey meter, turn it off and return it to Room 169, Building 1505 or its proper storage location.

8.5.9 Alpha detectors are easily damaged and must be handled very carefully. If the instrument is damaged or becomes contaminated or in any way does not function properly, notify the ESD HP technician.

Approval

BMAP QA COORDINATOR _____ DATE _____

Exhibit SOP-7.2. (Continued)

MARTIN MARIETTA ENERGY SYSTEMS INC.
OAK RIDGE NATIONAL LABORATORY
HEALTH PHYSICS PROCEDURE

NUMBER RP-A3
REV. 0
PAGE 1 of 2
DATE 8-21-90

SUBJECT: Attachment 2 of DOE Order 5480.11

DOE 5480.11
02-21-88

Attachment 2
Page 1

SURFACE RADIOACTIVITY GUIDES

NUCLIDE[1]	REMOVABLE [2/4]	TOTAL [2/3] (FIXED PLUS REMOVABLE)
U-nat, U-235, U-238, and associated decay products	1,000 dpm α/100 cm²	5,000 dpm α/100 cm²
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20 dpm/100 cm²	300 dpm/100cm²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm/100 cm²	1,000 dpm/100 cm²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.[5]	1,000 dpm β-Γ/100 cm²	5,000 dpm β-Γ/100 cm²

1. Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

MARTIN MARIETTA ENERGY SYSTEMS INC.
OAK RIDGE NATIONAL LABORATORY
HEALTH PHYSICS PROCEDURE

NUMBER RP-A3
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SUBJECT: Attachment 2 of DOE Order 5480.11

2. As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

3. The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the guide values. For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of a representative number n of sections it is determined that $1/n \ \Sigma n \ S_i \geq G$, where S_i is the dis/min-100 cm^2 determined from measurement of section i; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G.

4. The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium.) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 alpha emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination.

5. This category of radionuclides includes mixed fission products, including the SR-90 which is present in them. It does not apply to SR-90 which has been separated from the other fission products or mixtures where the SR-90 has been enriched.

APPROVALS:

J. H. Swanks, Acting Director
Environmental, Safety
and Health Compliance

Exhibit SOP-7.2. (Continued)

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Purpose

To measure the chronic toxicity of water samples to fathead minnows during 7-d static renewal exposures.

Reference

EPA Test Method 1000.0, in C. I. Weber et al., *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms*, EPA/600/4-89/001 (March 1989).

Equipment

Fathead minnow larvae (see SOP-6)
Temperature-controlled water bath or environmental chamber (maintained at 25 ± 2°C)
Dilute mineral water (DMW; see SOP-1)
Microbalance accurate to 0.0001 mg (e.g., Cahn)
Microweight aluminum pans (e.g., Cahn)
Drying oven
10- and 600-mL beakers
250-mL glass beaker or a crystallizing dish
Volumetric flasks
Graduated cylinders
Fixed- or adjustable-volume pipettes
Disposable pipette tips
Various colored stickers (for color-coding beakers)
Polished glass tubing (2-mm ID)
1-mL pipette bulbs
Siphoning hose with modified Y-shaped tygon connector
White plastic photographic tray
1-oz disposable polystyrene beakers
8-oz specimen containers (or equivalent)
Newly hatched brine shrimp (see SOP-5)
Perforated aluminum foil
Desiccator
Scintillation vial
Formaldehyde solution
Disposable gloves
Fine mesh aquarium net
Tweezers (or equivalent)
Registered fathead minnow logbook
Registered test organism shipment logbook (if required)
Fathead Minnow Test Information Logsheet (exhibit SOP-9.1)
Fathead Minnow Daily Test Information Logsheet (exhibit SOP-9.2)
Fathead Minnow Daily Test Results Logsheet (exhibit SOP-9.3)

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Fathead Minnow Shipment Logsheet (exhibit SOP-9.4)
Fathead minnow Weight and Survival Data for Lotus Program Logsheet (exhibit SOP-9.5)
Lotus 1-2-3 computer program

Procedure

1. The following tasks shall be performed in preparation for the test.

   a. Prepare the glassware. Label and color code four 600-mL beakers per test concentration (or site). Each of these four will be replicates (REPs). Label the necessary graduated cylinders and volumetric flasks.

   b. Prepare the weight beakers for the test larvae. Label 10-mL beakers with the sample, dilution, and REP number. Predry microweight pans in a 100 $\pm$ 2°C oven for at least 2 h. Place a microweight pan in each 10-mL beaker, and put the beakers in a suitable container (e.g., a 250-mL glass beaker or a crystallizing dish, depending upon the number of 10-mL beakers needed). Weigh the microweight pan from each beaker on a calibrated microbalance, and record the initial weight of each pan on the "Fathead Minnow Weight and Survival Data for Lotus Program" logsheet. Use tweezers (or equivalent) to handle microweight pans. Put each microweight pan back in its appropriate beaker. Cover the container of beakers with perforated foil, and store in a sealed desiccator. Store the logsheet in a safe location until the test is over.

   c. Prepare the weight beakers for the initial larvae. Label four 10-mL beakers as "initial 1," "initial 2," "initial 3," and "initial 4." These beakers will be used to find the weight of the larvae that initiate the test. Place a microweight pan in each 10-mL beaker, and weigh as described in step 1b.

   d. Check the number of in-house larvae available for the toxicity test. Only if necessary, order larvae from an approved outside source. The Laboratory Steward or designee is responsible for ordering larvae needed for conducting toxicity tests.

      (1) If larvae are ordered from an outside source, the following steps are performed.

         (a) Glue a "Fathead Minnow Shipment Logsheet" (exhibit SOP-9.4) into the registered test organism shipment logbook. Initial and date the logsheet so that half of the writing extends onto the logbook page.

         (b) Record the larvae source, approximate number of larvae received, date larvae received, and your initials. Also record the initial temperature of the water the larvae were shipped in, the time the temperature was taken, the thermometer number, your initials, and any observations or comments (i.e., condition of larvae).

(c) Measure the temperature of the water hourly to record the acclimation of the test organisms. Record the necessary information on the logsheet until the end of the workday or until the water reaches ~25°C.

e. Prepare brine shrimp according to SOP-5.

2. To start the test do the following.

a. Glue a "Fathead Minnow Test Information" logsheet, a "Fathead Minnow Daily Test Information Logsheet," and a "Fathead Minnow Daily Test Results" logsheet into the registered fathead minnow logbook. Initial and date each logsheet so that half of the writing is on the logsheet and half extends onto the logbook page. Note: more than one daily test results logsheet may be needed for a test.

b. Isolate the larvae. Using a polished glass tube and pipette bulb, transfer ten larvae that are <24 h old from the hatching chamber to a 1-oz polystyrene beaker containing 5-8 mL of control water. Transfer ten larvae for every REP of the test. Also transfer at least ten larvae for each initial beaker.

c. Begin the test. Randomly transfer larvae from the 1-oz polystyrene beakers to 600-mL beakers containing about 250 mL of test solution. The amount of water transferred with the larvae should be kept to a minimum to avoid dilution of the test solution.

d. Randomly arrange test beakers in a temperature-controlled water bath or environmental chamber (25 ± 2°C).

e. Feed the larvae in each test beaker 100 µL (~1500 shrimp) of newly-hatched brine shrimp twice daily at a ~8 h interval (at the beginning and at the end of the work day). Record the feeding time on the "Fathead Minnow Daily Test Information Logsheet."

f. Record the test name, test number, test dates, sites/concentrations tested, control water type, source of test larvae, date larvae hatched, and your initials on the "Fathead Minnow Test Information" sheet.

g. Record the date, the time the first test beaker received its larvae, the time the last test beaker received its larvae, test name, test number, test dates, test beaker and water bath or chamber temperatures, thermometer number, control water batch number, and your initials on the "Fathead Minnow Daily Test Information Logsheet."

h. Record the test name, test number, test dates, and sites/concentrations tested on the "Fathead Minnow Daily Test Results" logsheet.

i. Transfer all the larvae from the initial beakers into a scintillation vial containing dechlorinated tap water. Add several drops of formaldehyde solution. The scintillation

vial will now contain at least 40 larvae. Label the vial with "initials," the date and the name of the test. Store the vial in a safe location until the end of the test.

3. Repeat the following renewal process every day, starting 24 h after the test begins and continuing until the test is finished on Day 7.

   a. Use fresh samples and make fresh dilutions.

   b. Feed the larvae 100 μL of newly-hatched brine shrimp a minimum of 2 h prior to solution renewal. Record the feeding time on the "Fathead Minnow Daily Test Information Logsheet."

   c. Measure the temperature in two test beakers and record on the "Fathead Minnow Daily Test Information Logsheet." Also record the water bath or chamber temperature and thermometer number.

   d. Prior to solution renewal, carefully pour test water (~ 180 mL total) from at least two REP beakers into a labelled beaker or plastic cup. This water will be used to determine the final pH and dissolved oxygen concentration. NOTE: test water will only need to be collected from sites or concentrations in which water chemistry is being performed.

   e. Change the water in all REP beakers for a particular concentration (or site) before starting the next four-beaker series.

      (1) Siphon off old water, excess shrimp, and detritus from the beakers, using rubber tubing and a modified foot made from a Y-shaped tygon connector. Slowly siphon the water from the beaker into a white plastic photographic tray until ~ 50 mL of old test solution remains. Control the flow through the siphon by holding one gloved finger over the end of the tubing.

      (2) If any larvae are accidentally siphoned off with the water, retrieve them from the plastic tray, using a polished glass tube and pipette bulb. Then return them to the beakers.

      (3) Record the number of larvae surviving in each beaker, the total number of larvae alive for each concentration, and any appropriate code (see the "Fathead Minnow Daily Test Results" logsheet for key to codes) on the "Fathead Minnow Daily Test Results" logsheet in the registered fathead minnow logbook. Discard the dead larvae.

      (4) Add ~ 250 mL of fresh sample to each beaker. Add the fresh solution very slowly, gently pouring it down the side of the beaker to avoid disturbing the larvae.

   f. Record minor test non-conformities (e.g., a temperature that falls outside the acceptable range), on the "Fathead Minnow Test Information" logsheet.

g. Feed the larvae 100 μL of newly-hatched brine shrimp ~8 h after the first feeding. Record the feeding time on the "Fathead Minnow Daily Test Information Logsheet."

4. Method for terminating the fathead minnow chronic toxicity test when performed in the Toxicology Laboratory, Room 12, Building 1504.

a. Terminate the test after the fish have been exposed to the test solution for 7 consecutive days $\pm$ 2 h.

b. Siphon out as much of the test solution as possible from a REP beaker and pour the remaining solution (containing the surviving larvae) through a fine mesh aquarium net. Carefully rinse the larva with distilled water to remove any excess food or detritus, if necessary.

c. Kill the larvae that are retained on the net by severing their spinal cords with forceps.

d. Obtain the corresponding 1-mL weight beaker prepared in step 1b. Remove the microweight pan from the beaker. Using forceps, remove the larvae from the net and place on the microweight pan. Return the pan to the beaker. Place the beaker in a suitable container. Continue this procedure for the remaining REP beakers.

e. Obtain the scintillation vial containing the initial larvae. Pour the contents of the vial through the aquarium net to obtain the larvae. You may need to rinse the vial several times with distilled water to remove all the larva. After all the larvae are on the net, rinse the larva several times with distilled water to remove the formaldehyde solution. Remove ten larvae from the net and place on the preweighed microweight pan from an initial beaker. Repeat this procedure for all four initial beakers. Discard the waste formaldehyde solution in an appropriately labeled bottle located in the fume hood in Room 11, Building 1504.

f. Cover the container holding the beakers with the microweight pans with perforated aluminum foil. Place the container in a drying oven and let the contents dry a minimum of two hours at 100 $\pm$ 2°C.

g. Remove the container from the oven and place in a desiccator a minimum of four hours to cool the larvae before weighing them on a calibrated microbalance.

h. Record the final pan weights and the number of larvae surviving in each beaker on the "Fathead Minnow Weight and Survival Data for Lotus Program" logsheet that was prepared in step 1.b.

5. Method for terminating the fathead minnow chronic toxicity test when performed in laboratory facilities other than the ESD Toxicology Laboratory, Room 12, Building 1504.

   a. Follow the procedure described in steps 4.a through 4.e with the following exception:

      1. Screw-cap scintillation vials will be used in lieu of 10-mL beakers for drying and transporting the larvae.

   b. If the facility in which the test is being conducted contains a drying oven, place the vials containing the microweight pans and larvae in the oven for at least 20 minutes at 100 $\pm$ 2°C. Remove the vials from the oven and let cool at least 20 minutes before capping and transporting to the ESD Toxicology Laboratory.

   c. Upon return to the ESD Toxicology laboratory, uncap the vials and place in a suitable container. Cover the container with perforated aluminum foil and place in a drying oven for at least two hours at 100 $\pm$ 2°C.

   d. Remove the container from the oven and place in a desiccator a minimum of four hours to cool the larvae before weighing them on a calibrated microbalance.

   e. Record the final pan weights and the number of larvae surviving in each beaker on the "Fathead Minnow Weight and Survival Data for Lotus Program" logsheet that was prepared in step 1.b.

   f. If the facility does not contain a drying oven, transfer the larvae to the preweighed microweight pans in the corresponding scintillation vials. If possible, allow the larvae to air dry at least 24-h before capping the vials and transporting them to the ESD Toxicology Laboratory. Continue with the procedure described in steps 5.c through 5.e.

6. Calculate the mean percent survival and mean growth of larvae in each concentration using a Lotus 1-2-3 program.

   a. Important keys and notes about the directions below.

      (1) Use the arrows on the keyboard to move around the worksheet.

      (2) Use the forward slash (/) to get to the main menu.

      (3) Use the Esc key to get out of trouble and move to the previous selection/menu.

      (4) Commands to be typed are in single quotes, do not type the quotation marks.

   b. Turn on the computer and printer if they are not already on.

c. Start Lotus 1-2-3.

(1) If the prompt on the screen is C:\, type '123', and press enter;

(2) If the prompt is C:\WP50, type 'cd\', enter, type '123', and press enter;

(3) If the prompt is A:\ type 'C:', press enter, type '123' and press enter;

(4) If the prompt is B:\ type 'C:', press enter, type '123', and press enter.

d. Retrieve the Lotus 1-2-3 worksheet entitled FHM.WK1.

(1) Obtain disk (low density) labeled "FHM Worksheet". It will be next to the computer designated for laboratory use or available from the Principal Investigator.

(2) Place the disk in the lower (B) drive.

(3) Type '/' (forward slash).

(4) Type 'F' (file).

(5) Type 'R' (retrieve).

(6) Use the arrows on the keyboard to highlight FHM.WK1 (If you don't see FHM.WK1 at the top of the screen, press the page down key until you find FHM.WK1)

(7) Press enter.

e. Enter the Test Description Data.

(1) Use the arrows to highlight the entry after "Date:" (column B, row 1). Type an apostrophe ('), the month the test was conducted, a forward slash (/) the first day of the test, a hyphen (-), the last day of the test, a forward slash (/), and the year that the test was conducted. For example: '01/05-12/89. Press enter.

(2) Use the arrows to highlight the entry after "Test Name:" (column B, row 3). Type the name of each test conducted and press enter. For example, Coal Yard Runoff Treatment Facility, Nonradiological Wastewater Treatment Plant.

(3) Use the arrows to highlight the entry after "Test #:" (column B, row 5). Type an apostrophe ('), test number(s), and press enter. For example: '298,299.

(4) Use the arrows to highlight the entry after "Tester:" (column B, row 7). Type your name and press enter.

(5) Use the arrows to highlight the entry after "Comments:" (column B, row 9). If you need to change the comments, type the new information and press enter.

f. Enter the fathead minnow weight and survival data.

(1) Obtain the "Fathead Minnow Weight and Survival Data for Lotus Program" logsheet (exhibit SOP-9.1) that you filled out when you weighed the microweight pans and the microweight pans + larvae.

(2) Use the arrows on the keyboard to highlight the first concentration in the "A" column.

(3) If the concentration needs to be changed (refer to the log sheet), type an apostrophe ('), the new concentration, and press enter. Repeat for each concentration. If you need to add additional concentrations to the worksheet go to step 5g. If there are more concentrations on the worksheet then you need, go to step 5h.

(4) Use the arrows on the keyboard to highlight the first entry under column "C" entitled "PanWt". Refer to the log sheet, type in the new pan weight, and press enter.

(5) Use the right arrow to highlight the first entry under column "D" entitled "Pan+Larv". Refer to the log sheet, type in the new pan+larvae weight, and press enter.

(6) Use the right arrow to highlight the first entry under column "E" entitled "NoSurv". Refer to the log sheet, type in the number of larvae surviving in that replicate, and press enter.

(7) Repeat for each successive replicate and concentration.

(8) DO NOT enter any data in columns "F" to "J".

g. Add extra concentrations to the "FHM.WK1" worksheet as follows.

(1) Determine the number of extra concentrations needed.

(2) Use the arrows to move to the first concentration in the worksheet. (You should be in the "A" column.)

(3) Type '/' (forward slash).

(4) Type 'C' (copy).

(5) Use the right arrow to move the curser over to the "J" column.

(6) Use the down arrow to highlight the number of extra concentrations that you need.

(7) Press enter.

(8) Use the down arrow to go to the first blank line at the bottom of the work sheet (this is where the extra concentrations will be added).

(9) Press enter. The extra concentrations should appear at the bottom of the worksheet. Go to step 5f to enter data.

h. Erase extra concentrations as follows.

(1) Place the cursor on "Rep#1" line in "A" column of the first concentrations that you want to erase.

(2) Type '/' (forward slash).

(3) Type 'R' (range).

(4) Type 'E' (erase).

(5) Use the right arrow to move the cursor to the "J" column.

(6) Use the down arrow to highlight the number of concentrations that you want to erase.

(7) Press enter.

i. When you have "0" survival in a replicate complete the following steps.

(1) Use the arrows on the keyboard to move the cursor to the "C" column for that replicate.

(2) Type '/' (forward slash).

(3) Type 'R' (range).

(4) Type 'E' (erase).

(5) Use the right arrow to move the cursor to the "G" column.

(6) Press enter.

(7) Use the left arrow to move the cursor to the "E" column titled "NoSurv".

(8) Type '0'.

(9) Press enter.

j. When all the new data have been entered, save the file onto the disk as follows.

(1) Type '/' (forward slash).

(2) Type 'F' (file).

(3) Type 'S' (save).

(4) "Enter save file name: B:\fhm.wk1" will appear at the top of the screen.

(5) Type tst followed by the test number. For example: tst312.

(6) Press enter.

k. Print the worksheet as follows.

(1) Press the "Home" key (this will move you to the top of the worksheet).

(2) Type '/' (forward slash).

(3) Type 'P' (print).

(4) Type 'P' (printer).

(5) Type 'R' (range).

(6) Use the arrows on the keyboard to highlight the entire worksheet.

(7) Press enter.

(8) Type 'O' (options).

(9) Type 'S' (set-up). If the set-up reads "\015" press enter (this compresses the print). If the set-up does not read "\015", enter '\015'.

(10) Type 'Q' (quit).

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

(11) Type 'A' (align). This tells the printer to align the top of the page. Make sure your paper is lined up in the printer.

(12) Type 'G' (go).

l. Exit the Lotus 1-2-3 program as follows.

(1) Type '/' (forward slash).

(2) Type 'Q' (quit).

(3) Type 'Y' (yes).

7. Test acceptability criteria is based on 80% or greater survival in the controls and a mean dry weight of surviving control larvae of ≥ 0.25 mg/fish. Notify the Group Leader if the acceptability criteria are not achieved.

8. Glue the Lotus 1-2-3 weight and survival worksheet in the registered fathead minnow logbook.

9. The technician responsible for conducting the test will make a Xerox® copy of the applicable test logsheets from the registered fathead minnow logbook. Place the copies in the backup fathead minnow test notebook.

10. File the original "Fathead Minnow Weight and Survival Data for LOTUS Program Logsheet" in the fathead minnow original weight sheet notebook located in Room 12, Building 1504.

Approval

All Standard Operating Procedures generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader.

Approved by Lynn A. Kszos — Group Leader — 9/14/93 — Date

Effective Date 10/1/93

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

FATHEAD MINNOW TEST INFORMATION

Test Name: _____ Test No.:_____

Test Conducted From _____ (Day 0) To _____ (Day 7)

Sites/Concentrations Tested: _____

_____

Stock (if applicable):_____

Control Water Type (✓):

20% Dilute Mineral Water (DMW) + Trace Metals ☐
25% Dilute Mineral Water (DMW) + Trace Metals ☐
Other (describe):_____ ☐

Source of Test Larvae (✓):

ESD Cultures ☐
Florida Bioassay ☐
Other (described)_____ ☐

Date larvae hatched:_____ Initials:_____

==========

Record of Minor Test Non-Conformities		
Date	Description of Non-Conformity	Initials

Exhibit SOP-9.1. Fathead Minnow Test Information Logsheet

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Fathead Minnow - Daily Test Information Logsheet

TEST NAME: _____ TEST DATES: _____ TEST NO.: _____

Daily Test Information	Temperature Information			Feeding Information		Test Initiation, Water Change, or Test Termination		Control Water Batch No.
Date and Initials	Water Bath (°C)	Beaker (°C)	Thermo. No.	Fed 100 µL Brine Shrimp (✓)	Feeding Time	Start Time	End Time	additional comments
Day 0:					___ am ___ pm			
Day 1:					___ am ___ pm			
Day 2:					___ am ___ pm			
Day 3:					___ am ___ pm			
Day 4:					___ am ___ pm			
Day 5:					___ am ___ pm			
Day 6:					___ am ___ pm			
Day 7:								

Exhibit SOP-9.2. Fathead Minnow Daily Test Information Logsheet

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Fathead Minnow Daily Test Results

Test Name:_____ Test No.:_____ Dates:_____ to _____

Comment Codes: C = Clear; D = Dead; Fg = Fungus; K = Killed by siphoning; M = Missing; Sk = Sick; SM = Unusually small; SOR = Siphoned out and returned; W = Wounded by siphoning

Conc.	REP	Enter the number alive and comment code, if applicable						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
	1							
	2							
	3							
	4							
	total alive							
	1							
	2							
	3							
	4							
	total alive							
	1							
	2							
	3							
	4							
	total alive							
	1							
	2							
	3							
	4							
	total alive							

Exhibit SOP-9.3. Fathead Minnow Daily Test Results Logsheet

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Fathead Minnow Shipment Logsheet

Larvae Source:	No. Received (Approx.):	Date Received:	Received By: (Initials)

	Hour							
	Initial	1	2	3	4	5	6	7
Temp. (°C)								
Time:								
Therm. No.								
Initials:								

Comments (e.g., condition of larvae received)

Exhibit SOP-9.4. Fathead Minnow Shipment Logsheet

SUBJECT: FATHEAD MINNOW CHRONIC TOXICITY TEST

Fathead Minnow Weight and Survival Data for LOTUS Program

Test Name:_____ Test No.:_____

Calibration of Cahn C-30 Microbalance (use 20 mg weight) (acceptable range = 19.9000-20.1000)

1. Weighing empty pans
   Weight Before:_____
   Weight After: _____

2. Weighing pans + larvae
   Weight Before:_____
   Weight After: _____

Site/ Conc.	REP	Pan Wt.	Pan + Larvae	No. Surv	Site/ Conc.	REP	Pan Wt.	Pan + Larvae	No. Surv
Initial	1					1			
	2					2			
	3					3			
	4					4			
Control	1					1			
	2					2			
	3					3			
—	4					4			
	1					1			
	2					2			
	3					3			
	4					4			
	1					1			
	2					2			
	3					3			
	4					4			
	1					1			
	2					2			
	3					3			
	4					4			
	1					1			
	2					2			
	3					3			
	4					4			
	1					1			
	2					2			
	3					3			
	4					4			

Exhibit SOP-9.5. Fathead Minnow Weight and Survival Data for Lotus Program Logsheet

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

Purpose

To measure the chronic toxicity of ambient or waste waters to *Ceriodaphnia* in 7-d static renewal exposures.

Reference

EPA Test Method 1002.0, in C. I. Weber et al., *Short-Term Methods for Estimating the Chronic Toxicity of Effluent and Receiving Water to Freshwater Organisms*, EPA/600/4-89/001 (March 1989).

Equipment

Ceriodaphnia neonates (collected per SOP-4)
Temperature-controlled water bath or environmental chamber (maintained at 25± 2°C)
Dilute mineral water (DMW; see SOP-1)
1-oz disposable plastic beakers (pre-rinsed in distilled water, if necessary)
8-oz specimen containers
Glass tubing (2-mm ID) cut to approximately 17 cm, with ends polished
Pasteur pipettes
1-mL pipette bulbs
Holding racks for 1-oz plastic cups
Randomizing templates (exhibit SOP-10.1)
Thermometer
Ceriodaphnia food (YCT and *Selenastrum*; see SOP-3)
Volumetric flasks
Graduated cylinders
Fixed- or adjustable-volume pipette
Light table
Binocular stereomicroscope (optional)
Magnifying lamp (optional)
Registered *Ceriodaphnia* toxicity test logbook
Sample randomizing template (exhibit SOP-10.1)
Ceriodaphnia Information Sheet for Randomized Test (exhibit SOP-10.2)
Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test (exhibit SOP-10.3)
Ceriodaphnia Daily Test Information Logsheet (exhibit SOP-10.4)
Ceriodaphnia Information Sheet for Non-Randomized Test (exhibit SOP-10.5)
Daily Survival and Reproduction Logsheet For Non-Randomized *Ceriodaphnia* Test (exhibit SOP-10.6)
Lotus 1-2-3® computer software program
WordPerfect® computer software program
SAS® computer software program
Data disk labeled "*Ceriodaphnia* SAS program"

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

I. Procedure for conducting the *Ceriodaphnia* randomized test

NOTE: Toxicology Laboratory personnel have the option of conducting ambient tests using either this method or the proceeding method.

A. In preparation for the test, complete the following steps.

1. Glue a "*Ceriodaphnia* Information Sheet for Randomized Test", a "Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test", and a "*Ceriodaphnia* Daily Test Information Logsheet" into the registered *Ceriodaphnia* toxicity test logbook. Initial and date each logsheet so that half of the writing extends onto the logbook page.

2. Prepare the glassware. Label the necessary volumetric flasks, graduated cylinders, and 8-oz. specimen containers with the site identification (sample name) and dilution. In addition, label 8-oz. specimen containers with the site identification, dilution, and "final pH and D.O." These containers will be used to collect test water during the daily renewal.

3. Collect the neonates for the toxicity test (see SOP-4).

B. To start the test, the following steps are performed.

1. Prepare the test concentrations specified in the test write-up prepared by the Laboratory Steward or designee in accordance with the procedure described in SOP-8. Include a "control" (consisting DMW) for each individual test conducted.

2. Record the concentrations on the "*Ceriodaphnia* Information Sheet for Randomized Test", reserving "1" for the control (DMW).

3. Record the following additional information on the "*Ceriodaphnia* Information Sheet for Randomized Test."

   a. Test name, test number, test dates, stock used (if applicable), control water (DMW) and dilution water types and batch numbers, the source of test animals, and your initials.

4. Select a randomizing template. Use a different template for each holding rack needed to conduct the test. Record the template number on the "*Ceriodaphnia* Information Sheet for Randomized Test" logsheet.

5. Place the template under the holding rack so that the numbers on the template are aligned with the holes in the rack. Pour 15 mL of each test concentration into ten individual replicate (REP) beakers and place the beakers in the corresponding positions in the rack. For example, the ten beakers containing control water are placed in each of the holes where there is a "1." Continue this procedure for each test concentration.

6. Using the fixed- or adjustable-volume pipette, add 50 µL of YCT and 50 µL of *Selenastrum* to each beaker.

7. Using a Pasteur pipette, place one neonate (collected as in SOP-4) in each test beaker as follows.

   a. Obtain a beaker with a minimum of 8 neonates from one adult (collected as in SOP-4). Place one neonate in each of the six test beakers in the first column on the test board. Select another beaker with a minimum of 8 neonates from one adult and place one neonate into each of the six test beakers in the second column of the test board. Repeat this process until each of the 60 beakers contains one neonate.

   b. This procedure allows the performance of each adult to be tracked. Adults that produce one weak offspring or male offspring have a greater likelihood of producing more young that are males or weak. In this manner, if all of the REPs for each concentration are male or have low reproduction, they may be excluded from statistical analyses.

8. Record the following information on the "*Ceriodaphnia* Daily Test Information Logsheet." Refer to the logsheet for specific information required.

   a. Test name, test number, test dates, temperature information, feeding information, starting and ending times (i.e., the time the first neonate was added to the test to the time the last neonate was added), DMW batch number, test initiation date (Day 0), and your initials.

9. Record the following information on the "Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test."

   a. Test name, test number, test dates, and template number.

C. Perform a 24-h renewal each day during the 7-d test period.

1. Prepare fresh concentrations each day.

2. Using a polished glass tube affixed to a pipette bulb, transfer each animal to a new test beaker containing 15 mL of freshly prepared test solution and 50 µL of YCT and 50 µL of *Selenastrum*. Count and record (for the appropriate day and replicate) the number of young in each beaker on the "Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test." If no young were produced, code the adult appropriately (refer to the codes on the "Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test"). Holding the beaker over a light table will facilitate counting the number of young produced. A dissecting microscope may also be used.

3. Carefully pour the old test water from at least eight REP beakers into the 8-oz. specimen containers marked "final pH and DO." NOTE: you will only need to collect test water from the concentrations used for water chemistry analyses. Discard the remaining neonates produced by the test animals and the old test water in accordance with the procedure outlined in SOP-7.

4. Record the date of transfer, time of transfer, feeding information, DMW batch number, temperature information, and your initials on the "*Ceriodaphnia* Daily Test Information Logsheet" in the registered *Ceriodaphnia* toxicity test logbook.

5. Record minor test non-conformities (e.g., a temperature that falls outside the acceptable range), on the "*Ceriodaphnia* Information Sheet for Randomized Test."

D. Terminating the test involves the following.

1. The test should be terminated when 60% of the surviving females in the control have had their third brood and there is an average of 15 or more neonates per surviving female in the control. The test is terminated ± 2 h from the time it was initiated.

2. Record the number of neonates in each beaker as described in C.2 above.

3. Record the starting and ending times of the test take down on the "*Ceriodaphnia* Daily Test Information Logsheet." Also record the water bath or incubator temperature, beaker temperature, thermometer number, and your initials on the logsheet.

4. Collect the old test water for final pH and D.O. measurements as described in C.3. Discard the remaining test water, neonates and adults in accordance with the procedures outlined in SOP-7.

E. Generate the summary statistics and tables using SAS© and WordPerfect© computer software programs.

1. Create a data file using WordPerfect.

a. Turn on the computer and printer if they are not already on.

b. Insert a data disk into a disk drive.

c. Access the WordPerfect® program. Commands to be typed are in single quotes; do not type the quotation marks.

(1) If the prompt on the screen is C:\>, type 'cd WP51' and press enter. Type 'WP' and press enter again.

(2) If the prompt on the screen is A:\> or B:\>, type 'C:' and press enter, then type 'cd WP51' and press enter again. Type 'WP' and press enter.

d. Important notes about entering data for the data file.

(1) Capitalize all letters.

(2) Enter the reproduction data for each test beaker starting with the beaker number. Use two characters to enter the beaker number (e.g., 03, 27).
On the same line enter the reproduction data. Space between each entry and return after each line. EXCEPTION: DO NOT RETURN AFTER THE LAST LINE IS ENTERED. This will normally be line 60.

Example: 34 0 0 4 0 0 18 22 (Test beaker number 34; followed by seven days of reproduction data.)

(3) Enter a zero (0) if the animal was alive and no reproduction was observed for the test day.

(4) If the test was not conducted for all seven days, type a period (.) in place of the missing reproduction data.

Example: 27 0 0 5 0 15 19 . (Test beaker number 27. The test was terminated on day 6. No reproduction data for day 7 were available.)

(5) If the test animal reproduced and died, enter the number of neonates followed by a capital "X." Type an X for each remaining day the test was conducted.

Example: 03 0 0 8X X X X . (Test beaker number 3. The adult died on day 3 and had 8 young. Test was terminated on day 6.)

(6) If the test animal died and did not reproduce, enter a capital "X". Type an X for each remaining day the test was conducted.

Example: 49 0 0 X X X X X (Test beaker number 49; animal died on day 3.)

(7) If the test animal was male, enter a capital "M" for each day the test was conducted.

Example: 17 M M M M M M M

(8) If the test contained less than 60 test beakers, enter only the beaker numbers and reproduction data that were used.

e. Enter the *Ceriodaphnia* survival and reproduction data.

f. When all the data are entered, convert the data file to an ASCII file.

(1) Press Ctrl + F5.

(2) Select option 1 (DOS Text).

(3) Select option 1 (SAVE) and name the ASCII file.

(a) Suggestion: Use the test name, test number, or a combination thereof, followed by an ASC extension. Also, designate the disk drive. For example, if your data disk is in the "A" drive, type 'A:\WOC932.ASC' and press enter.

g. Print the data file.

(1) Press shift + F7.

(2) Select option 1 (Full Document)

h. Verify data input.

(1) On the copy of the data file you printed in step g, write the test name, test number, test date, and template number. Verify the accuracy of the inputted data against the original data in the registered *Ceriodaphnia* test logbook. Initial and date the printed copy after the data have been verified. File the original in the "*Ceriodaphnia* toxicity test ASCII files" notebook located in Building 1504, Room 12.

g. Exit WordPerfect.

(1) Press F7.

(2) Press 'Y' if you want to save the data file you created. It is not necessary to save this file in WordPerfect since it was saved as an ASCII file. If you do save the data file, follow the instructions described in 3a above except do not use the ASC extension.

(3) Press 'N' if you do not want to save the data file, then press 'Y' to exit WordPerfect.

2. Generate the summary statistics and tables using the SAS® computer program.

a. Access the SAS® program. Commands to be typed are in single quotes; do not type the quotation marks.

(1) If the prompt on the screen is C:\>WP51, type 'cd C:\' and press enter.

(2) If the prompt on the screen is C:\>, type 'cd SAS' and return. When C:\>SAS> appears, type 'SAS' and return again.

(3) If the prompt on the screen is A:\> or B:\>, type 'C:' and press enter. Follow the instructions described above.

b. Insert the data disk titled "*Ceriodaphnia* SAS Program" into a disk drive. NOTE: All proceeding instructions will be based on using the B drive for the data disk. If another drive is used, make the appropriate substitution.

c. Important keys and notes about using the SAS program.

(1) The SAS screen is divided into three sections: Output, Log, and Program Editor. Each section title is followed by a command line.

(2) Press F5 to move between the sections.

(3) Press F7 to pull up a full screen for the section in which the curser lies.

(4) Press F10 to execute the SAS program.

(5) Ctrl + break ("pause key") will stop the program.

d. Load the SAS program written for compiling the *Ceriodaphnia* reproduction data. Commands to be typed are in boldface print.

(1) If the curser is not on the command line of the Program Editor section, press F5 until it is in the proper location.

(2) At the command line, type **include "b:\table.prg"** and press enter.

(3) Press F7 to pull up a full screen.

(4) Use the page down (PgDn) and/or arrow keys (↓ ↑) to move to the last line (should be line 271). The line should read as follows:

%cerio(title,tempfil,datafil,temp,nconc,days,c1,c2,c3,c4,c5,c6)

(5) Replace the following. Text to be typed are in boldface print. Do not space after each comma.

Title — Designate the name. Suggestion: use the test name or test number. Example: **K25STP.940** = K-25 Sewage Treatment Plant, test number 940.

Tempfil — **b:\template.dat**

Datafil — Type the name of the ASCII file you created using WordPerfect. Designate the disk drive. Example: **b:\K25STP.ASC**

Temp — Enter the template number.

Nconc — Enter **6**.

Days — Enter the number of days the test ran. This will normally be 6 or 7.

C1-C6 — Enter the concentrations used in order from 1-6. Refer to the "*Ceriodaphnia* Information Sheet for Randomized Test" in the registered *Ceriodaphnia* logbook. Since C1 is reserved for the control, this must be zero (0). Enter the concentrations tested for C2-C6 as whole numbers. DO NOT ENTER DECIMAL POINTS OR PERCENT SIGNS. If there were less than six total concentrations tested (including the control), use zero (0) as a place-holder for the missing concentrations. THERE MUST BE SIX TOTAL ENTRIES. Example: 0, 100, 50, 25, 12, 0 (The first zero designates the control, the last zero is a place-holder).

(6) Press F10 to run the SAS program.

(7) After the program has finished compiling the data, press F5 once to move the curser to the Output section on the screen.

(8) Type file **'LPT1:'** or file **'prn'** to send the output to the printer. Note: This command is appropriate for the computer and printer located in Room 12.

(9) After the document has printed, type **bye** to exit SAS.

(10) Glue a copy of the output document in the registered *Ceriodaphnia* toxicity test logbook. Initial and date each sheet so that half of the writing extends onto the logbook page.

(11) The technician responsible for conducting the test will make a Xerox® copy of the applicable log sheets from the registered *Ceriodaphnia* test logbook. Place the copy in the backup *Ceriodaphnia* test notebook.

3. Test acceptability criteria is based on 80% or greater survival in the controls and reproduction in the controls must average 15 or more young per surviving female. If the test does not meet these criteria, notify the Group Leader or designee.

II. Procedure for conducting the non-randomized *Ceriodaphnia* test

A. In preparation for the test, complete the following steps.

1. Prepare the glassware. Label 1-oz plastic beakers with the sample identification, dilution, and replicate (REP) number (ten REPs are typically used per concentration or site; additional REPs may be required for some tests). Label the necessary volumetric flasks, graduated cylinders, and beakers.

2. Collect neonates for the toxicity test (step B, SOP-4).

3. Glue a "*Ceriodaphnia* Information Sheet for Non-Randomized Test" (exhibit SOP-10.4), a "*Ceriodaphnia* Daily Test Information Logsheet" (exhibit SOP-10.3), and a "Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test" (exhibit SOP-10.5) into the registered *Ceriodaphnia* toxicity test logbook. Note: You may need more than one daily survival and reproduction log sheet for the test. Initial and date each sheet so that half of the writing is on the log sheet and half extends onto the logbook page.

B. To start the test, the following steps are performed.

1. Prepare the test concentrations specified in the test write-up in accordance with the procedure described in SOP-8. Include a "control" (consisting of DMW) for each individual test conducted. Record the sites/concentrations tested on the *Ceriodaphnia* Information Sheet for Non-Randomized Test" logsheet.

2. Record the following additional information on the "*Ceriodaphnia* Information Sheet Non-Randomized Test" logsheet.

   a. Test name, test number, test dates, stock used (if applicable), control water and dilution water types and batch numbers, the source of test animals, and your initials.

3. Pour 15 mL of test solution in each of the ten REP beakers.

4. Using a fixed- or adjustable-volume pipette, add 50 µL of YCT and 50 µL of *Selenastrum* to each beaker.

5. Place one neonate (collected as in SOP-4) in each test beaker using a Pasteur pipette as follows.

   a. Obtain a beaker with a minimum of 8 neonates from one adult (collected as in SOP-4). Place one neonate in each of the six test beakers in the first column on the test board. Select another beaker with a minimum of 8 neonates from one adult and place one neonate into each of the six test beakers in the second column of the test board. Repeat this process until each of the 60 beakers contains one neonate.

   b. This procedure allows the performance of each adult to be tracked. Adults that produce one weak offspring or male offspring have a greater likelihood of producing more young that are males or weak. In this manner, if all of the REPs for each concentration are male or have low reproduction, they may be excluded from statistical analyses.

6. Place the beakers in holding racks, and put the racks in the temperature-controlled water bath or environmental chamber.

7. Record the following information on the "*Ceriodaphnia* Daily Test Information Logsheet." Refer to the logsheet for specific information required.

   a. Test name, test number, test dates, temperature information, feeding information, starting and ending times (i.e., the time the first neonate was added to the test to the time the last neonate was added), DMW batch number, test initiation date (Day 0), and your initials.

8. Record the following information on the "Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test."

   a. Test name, test number, and test dates.

C. Perform a 24-h renewal each day during the 7-d test period.

1. Prepare fresh dilutions each day.

2. Using a polished glass tube affixed with a pipette bulb and a dissecting microscope, if necessary, transfer each animal daily to a new test beaker containing 15 mL of freshly prepared test solution and 50 µL of YCT and 50 µL of *Selenastrum*. Count and record (for the appropriate day and replicated number) the number of young in each beaker on the "Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test" in the registered *Ceriodaphnia* logbook. Holding the beaker over a light table will facilitate counting the number of young produced.

3. If no young were produced, if the animal died, or if the animal is male, use the appropriate code and record on the "Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test." Refer to the logsheet for the codes.

4. After counting, discard the neonates produced, any dead animals, and the old test solution in accordance with the procedure described in SOP-7.

5. Record the date of transfer, time of transfer, feeding information, temperature information and your initials on the "*Ceriodaphnia* Daily Test Information Logsheet" in the registered *Ceriodaphnia* logbook.

6. Record minor test non-conformities (e.g., a temperature that falls outside the acceptable range), on the "*Ceriodaphnia* Information Sheet for Randomized Test."

D. Terminating the test involves the following.

1. The test should be terminated when 60% of the surviving females in the control have had their third brood and there is an average of 15 or more neonates per surviving female in the control. The test is terminated ± 2 h from the time it was initiated.

2. Count and record the number of neonates in each beaker as described in C.2 through C.3.

3. Record the starting and ending times of the test take down on the "*Ceriodaphnia* Daily Test Information Logsheet."

4. Discard the test animals, neonates, and test solutions per the procedure described in SOP-7.

5. Record the date the test was terminated, temperature information, and your initials on the "*Ceriodaphnia* Daily Test Information Logsheet" in the registered *Ceriodaphnia* logbook.

E. Calculate the total number of offspring produced, the mean number of offspring for all females, and the mean number of offspring for surviving females, using the Lotus 1-2-3® computer program.

1. Important keys and notes about using the Lotus 1-2-3 computer program.

(a) Use the arrows on the keyboard to move around the worksheet.

(b) Use the forward slash (/) to get to the main menu.

(c) Use the Esc key to get out of trouble and move to the previous selection/menu.

(d) Commands to be typed are in single quotes; do not type the quotation marks.

(e) The Lotus 1-2-3 worksheet is divided into two parts. On the left (Columns A-K) there are two rows of squares that will do the statistical calculations. This is the part you will print out. On the right there are rows of squares into which you will enter the test data. The information on the right will not be printed.

(f) There are numbers in the upper right hand corners of the boxes on the left side of the worksheet under column "E" or "J". These numbers correspond to the numbers above each "Concentration/Site" on the right side of the worksheet under column "L".

2. Turn on the computer and printer if they are not already on.

3. Start Lotus 1-2-3.

(a) If the prompt on the screen is C:\, type '123', and press enter;

(b) If the prompt is C:\WP50, type 'cd\', press enter, type '123', and press enter;

(c) If the prompt is A:\ type 'C:', press enter, type '123', and press enter;

(d) If the prompt is B:\ type 'C:', press enter, type '123', and press enter.

4. Retrieve the Lotus 1-2-3 worksheet entitled CDBLANK1.WK1.

(a) Obtain the disk (low density) labeled "CDBLANK". It will be next to the computer designated for laboratory use or available from the Principal Investigator.

(b) Place the disk in the lower (B) drive.

(c) Type '/' (forward slash).

(d) Type 'F' (file).

(e) Type 'R' (retrieve).

(f) Use the arrows on the keyboard to highlight CDBLANK1.WK1 (If you don't see CDBLANK1.WK1 at the top of the screen, press the page down key until you find CDBLANK.WK1).

(g) Press enter.

5. Enter the Test Description Data.

   (a) Use the arrows to highlight the entry after "TEST NAME:" (column C, row 3). Type in the name of the test and press enter. For example: Coal Yard Runoff Treatment Facility.

   (b) Use arrows to highlight the entry after "TEST DATE:" (column E, row 3). Type an apostrophe ('), the month the test was conducted, a forward slash (/) the first day of the test, a hyphen (-), the last day of the test, a forward slash (/), and the year that the test was conducted. For example: '01/05-12/89. Press enter.

   (c) Use the arrows to highlight the entry after "TEST NUMBER:" (column H, row 3). Type an apostrophe ('), the number(s) of the test(s) and press enter. For example: '554.

   (d) Use the arrows to highlight the entry after "PERSONNEL:" (column J, row 3). Type your name and press enter.

6. Enter *Ceriodaphnia* survival and reproduction data. (Note: The steps below this point may be completed for up to ten concentrations/sites. The worksheet is so large that more than ten concentrations/sites becomes cumbersome. If you have more than ten concentrations/sites, complete all of the steps below for the first ten concentrations/sites, call up the CDBLANK2.WK1 worksheet, and repeat all steps for the remaining concentrations/sites.)

   (a) Obtain the registered *Ceriodaphnia* logbook which contains the test data.

   (b) Enter the test concentrations/sites as follows.

      (1) Use the arrows to move to the "L" column and highlight the first concentration.

      (2) Type an apostrophe (') and the test concentration/site.

      (3) Repeat for each test concentration/site (up to a total of ten; see note at step f.)

   (c) Enter the survival data for each replicate of each concentration/site as follows.

      (1) Use the right arrow to move to the "P" column. Highlight the first replicate under the first concentration/site.

      (2) If the animal that represents that replicate (refer to the registered *Ceriodaphnia* logbook) was female and survived, enter a '1' in that cell.

(3) If the animal that represents that replicate was a female and died during the test or was a male, enter a '0' in that cell.

(4) Repeat for each replicate of each concentration/site.

(d) Enter the reproduction data for each replicate of each concentration/site as follows.

(1) Use the arrows to move to the "R" column. Highlight the first replicate under the first concentration/site.

(2) If the animal that represents that replicate did not have any young enter a '0'.

(3) If animal that represents that replicate had young, or died and had young, enter the number of young the animal produced.

(4) If the animal was male, enter a '0'.

(5) Repeat for each replicate.

(e) Do not enter anything in column "T".

(f) If you entered a '0' in column "P" for any replicate (step f(4)), complete the following.

(1) Use the arrows to move to column "V" with the heading "Corrected # Young SF" (short for surviving females).

(2) Use the arrows to highlight the word "blank".

(3) Type '/' (forward slash).

(4) Type 'R' (range).

(5) Type 'E' (erase).

(6) Press enter (the word "blank" should be erased).

(g) Enter the concentration/site names into the statistical part of the worksheet (left side) as follows.

(1) Use the arrows to highlight the cell to the right of the first "Concentration/Site:" (either column "D" or column "I").

(2) Type the concentration/site that corresponds to the same numbered box on the right hand of the worksheet. For example: if box #5 on the right hand side of the worksheet is labeled "Site 3", label box #5 on the left hand of the worksheet "Site 3".

(3) Repeat for each concentration/site.

7. When all the new data have been entered, save the file onto the disk as follows.

(a) Type '/' (forward slash).

(b) Type 'F' (file).

(c) Type 'S' (save).

(d) "Enter save file name: B:\CDBLANK1.WK1" will appear at the top of the screen.

(e) Type cd followed by the test number. For example: cd312.

(f) Press enter.

8. Print the worksheet as follows.

(a) Press the "Home" key (this will move you to the top of the worksheet).

(b) Type '/' (forward slash).

(c) Type 'P' (print).

(d) Type 'P' (printer).

(e) Type 'R' (range). The top of the screen should now read "range A1..K86". If the top of the screen does not read "A1..K86", press Esc, press home to get to A1, type a period (.), and highlight all of the boxes from A1 through K86.

(f) Press enter.

(g) Type 'O' (options).

(h) Type 'S' (set-up). If the set-up reads "\027\048\015" press enter (this compresses the print). If the set-up does not read "\027\048\015", enter '027\048\015'.

(i) Press enter.

(j) Type 'Q' (quit).

(k) Type 'A' (align). This tells the printer to align the top of the page. Make sure your paper is lined up in the printer.

(l) Type 'G' (go).

9. Exit the Lotus 1-2-3 program as follows.

(a) Type '/' (forward slash).

(b) Type 'Q' (quit).

(c) Type 'Y' (yes).

10. Make a Xerox® copy of the Lotus worksheet. Glue the original in the registered *Ceriodaphnia* logbook.

11. The technician responsible for conducting the test will make a Xerox® copy of the applicable test logsheets from the registered *Ceriodaphnia* test logbook. Place the copies in the backup *Ceriodaphnia* test notebook.

12. Test acceptability criteria is based on 80% or greater survival in the controls and reproduction in the controls must average 15 or more young per surviving female. If the test does not meet these criteria, notify the Group Leader or designee.

Approval

All Standard Operating Procedures generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader.

Approved by Lynn A. Kogo — Group Manager — 9/13/93 — Date

Effective Date 10/1/93

5	3	3	4	2	4	4	2	6	1
1	5	6	2	5	6	2	5	4	6
2	6	4	6	3	3	1	6	5	4
4	4	2	1	1	5	6	3	2	2
6	1	5	3	4	1	3	1	1	5
3	2	1	5	6	2	5	4	3	3

Exhibit SOP-10.1. Sample randomizing template.

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

CERIODAPHNIA INFORMATION SHEET FOR RANDOMIZED TEST

Test Name: _____ Test No.: _____

Test Conducted From _____ (Day 0) To _____ (Day 7)

Sites/Concentrations: 1 = _____ 4 = _____ Template No.:_____
2 = _____ 5 = _____
3 = _____ 6 = _____

Stock (if applicable):_____

Control Water Type (✓):

20% Dilute Mineral Water (DMW) + Trace Metals ☐
25% Dilute Mineral Water (DMW) + Trace Metals ☐
Other (describe):_____ ☐

Dilution Water Type (✓):

20% Dilute Mineral Water (DMW) + Trace Metals ☐
25% Dilute Mineral Water (DMW) + Trace Metals ☐
Other (describe):_____ ☐

Source of Test Animals:

Transferred ESD culture board nos. _____ - _____ on _____ (Wed. date)
from _____ to _____ (time) Initials:_____

Isolated neonates for test on _____ (date) from boards _____
from _____ to _____ (time) Initials:_____

Record of Minor Test Non-Conformities		
Date	Description of Non-Conformity	Initials

Exhibit SOP-10.2. *Ceriodaphnia* Information Sheet for Randomized Test.

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test Template No.___

Date:	Test:	Test No.

Codes: (-)Alive and No Reproduction; (M)Alive and Reproduction; (x)Dead; (xM)Dead and Reproduction; (M)Male

	Test Beaker Number					
Day	1	2	3	4	5	6
1						
2						
3						
4						
5						
6						
7						
	7	8	9	10	11	12
1						
2						
3						
4						
5						
6						
7						
	13	14	15	16	17	18
1						
2						
3						
4						
5						
6						
7						
	19	20	21	22	23	24
1						
2						
3						
4						
5						
6						
7						
	25	26	27	28	29	30
1						
2						
3						
4						
5						
6						
7						

Exhibit SOP-10.3.1. Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test.

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

Daily Survival and Reproduction Log Sheet for Randomized *Ceriodaphnia* Test (cont.)

Date:		Test:			Test No.	
Codes: (-)Alive and No Reproduction: (+)Alive and Reproduction: (x)Dead: (x+)Dead and Reproduction: (M)Male						
Test Beaker Number						
Day	31	32	33	34	35	36
1						
2						
3						
4						
5						
6						
7						
	37	38	39	40	41	42
1						
2						
3						
4						
5						
6						
7						
	43	44	45	46	47	48
1						
2						
3						
4						
5						
6						
7						
	49	50	51	52	53	54
1						
2						
3						
4						
5						
6						
7						
	55	56	57	58	59	60
1						
2						
3						
4						
5						
6						
7						

Exhibit SOP-10.3.2. Daily Survival and Reproduction Logsheet for Randomized *Ceriodaphnia* Test (cont.)

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

Ceriodaphnia - Daily Test Information Logsheet

TEST NAME: _____ TEST DATES: _____ TEST NO.: _____

Daily Test Information	Temperature Information			Feeding Information				Test Initiation, Water Change, or Test Termination		Control Water Batch Number
				YCT		*Selenastrum*				
Date and Initials	Chamber (°C)	Beaker (°C)	Therm. No.	Fed 50 µL	YCT Date	Fed 50 µL	*Sel.* Date	Start Time	End Time	additional comments
Day 0:										
Day 1:										
Day 2:										
Day 3:										
Day 4:										
Day 5:										
Day 6:										
Day 7:										

Exhibit SOP-10.4. *Ceriodaphnia* Daily Test Information Logsheet

CERIODAPHNIA INFORMATION SHEET FOR NON-RANDOMIZED TEST

Test Name:_____ Test No.:_____

Test Conducted From _____ (Day 0) To _____ (Day 7)

Sites/Concentrations Tested:_____

_____

Stock (if applicable):_____

Control Water Type (✓):

20% Dilute Mineral Water (DMW) + Trace Metals ☐
25% Dilute Mineral Water (DMW) + Trace Metals ☐
Other (describe):_____ ☐

Dilution Water Type (✓):

20% Dilute Mineral Water (DMW) + Trace Metals ☐
25% Dilute Mineral Water (DMW) + Trace Metals ☐
Other (describe):_____ ☐

Source of Test Animals:

Transferred ESD culture board nos._____ - _____ on _____(Wed. date)
from _____ to _____ (time) Initials:_____

Isolated neonates for test on _____(date) from boards _____
from _____ to _____ (time) Initials:_____

Record of Minor Test Non-Conformities		
Date	Description of Non-Conformity	Initials

Exhibit SOP-10.5. *Ceriodaphnia* Information Sheet for Non-Randomized Test

SUBJECT: *CERIODAPHNIA* CHRONIC TOXICITY TEST

Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test

DATE		TEST.									TEST NO		
CODES (-) Alive and no reproduction; (+) Alive and reproduction. (X) Dead (X+) Dead and reproduction. (M) Male; (DY+) Dead Young													
		REPLICATE											
Conc.	Day	1	2	3	4	5	6	7	8	9	10	Live Adults	No Young
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	Total												
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	Total												
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	Total												
	1												
	2												
	3												
	4												
	5												
	6												
	7												
	Total												

Exhibit SOP-10.6. Daily Survival and Reproduction Logsheet for Non-Randomized *Ceriodaphnia* Test

SUBJECT: PERFORMANCE OF CHEMICAL ANALYSES

Purpose

To analyze pH, alkalinity, conductivity, hardness, dissolved oxygen, and total residual and free chlorine in all water samples and to measure the final dissolved oxygen and pH in samples during the fathead minnow ambient and effluent tests and the *Ceriodaphnia* effluent (randomized) test.

Equipment

pH meter equipped with temperature probe
Chlorine titrator (Wallace and Tiernan)
Dissolved oxygen meter with submersible probe
Hardness titrating solution (EDTA Solution, e.g., Betz)
Eriochrome Black T
Sodium chloride (NaCl)
Hardness buffer (e.g., Instruments Buffer Solution Hardness 1)
0.00564 *N* Phenylarsene oxide (e.g., Banco)
0.01 *N* Hydrochloric acid (HCl)
Potassium iodide (5% w/v)
Stir bars
Magnetic stirrer
pH buffer 7.00 (for probe storage)
Wallace and Tiernan pH 4.00 acetic acid buffer
Wallace and Tiernan pH 7.00 buffer solution
Two 25-mL burettes
100-mL beakers
50-mL graduated cylinders
Pasteur pipettes
1-mL pipette bulbs
8-oz. specimen containers
Kimwipes or facial tissues
Rinse bottles
Deionized distilled water
Registered chemistry logbook
Registered daily calibration logbook
Daily chemistry data logsheet (exhibit SOP-11.1)
Daily calibration information logsheet (exhibit SOP-11.2)

Procedure

1. When a new toxicity test begins, glue a "Daily Chemistry Data Logsheet" into the registered chemistry logbook. NOTE: More than one logsheet may be necessary. Initial and date each logsheet so that half of the writing extends onto the logbook page.

2. Determine the pH as follows.

   a. Each day before making pH measurements (including alkalinity and hardness), calibrate the meter. Refer to the Task Instruction located in the Laboratory Operations Manual in Room 12.

   b. Measure the initial pH of the fresh water samples collected daily and used for the fathead minnow and *Ceriodaphnia* toxicity tests.

      (1) Slide the protective sleeve on the probe downwards to expose the vent hole.

      (2) Submerge the pH probe in ~50 mL of sample water. Gently stir the sample with a stir bar and magnetic stirrer while measuring.

      (3) Allow the pH reading to stabilize. Record the value in the "Initial pH" blank on the "Daily Chemistry Data Logsheet" in the registered water chemistry logbook.

      (4) Rinse the probe with deionized distilled water after measuring each sample.

   c. Measure the final pH of the water samples collected during the daily test renewal in the ambient and effluent fathead minnow tests and the *Ceriodaphnia* effluent (randomized) test.

      (1) Measure the final pH of the sample water that was collected per the procedures outlined in SOP-9 and SOP-10.

      (2) Submerge the pH probe in ~50 mL of sample water. Gently stir the samples with a stir bar and magnetic stir plate while measuring.

      (3) Allow the pH reading to stabilize. Record the value in the "Final pH: FHM" or "Final pH: CD" blanks, as appropriate, on the "Daily Chemistry Data Logsheet" in the registered water chemistry logbook.

      (4) Rinse the probe with deionized distilled water after measuring each sample.

   d. When finished using the meter, slide the protective sleeve upwards to cover the vent hole of the probe. Store the pH probe immersed in pH 7.00 buffer.

3. Determine the alkalinity as follows.

   a. Alkalinity is a measure of a water sample's capacity to neutralize a strong acid. A sample's alkalinity is determined by titrating a 50-mL volume of the sample with 0.01 *N* HCl to a potentiometric endpoint of 4.50 $\pm$ 0.04. Gently stir the sample with a stir bar and magnetic stirrer during the titration.

b. Submerge the pH probe (calibrated per task instructions) in the 50-mL sample. Fill the 25-mL burette (graded into 0.1-mL units, readable to the nearest 0.05 mL) with the titrant (0.01 *N* HCl).

c. Allow the pH to stabilize (this step can be used to measure initial pH). Slowly add the titrant (0.01 *N* HCl) until the sample reaches a pH of 4.50 $\pm$ 0.04. If a full-strength sample is being analyzed, calculate the amount of alkalinity (expressed as milligrams of $CaCO_3$ per liter) by multiplying the milliliters of acid solution consumed (see the reading on the burette) by 10 (e.g., 10.5 mL of 0.1 *N* HCl $\times$ 10 = 105.0 mg $CaCO_3$ per L).

d. If the amount of titrant needed to reach pH 4.50 is greater than 25 mL (in rare instances), a 1:1 dilution of the sample is necessary. In a 50-mL graduated cylinder, add 25 mL of full-strength sample, and bring it to volume with deionized distilled water. Titrate as in step 2c. Calculate the amount of alkalinity, in milligrams $CaCO_3$ per liter, by multiplying the milliliters of consumed acid solution by 20.

e. Record the amount of alkalinity (expressed as mg of $CaCO_3$ per liter, as calculated above) directly onto the "Daily Chemistry Data Logsheet" in the registered chemistry logbook. If the sample is diluted, enter a small capital "D" next to the alkalinity value.

4. Determine the hardness as follows.

a. Hardness is a measure of divalent cations (primarily Ca^{2+} and Mg^{2+}) per unit volume of water. Hardness, like alkalinity, is expressed in terms of the amount of $CaCO_3$ (mg/L) that it would take to yield a particular value. Determine a water sample's hardness by titrating a 50-mL volume of the sample with hardness titrating solution (1 mL of which is equivalent to 1 mg of hardness) to a colorimetric endpoint. Use eriochrome Black T, which changes color when complexed with Ca^{2+} and Mg^{2+}, to determine when all hardness ions have been complexed by the titrant. Stir the sample with a stir bar and magnetic stir plate during titration.

b. Submerge the pH probe (calibrated per task instructions) into the 50-mL sample. Fill a 25-mL burette (graded into 0.1-mL units and readable to the nearest 0.05 mL) with the hardness titrating solution.

c. Allow the pH reading to stabilize. Adjust the pH of the sample to 10.0 $\pm$ 0.1, adding hardness buffer one drop at a time. Add 0.05 g (a "pinch") of the indicator (0.5 g Eriochrome Black T mixed with 100 g NaCl).

d. Slowly add hardness titrating solution until the color of the sample changes from red to purple. At this point, add the hardness titrating solution one drop at a time until the color of the sample changes from purple to blue. If a full-strength sample is being analyzed, calculate the amount of hardness, expressed as milligrams of $CaCO_3$ per liter,

by multiplying the milliliters of titrant by 20 (e.g., hardness is 10.5 mL of titrant × 20 = 210 mg $CaCO_3$ per L).

e. If the amount of titrating solution needed to reach the colorimetric endpoint (blue) is greater than 15 mL, a dilution of the sample is necessary.

(1) To make a 1:1 (v:v) dilution, in a 50-mL graduated cylinder, add 25 mL of full-strength sample, and bring it to volume with deionized distilled water. Titrate as in step 4d. Calculate the amount of hardness, expressed as milligrams of $CaCO_3$, by multiplying the milliliters of titrant by 40 (e.g., 12 mL of titrant × 40 = 480).

(2) To make a 1:4 (v:v) dilution, in a 50-mL graduated cylinder, add 10 mL of full-strength sample, and bring it to volume with deionized distilled water. Titrate as in step 4d. Calculate the amount of hardness, expressed as milligrams of $CaCO_3$, by multiplying the milliliters of titrant by 100.

f. Record the amount of hardness in milligrams of $CaCO_3$ (as calculated) on the "Daily Chemistry Logsheet" in the registered chemistry logbook. Also record the number of the pH meter you are using. If the sample is diluted, place a small capital "D" next to the hardness value; use a subscript 1 or 4 to indicate a 1:1 or 1:4 dilution, respectively.

5. Determine the conductivity as follows.

a. Conductivity provides a measure of the dissolved electrolytes in water. Measure the conductivity of each water sample with the conductance meter equipped with the conductance cell and probe.

b. Fill a suitable container (e.g., 8-oz. specimen container) with a water sample.

c. Submerge the conductance cell and the temperature probe in the sample; carefully stir the sample with the probe to ensure that the electrode is exposed to a well-mixed sample.

d. Record the conductivity values onto the "Daily Chemistry Data Logsheet" in the registered chemistry logbook, after multiplying by the appropriate factor. Between samples, rinse the cell and probe with deionized distilled water.

e. Record the number of the conductance meter that you are using on the "Daily Calibration Information Logsheet" in the registered daily calibration logbook.

f. Always turn the function knob to "off" when the meter is not in use, and store the cell and probe in deionized distilled water.

6. Measure the amount of total residual chlorine (TRC) and free chlorine (FC) as follows.

   a. Measure TRC and FC amperometrically with the chlorine titrator. Use 0.00564 *N* phenylarsene oxide solution as the titrant.

   b. Always titrate samples to be analyzed for TRC or FC immediately upon their arrival at the laboratory because of the rapidity with which chlorine species are converted to chloride.

   c. Fill the sample vessel with 200 mL of water (to the white line). Measure TRC by adding 1 mL of the Wallace and Tiernan pH 4.00 acetic acid buffer and 1.0 mL of potassium iodide solution to 200 mL of the sample before titrating. Measure FC by adding 1 mL of the Wallace and Tiernan 7.00 pH buffer solution to 200 mL of sample before titrating.

   d. Adjust the range of the chlorine titrator to read approximately 80-100. Wait for the needle to stabilize. Slowly add the titrant (~0.01 mL at a time) until an addition of titrant no longer causes the needle to deflect (i.e., move downward). As titration proceeds, readjust the range upward to 80-100 if the needle falls below 10.

   e. The amount of titrant used is equal to the amount of TRC (or FC) in mg/L. Read the amount of titrant directly from the burette, and record the amount on the "Daily Chemistry Data Logsheet" in the registered chemistry logbook. Record the number of the titrator you are using on the "Daily Calibration Information Logsheet" in the registered daily calibration logbook.

7. Determine the amount of dissolved oxygen (DO) as follows.

   a. Calibrate the dissolved oxygen meter before use. Refer to the Task Instruction located in the Laboratory Operations Manual in Room 12.

   b. Measure the initial amount of dissolved oxygen (DO) in fresh water samples collected daily for use in the fathead minnow and *Ceriodaphnia* toxicity tests.

      (1) Immerse the probe in the sample and gently stir.

      (2) Allow the DO reading to stabilize and record the value, in mg/L, in the "Initial D.O." blank on the "Daily Chemistry Data Logsheet" in the registered chemistry logbook.

   c. Measure the final amount of dissolved oxygen of the water samples collected during the daily test renewal for the ambient and effluent fathead minnow tests and the *Ceriodaphnia* effluent (randomized) test.

      (1) Measure the final DO in the sample water that was collected per the procedures outlined in SOP-9 and SOP-10.

(2) Immerse the probe in the sample and gently stir.

(3) Allow the DO reading to stabilize and record the value, in mg/L, in the "Final D.O.: FHM" or "Final D.O.: CD" blank, as appropriate, on the "Daily Chemistry Data Logsheet" in the registered chemistry logbook.

Approval

All Standard Operating Procedures generated by, revised by, and/or applicable to the ESD Toxicology Laboratory must receive the signed approval of the Group Leader.

Approved by Lynn A. Kszos _____ 1/28/94
Group Leader Date

Effective Date 2/15/94

SUBJECT: PERFORMANCE OF CHEMICAL ANALYSES

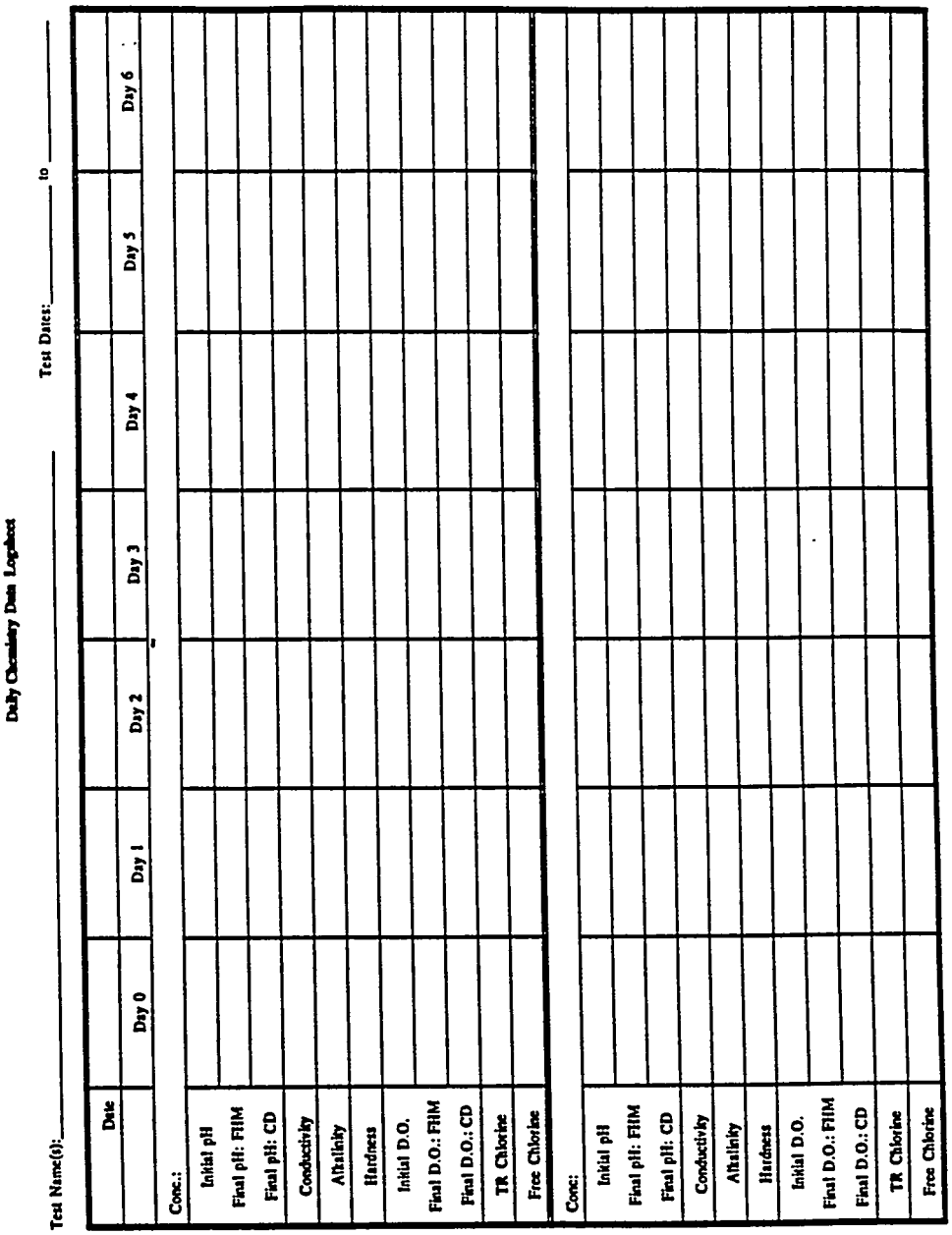


Exhibit SOP-11.1. Daily Chemistry Data Logsheet

SUBJECT: PERFORMANCE OF CHEMICAL ANALYSES

Daily Calibration Information Logsheet

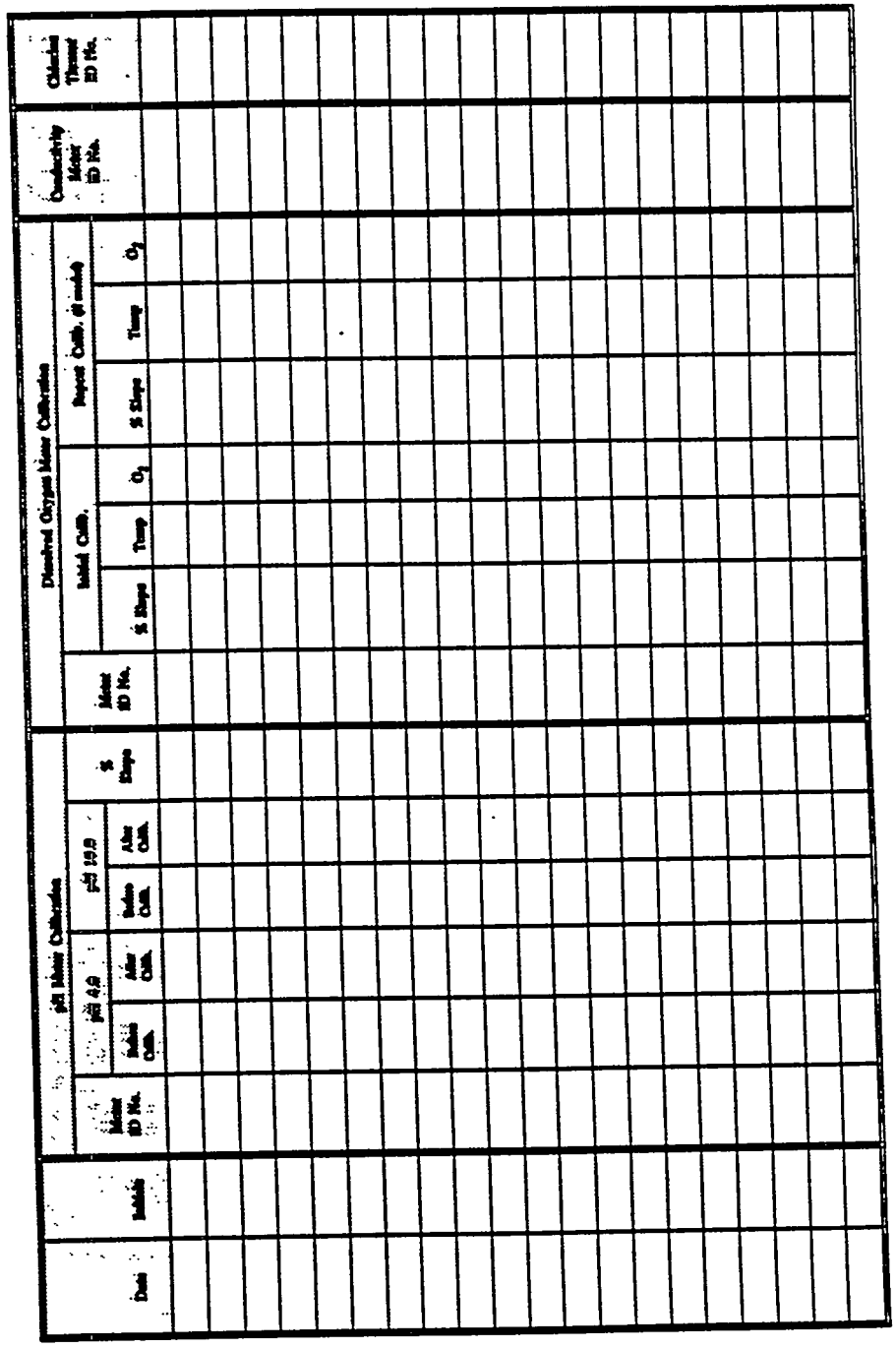


Exhibit SOP-11.2. Daily Calibration Information Logsheet

APPENDIX D

LIST OF TCL/TAL PARAMETERS

Target Compound List

Volatiles

1. Chloromethane
2. Bromomethane
3. Vinyl Chloride
4. Chloroethane
5. Methylene Chloride
6. Acetone
7. Carbon Disulfide
8. 1,1-Dichloroethene
9. 1,1-Dichloroethane
10. 1,2-Dichloroethene (total)
11. Chloroform
12. 1,2-Dichloroethane
13. 2-Butanone
14. 1,1,1-Trichloroethane
15. Carbon Tetrachloride
16. Bromodichloromethane
17. 1,2-Dichloropropane
18. cis-1,e-Dichloropropene
19. Trichloroethene
20. Dibromochloromethane
21. 1,1,2-Trichloroethane
22. Benzene
23. trans-1,3-Dichloropropene
24. 4-Methyl-2-pentanone
26. 2-Hexanone
27. Tetrachloroethene
28. Toluene
29. 1,1,2,2-Tetrachloroethane
30. Chlorobenzene
31. Ethyl Benzene
32. Styrene
33. Xylenes (Total)

Semivolatiles

34. Phenol
35. bis(2-Chloroethyl) ether
36. 2-Chlorophenol
37. 1,3-Dichlorobenzene
38. 1,4-Dichlorobenzene
39. 1,2-Dichlorobenzene
40. 2-Methylphenol
41. 2,2'-oxybis (1-Chloropropane)[a]
42. 4-Methylphenol
43. N-Nitrose-di-n-propylamine
44. Hexachloroethane
45. Nitrobenzene
46. Isophorone
47. 2-Nitrophenol
48. 2,4-Dimethylphenol
49. bis(2-Chloroethoxy) methane
50. 2,4-Dichlorophenol
51. 1,2,4-Trichlorobenzene
52. Naphthalene
53. 4-Chloroaniline
54. Hexachlorobutadiene
55. 4-Chloro-3-methylphenol
56. 2-Methylnaphthalene
57. Hexachlorocyclopentadier
58. 2,4,6-Trichlorophenol
59. 2,4,5-Trichlorophenol
60. 2-Chloronaphthalene
61. 2-Nitroaniline
62. Dimethylphthalate
63. Acenaphthylene
64. 2,6-Dinitrotoluene
65. 3-Nitroaniline

66. Acenaphthene
67. 2,4-Dinitrophenol
68. 4-Nitrophenol
69. Dibenzofuran
70. 2,4-Dinitrotoluene

71. Diethylphthalate
72. 4-Chlorophenyl-phenyl ether
73. Fluorens
74. 4-Nitroaniline
75. 4,6-Dinitro-2-methylphenol

76. N-nitrosodiphenylamine
77. 4-Bromophenyl-phenylether
78. Hexachlorobenzene
79. Pentachlorophenol
80. Phenanthrene

81. Anthracene
82. Carbazole
83. Di-n-butylphthalate
84. Fluoranthene
85. Pyrene

86. Butylbenzylphthalate
87. 3,3'-Dichlorobenzidine
88. Benzo(a)anthracene
89. Chrysene
90. bis(2-Ethylhexyl)phthalate

91. Di-n-octylphthalate
92. Benzo(b)fluoranthene
93. Benzo(k)fluoranthene
94. Benzo(a)pyrene
95. Indeno(1,2,3-ed)pyrene

96. Dibenz(a,h)anthracene
97. Benzo(g,h,i)perylene

Pesticides/PCBs

98. alpha-BHC
99. Beta-BHC
100. Delta-BHC
101. gamma-BHC (Lindane)
102. Heptachlor

101. gamma-BHC (Lindane)
102. Heptachlor
103. Aldrin
104. Heptachlor epoxide
105. Endosulfan I

106. Dieldrin
107. 4,4'-DDE
108. Endrin
109. Endosulfan II
110. 4,4'-DDD

111. Endosulfan sulfate
112. 4,4'-DDT
113. Methoxychlor
114. Endrin ketone
115. Endrin Aldehyde

116. alpha-Chlordane
117. gamma-Chlordane
118. Toxaphene
119. Aroclor-1016
120. Aroclor-1221

121. Aroclor-1232
122. Aroclor-1242
123. Aroclor-1248
124. Aroclor-1254
125. Aroclor-1260

Target Analyte List

Aluminum	Magnesium
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Beryllium	Potassium
Cadmium	Selenium
Calcium	Silver
Chromium	Sodium
Cobalt	Thallium
Copper	Vanadium
Iron	Zinc
Lead	

[a]Previously known by the name bis(2-Chloroisopropyl) ether

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