DOE/OR/21949-368

COLONIE INTERIM STORAGE SITE
ENVIRONMENTAL REPORT
FOR CALENDAR YEAR 1992

1130 CENTRAL AVENUE
COLONIE, NEW YORK

MAY 1993

Prepared for

United States Department of Energy
Oak Ridge Operations Office
Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.
Oak Ridge, Tennessee

Bechtel Job No. 14501

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

EXECUTIVE SUMMARY

This report describes the environmental surveillance program at the Colonie Interim Storage Site (CISS) and provides the results for 1992. The site is located in eastern New York State, approximately 6.4 km (4.0 mi) northwest of downtown Albany, and occupies approximately 4.5 ha (11 acres). The CISS property includes a large masonry manufacturing facility, an office building, temporary trailers, a warehouse, a storage building, approximately 1.6 ha (4.0 acres) of paved surface, and approximately 1.6 ha (4.0 acres) of grassland. From 1958 to 1984, National Lead (NL) Industries used the facility to manufacture various components from depleted and enriched uranium and natural thorium. Before 1958 the facility was a brass foundry used to manufacture railroad components and brass bearing housings with babbitt metal surfaces. The bearing surfaces were degreased by immersion in an acid bath to prepare them for bonding with the brass housing.

Environmental monitoring of CISS began in 1984 when Congress added the site to the U.S. Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP). FUSRAP is a program established to identify and decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

The environmental surveillance program at CISS includes sampling networks for external gamma radiation exposure and for thorium-232 and total uranium concentrations in surface water, sediment, and groundwater. Several chemical parameters are also measured in groundwater, including total metals, volatile organics, and water quality parameters. This surveillance program assists in fulfilling the DOE policy of measuring and monitoring effluents from DOE activities and calculating hypothetical doses. Results are compared with applicable Environmental Protection Agency (EPA) and New York State Department of Environmental Conservation (NYSDEC) standards, DOE derived concentration guides (DCGs), dose limits, and other DOE requirements.

Results of 1992 monitoring indicate that, except for uranium-238 concentrations in well B39W06S, average concentrations of radionuclides of concern were not significantly different from background. Concentrations of some chemicals in groundwater were above NYSDEC Class GA standards for groundwater and EPA standards for drinking water. These results will be factored into the decision-making process for selecting a final remedy for the site.

The potential annual radiation exposure rate (excluding background) calculated for a hypothetical maximally exposed individual is 0.4 mrem/yr (0.004 mSv/yr), which is less than an individual would receive while traveling in an airplane at 12,000 m (39,000 ft) for 1 h. The dose to the total population is essentially zero because the inhalation exposure pathway associated with CISS is minimal.

During 1992 there were no environmental occurrences or reportable quantity releases of contaminants as defined in DOE orders and in the Superfund Amendment and Reauthorization Act (SARA) Title III of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Site activities in 1992 included:

- Routine environmental surveillance of the site
- A soil gas survey
- Thermal treatment of containerized RCRA Part A mixed waste
- Installation of temporary trailers to support building cleanup activities
- Installation of a high-efficiency particulate air (HEPA) system for building exhaust
- Removal and packaging of asbestos-containing building materials
- Removal, packaging, and disposal of building electrical, mechanical, and nonstructural systems
- Disposal of solidified radiologically mixed electroplating waste

COMPLIANCE SUMMARY

The primary regulatory guidelines, limits, and DOE requirements for environmental monitoring originate in the following federal acts: the Clean Air Act (CAA); the Clean Water Act (CWA); the Safe Drinking Water Act (SDWA); the Resource Conservation and Recovery Act (RCRA); the Toxic Substances Control Act (TSCA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the National Environmental Policy Act (NEPA); and the National Historic Preservation Act (NHPA).

Environmental remediation of CISS is being conducted in accordance with CERCLA, the protocol for remediating low-level radioactive contamination at FUSRAP sites, and applicable DOE requirements authorized by the Atomic Energy Act. The following summaries identify applicable and relevant requirements as they existed in 1992 and the first quarter of 1993, define the status of compliance with the referenced requirements, and forecast the regulatory changes that may affect the site in the near future.

PRIMARY REGULATORY GUIDELINES

DOE Requirements for Radionuclide Releases

Site releases must comply with specific DOE requirements that establish quantitative limits, DCGs, and dose limits for radiological releases from DOE facilities. A review of environmental surveillance results for 1992 shows that CISS was in compliance with all applicable DOE radionuclide release standards, except that the uranium concentration in well B39W06S is five times greater than the DCG for uranium in water. However, there were no elevated concentrations of uranium in downgradient wells. The elevated value of uranium in well B39W06S was identified during characterization activities and will be factored into the decision-making process for selecting a final remedy for CISS.

Clean Air Act and National Emission Standards for Hazardous Air Pollutants

The primary federal statute governing air emissions is the CAA. The potential exists for point-source and fugitive emission sources of radionuclides at CISS. Point-source emissions could be emitted from the HEPA-filtered ventilation system, which was installed to facilitate remedial action activities currently being conducted throughout the building. The potential fugitive emission sources could occur from contaminated soil outside the building. The potential for releases of radionuclides from the HEPA ventilation system has been minimized to the extent possible because the system represents the best available control technology; results of HEPA filter monitoring demonstrate that the ventilation system is in compliance.

CISS is not required to have any state or federal air permits in accordance with CERCLA Section 121. Although CISS is a nonoperating DOE facility, Subparts A, H, and M of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) are applicable. NESHAPs Subpart A contains general provisions applicable to any new emission source or modification of any existing source. These provisions include requirements for an application for approval and notification of startup. These requirements, however, were not applicable to the installation of the HEPA ventilation system because it was determined that the resulting radionuclide emissions would total less than 1 percent of the standard, which is an effective dose equivalent of 10 mrem/yr (0.1 mSv/yr) All relevant calculations used to determine the resulting radionuclide emission rate were submitted to NYSDEC.

Compliance with the nonradon radionuclide standard in Subpart H of NESHAPs has been determined by evaluating the site with the Clean Air Act Assessment Package-1988 (CAP88) PC computer model (Version 1) approved by EPA. Results from the model indicate that CISS is in compliance with Subpart H.

NESHAPs Subpart M contains the National Asbestos Emission Standards. All applicable requirements of Subpart M were complied with during the asbestos removal activities conducted in several areas of the main building. The asbestos-containing materials were removed to prepare the building for decontamination and eventual demolition. These wastes are currently stored inside the building, and offsite disposal, which will be accomplished in full compliance with Subpart M, is scheduled for 1994.

Subpart Q of NESHAPs was determined not to apply to CISS. Calculations show that radium-226 concentrations in the contaminated soil outside the main building and in the soil stored inside are not sufficient to emit radon-222 in excess of the applicable standard.

Clean Water Act

Pollutants discharged to waters of the United States are regulated under the CWA through regulations promulgated and implemented by the State of New York.

On November 16, 1990, EPA issued changes in its National Pollutant Discharge Elimination System (NPDES) stormwater regulation provisions. As a result of these changes, DOE determined that a stormwater discharge permit is required for CISS. A stormwater discharge permit application was prepared and submitted before the regulatory deadline of October 1, 1992, to NYSDEC, the agency authorized by EPA to administer this program in New York State.

Safe Drinking Water Act

The SDWA was enacted by Congress in 1974 to regulate drinking water systems, require EPA to set national standards for levels of contaminants in drinking water, and provide for protection of aquifers. Under the 1986 Superfund Amendments and Reauthorization Act, drinking water standards and goals [maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) above zero] set under the SDWA became groundwater standards for CERCLA cleanups. Currently, there are no MCLs or MCLGs established for radionuclides. New York groundwater quality standards, which are applicable requirements under CERCLA, also became cleanup standards for CISS. These regulations are designed to protect ambient groundwater quality by establishing both radiological and chemical constituent standards for groundwater pollutant discharges and groundwater cleanups.

Radionuclide releases to groundwater must meet prevailing state SDWA regulations. Chemical data for groundwater monitoring have been evaluated to determine whether cleanup levels are meeting the newly enacted standards. Chemicals have been discovered in the groundwater at concentrations above applicable SDWA maximum contaminant levels; this is the subject of a special investigation to be conducted as part of the CERCLA remediation effort.

Resource Conservation and Recovery Act

RCRA is the principal federal statute governing the management of hazardous waste. Because RCRA-regulated wastes have been stored at CISS, an RCRA interim status Part A permit application was on file with NYSDEC. The application covered container storage and, in some cases, treatment of radioactively contaminated hazardous (mixed) wastes and RCRA-characteristic hazardous wastes that resulted from past NL Industries operations. However, on November 8, 1992, NYSDEC terminated RCRA interim status for all facilities. As a result, CISS is no longer subject to the requirements associated with this Part A permit application.

Before interim status was terminated, closure of CISS under RCRA had been initiated. On September 24, 1991, DOE submitted an official notice of site closure under RCRA to NYSDEC, and the site closure plan was given tentative approval by NYSDEC on November 5, 1992. Final approval, following a mandatory 30-day public comment period, was granted on January 5, 1993.

DOE is obligated to meet the requirements in the final CISS RCRA closure plan in accordance with applicable site closure regulations. These requirements include the removal of RCRA-regulated wastes that were previously listed on the interim status Part A permit application, the treatment of waste as necessary to meet applicable land disposal restriction (LDR) requirements, and the cleanup of storage and treatment areas associated with the RCRA waste listed on the Part A permit application. Completion of final RCRA closure activities at CISS is expected in fall 1993.

Approximately 55 gal of PCB mixed waste oil remains onsite pending approval to transport it to a DOE-designated facility for storage and ultimate disposal. Of the 55 gal, approximately 5 gal was generated in 1992 as a result of draining the oil reservoirs of radioactively contaminated equipment located onsite.

In 1992 the PCB mixed waste oil was packaged to meet the requirements for shipment to the DOE-Hanford facility. However, shipments of PCB wastes to Hanford have since been canceled pending the resolution of liability issues by DOE Headquarters; it is not known when these issues will be resolved. Currently, there are no other permitted storage or disposal facilities available to receive the CISS PCB mixed waste oil.

Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA, as amended by SARA, and the National Oil and Hazardous Substances Pollution Contingency Plan are the primary sources of statutory authority for response actions to be conducted at CISS. The site was assessed under the hazard ranking system by EPA in 1991 and did not meet the criteria for listing on the National Priorities List. However, CISS is listed on NYSDEC's Registry of Inactive Hazardous Waste Sites. Remediation of CISS and adjacent vicinity properties will be conducted as a CERCLA removal action. CERCLA documentation for this removal action will be an engineering evaluation/cost analysis (EE/CA) and will be based on the studies already conducted. The final draft is scheduled to be issued in the fourth quarter of 1994.

An EE/CA is also being prepared to evaluate alternatives for management and disposition of the former NL Industries building located at CISS. The EE/CA is scheduled to be issued in the fourth quarter of 1993.

No reports under SARA Title III, Section 313, were required. FUSRAP sites were not subject to toxic chemical release reporting provisions under 40 CFR 372.22 in 1992. However, FUSRAP evaluates and inventories any toxic chemicals used onsite.

Four RCRA closure activities were conducted in 1992. First, 191 drums of solidified, mixed, electroplating waste that met National Capacity Variance requirements were disposed of at a DOE-approved, permitted disposal facility before the May 8, 1992, expiration of the National Capacity Variance for mixed waste. Second, treatment of an additional 24 drums of mixed waste was initiated; completion is expected in the second quarter of 1993. This treatment is designed to remove elevated levels of halogenated organic carbons to meet LDR requirements. Before the interim status Part A permit application was terminated, it was revised to reflect these waste disposal and treatment activities. Third, mixed waste oils stored in 61 drums were screened to remove solid particles to prepare the oils for incineration. Finally, 55 gal of mixed waste oil contaminated with polychlorinated biphenyls (PCBs) was packaged for transport offsite. PCBs are regulated as RCRA hazardous waste and TSCA waste in New York State (refer to TSCA section below for further discussions of this packaging effort).

In August 1992 NYSDEC, as part of its annual RCRA audit, found minor deficiencies during inspections of the container storage areas and the documents in the RCRA operating log. The NYSDEC final audit report has not yet been issued; however, all the deficiencies identified during the audit exit meeting have been resolved. Although not identified during the audit as a deficiency, mixed wastes subject to the LDR requirements have been stored at CISS in violation of the one-year storage requirement. Even though this violation has been designated a low enforcement priority by EPA, continuous efforts are being made to identify a licensed disposal facility that will accept these wastes.

Toxic Substances Control Act

The most common toxic substances regulated by TSCA are PCBs and asbestos. As noted earlier, asbestos-containing materials were removed from several areas in the main building at CISS in 1992. TSCA, however, did not apply to this asbestos removal activity.

National Environmental Policy Act

It is DOE policy to incorporate the values of NEPA into CERCLA removal/remediation projects. The procedural and documentation requirements of the NEPA environmental assessment (EA) will be incorporated into the CERCLA EE/CA for CISS and the vicinity properties.

Compliance with NEPA for activities in support of waste removal and decontamination of the former NL Industries building was accomplished through documentation (approved by DOE in 1992) that justifies a categorical exclusion for the action. A categorical exclusion is a category of actions, defined by 40 CFR 1508, that would not normally require an EA or environmental impact statement.

National Historic Preservation Act

NHPA is the primary source of statutory authority related to the preservation of cultural and historical resources.

FUSRAP is committed to managing cultural resources that may be affected by environmental restoration activities. The FUSRAP cultural resource management program ensures that the early stages of project planning provide for a thorough consideration of the potential effects of environmental restoration activities on any cultural resources that may be located on FUSRAP sites. Consultation with state historical preservation officers, Native American groups, and local historians is ongoing to identify cultural resources that may be eligible for nomination to the National Register of Historic Places in accordance with requirements of Section 106 of NHPA.

To date, the FUSRAP cultural resource management program has not identified any historic properties, such as districts, sites, buildings, and structures, at any of the FUSRAP sites that are currently undergoing environmental restoration.

In August 1992, a cultural resource assessment was prepared and submitted to the New York State Division for Historical Preservation. The assessment provided background information on the main building at CISS to assist in determining compliance with the requirements of NHPA for decontamination and eventual demolition of the building.

Other Major Environmental Statutes and Executive Orders

In addition to DOE requirements and the environmental statutes discussed previously, several other major federal and state environmental statutes are applicable at CISS. For example, the Federal Insecticide, Fungicide, and Rodenticide Act and the Endangered Species Act have been reviewed for applicability. Executive Orders 11988 ("Floodplain Management") and 11990 ("Protection of Wetlands") and state laws and regulations have also been reviewed for applicability. CISS is in compliance with all other applicable environmental statutes, regulations, and executive orders not discussed in previous sections. These statutes, regulations, and executive orders are reviewed regularly to maintain continual regulatory compliance at CISS.

APPLICABLE ENVIRONMENTAL PERMITS

In March 1992 a permit was received from the Town of Colonie to connect the temporary trailers located onsite to the town's sanitary sewer system.

A stormwater discharge permit application was submitted pursuant to NPDES regulations before the regulatory deadline of October 1, 1992.

On November 8, 1992, NYSDEC terminated RCRA interim status. As a result, the requirements associated with the interim status Part A permit application are no longer applicable to CISS. However, CISS remains subject to the requirements set forth in the final RCRA closure plan and all applicable NYSDEC RCRA facility closure regulations.

SUMMARY OF REGULATORY COMPLIANCE IN CALENDAR YEAR 1993 (FIRST QUARTER)

Compliance issues currently being addressed include chemicals in excess of SDWA standards and/or NYSDEC groundwater quality guidelines, minor RCRA deficiencies, and elevated uranium concentrations in one well. Self-assessment activities are conducted to identify areas of noncompliance or circumstances that fail to meet best management practices.

During the first quarter of 1993, NYSDEC was notified of the presence of elevated concentrations of chemical contaminants in the groundwater. The notification indicated that actions are being implemented to determine the extent of the contamination and that the need for further action would be evaluated based on the results of this determination.

Also during the first quarter of 1993, compliance with NEPA for activities in support of removal of the former NL Industries building was accomplished through documentation that justifies a categorical exclusion for the action.

Final approval of the RCRA site closure plan was granted by NYSDEC on January 5, 1993. During the mandatory 30-day public comment period concerning the closure plan, no comments were submitted to NYSDEC.

Activities associated with meeting the requirements of the final closure plan were conducted during the first quarter of 1993. These activities included continued treatment of mixed waste listed on the now-terminated interim status Part A permit application in an effort to meet applicable LDR requirements. Also, cleanup began on designated RCRA storage areas at the facility where hazardous and mixed wastes listed on the Part A permit application were stored. Environmental surveillance continued, as did review of potentially applicable regulations for their impact on the site.

CONTENTS

Page

EXECUTIVE SUMMARY iii

COMPLIANCE SUMMARY v

FIGURES xvii

TABLES xix

ACRONYMS xxi

UNITS OF MEASURE xxiv

1.0 INTRODUCTION 1
    1.1 SITE DESCRIPTION 1
    1.2 REGIONAL DEMOGRAPHY 2
    1.3 HYDROLOGIC SETTING 3
        1.3.1 Geology 3
        1.3.2 Surface Water 4
        1.3.3 Groundwater 4
    1.4 CLIMATE 5

2.0 ENVIRONMENTAL PROGRAM INFORMATION 13
    2.1 PERMIT ACTIVITIES 13
    2.2 EMISSIONS MONITORING 13
    2.3 ENVIRONMENTAL DOCUMENTATION 13
    2.4 SIGNIFICANT ENVIRONMENTAL ACTIVITIES 14
        2.4.1 Special Studies 14
        2.4.2 Environmental Monitoring Changes 16
        2.4.3 Response Actions 17
    2.5 ENVIRONMENTAL AWARENESS ACTIVITIES 17
    2.6 TRAINING 18
    2.7 SELF-ASSESSMENTS 18

3.0 MONITORING NETWORKS AND RESULTS 33
    3.1 AIR AND EXPOSURE MONITORING 34
        3.1.1 Radon/Thoron Monitoring 34
        3.1.2 HEPA Exhaust Monitoring 35
        3.1.3 External Gamma Radiation 35
    3.2 SURFACE WATER AND SEDIMENT MONITORING 37
        3.2.1 Monitoring Network 37
        3.2.2 Surface Water Results 37
        3.2.3 Sediment Results 38
    3.3 GROUNDWATER MONITORING 38
        3.3.1 Well Network 38
        3.3.2 Results 40

CONTENTS

(continued)

Page

4.0 ESTIMATED DOSE 72
  4.1 HYPOTHETICAL MAXIMALLY EXPOSED INDIVIDUAL 72
    4.1.1 Direct Gamma Radiation Pathway 72
    4.1.2 Drinking Water Pathway 73
    4.1.3 Air Pathway 73
    4.1.4 Total Dose 74
  4.2 GENERAL POPULATION 74
    4.2.1 Direct Gamma Radiation Pathway 74
    4.2.2 Drinking Water Pathway 74
    4.2.3 Air Pathway 75
    4.2.4 Total Population Dose 75

5.0 QUALITY ASSURANCE 80
  5.1 INTRODUCTION 80
  5.2 PROCEDURES 80
  5.3 QUALITY ASSURANCE SUMMARY 81
    5.3.1 Data Usability 81
    5.3.2 Precision 82
    5.3.3 Accuracy 83
    5.3.4 Representativeness 83
    5.3.5 Comparability 84
    5.3.6 Completeness 84
    5.3.7 Interlaboratory Programs 85

REFERENCES R-1

APPENDIX A Hydrogeologic Details A-4

APPENDIX B Soil Gas Results for Volatile Organic Compounds at CISS, 1992 . . . . . B-1

APPENDIX C Radiation in the Environment C-1

APPENDIX D Parameters for Analysis D-1

APPENDIX E Methodology for Statistical Analysis of Data E-1

APPENDIX F Population Exposure Methodology F-1

APPENDIX G Environmental Standards G-1

APPENDIX H Distribution List for Colonie Interim Storage Site Environmental Report for Calendar Year 1992 . . . . . H-1

FIGURES

Figure	Title	Page
1-1	Location of CISS	9
1-2	Existing Structures and Interim Storage Area at CISS	10
1-3	Aerial View of CISS	11
1-4	Generalized Land Use in the Vicinity of CISS	12
2-1	Sediment and Surface Water Sampling Locations	21
2-2	Soil Gas and Groundwater Sampling Locations at CISS	22
2-3	Contour Map for Tetrachloroethene (PCE) Based on Soil Gas Survey at CISS	23
2-4	Contour Map for Trichloroethene (TCE) Based on Soil Gas Survey at CISS	24
2-5	Contour Map for Vinyl Chloride Based on Soil Gas Survey at CISS	25
3-1	Onsite and Boundary External Gamma Radiation Monitoring Locations at CISS	47
3-2	Background External Gamma Radiation and Surface Water Monitoring Locations at CISS	48
3-3	Surface Water and Sediment Sampling Locations in the Vicinity of CISS	49
3-4	Upper Groundwater System Wells Used for Radiological and Chemical Sampling	50
3-5	Lower Groundwater System Wells Used for Radiological and Chemical Sampling	51
A-1	Geologic Cross Section A-A′	A-7
A-2	Location Map Showing Cross Section A-A′	A-8
A-3	Wells Used for Water Level Measurements	A-9
A-4	Hydrograph for Wells B39W02M and B39W02S (1992)	A-10

FIGURES

(continued)

Figure	Title	Page
A-5	Hydrograph for Wells B39W02M and B39W02S (1989-1992)	A-11
A-6	Hydrograph for Wells B39W10M and B39W10S (1992)	A-12
A-7	Hydrograph for Wells B39W10M and B39W10S (1989-1992)	A-13
A-8	Upper Groundwater System Wells (6/4/92)	A-14
A-9	Upper Groundwater System Wells (9/24/92)	A-15
A-10	Lower Groundwater System Wells (6/4/92)	A-16
A-11	Lower Groundwater System Wells (10/10/92)	A-17

TABLES

Table	Title	Page
2-1	Field Study Results for Radionuclides in Sediments	29
2-2	Field Study Results for Radionuclides in Surface Water	30
2-3	Field Study Results for Metals in Sediments	31
2-4	Field Study Results for Metals in Surface Water	32
3-1	Trend Analysis for External Gamma Radiation Exposure Rates at CISS, 1987-1992	55
3-2	External Gamma Radiation Exposure Rates for Comparison	57
3-3	Trend Analysis for Total Uranium and Thorium-232 Concentrations in Surface Water in the Vicinity of CISS, 1987-1992	58
3-4	Trend Analysis for Total Uranium and Thorium-232 Concentrations in Sediment in the Vicinity of CISS, 1987-1992	60
3-5	Concentrations of Total Uranium, Radium-226, and Thorium-232 in Groundwater at CISS, 1992	61
3-6	Trend Analysis for Total Uranium and Thorium-232 Concentrations in Groundwater at CISS, 1987-1992	63
3-7	Concentrations of Chemicals at CISS that Exceeded the Detection Limits, 1992	65
3-8	EPA and NYSDEC Guidelines as Action Levels for Water Media	70
4-1	Summary of Calculated Doses for CISS, 1992	79
5-1	Results for Laboratory Duplicates	89
5-2	Results for Field Duplicates	89
5-3	Results for Laboratory Radiochemical Duplicates	90
5-4	Results for Chemical Spike Recoveries	90
5-5	Results for Radiological Spike Recoveries	91

TABLES

(continued)

Table	Title	Page
5-6	Results for Laboratory Blanks	91
5-7	Usability Rate for Each Analyte	92
5-8	Radiochemistry Laboratory Performance on DOE Quality Assessment Program Samples in 1992	94
5-9	Radiochemistry Laboratory Performance on EPA Intercomparison Program Samples in 1992	95
A-1	Colonie Interim Storage Site Radionuclide Results 1992	A-21
A-2	Colonie Interim Storage Site Chemical Results - Inorganics 1992	A-22
A-3	Key to Parameter Abbreviations	A-23
A-4	Colonie Interim Storage Site Chemical Results - Metals 1992	A-24
A-5	Colonie Interim Storage Site Chemical Results - Volatiles 1992	A-25
A-6	Colonie Interim Storage Site Field Parameters 1992	A-30
B-1	Soil Gas Results for Volatile Organic Compounds at CISS, 1992	B-1
B-2	Groundwater Sample Results for Volatile Organic Compounds at CISS, 1992	B-22
D-1	Parameters for Analysis at CISS, 1992	D-1
D-2	Detection Limits for Organic Chemical Analyses of Groundwater at CISS	D-2
D-3	Detection Limits for Metals Analyses of Groundwater at CISS	D-3
F-1	Radionuclides of Interest	F-9
F-2	Air Particulate Samples Report for CISS, 1992	F-10

ACRONYMS

AEC	Atomic Energy Commission
BNI	Bechtel National, Inc.
CAA	Clean Air Act
CAP88	Clean Air Act Assessment Package - 1988
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CISS	Colonie Interim Storage Site
CWA	Clean Water Act
DCE	dichloroethene
DCG	derived concentration guide
DOE	Department of Energy
DQO	data quality objective
EA	environmental assessment
EE/CA	engineering evaluation/cost analysis
EPA	Environmental Protection Agency
FUSRAP	Formerly Utilized Sites Remedial Action Program
HEPA	high-efficiency particulate air
LDR	land disposal restriction
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MS	matrix spike
MSD	matrix spike duplicate

ACRONYMS

(continued)

NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historical Preservation Act
NL	National Lead
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NYSDEC	New York State Department of Environmental Conservation
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RPD	relative percent difference
SARA	Superfund Amendment and Reauthorization Act
SDWA	Safe Drinking Water Act
TCA	trichloroethane
TCE	trichloroethene
TETLD	tissue-equivalent thermoluminescent dosimeter
TOC	total organic carbon

ACRONYMS

(continued)

TOX	total organic halides
TPQ	threshold planning quantity
TSCA	Toxic Substances Control Act
VOC	volatile organic compound
WMPPAP	Waste Minimization and Pollution Prevention Awareness Plan

UNITS OF MEASURE

Bq	becquerel
C	Celsius
cm	centimeter
cpm	counts per minute
F	Fahrenheit
ft	foot
g	gram
gal	gallon
h	hour
ha	hectare
in.	inch
kg	kilogram
km	kilometer
L	liter
m	meter
μCi	microcurie
μg	microgram
mg	milligram
mi	mile
min	minute
ml	milliliter
mm	millimeter
mph	miles per hour
mR	milliroentgen
mrem	millirem
mSv	millisievert
pCi	picocurie
ppb	parts per billion
ppm	parts per million
rem	roentgen equivalent man

UNITS OF MEASURE

(continued)

s	second
Sv	sievert
yr	year

1.0 INTRODUCTION

Environmental monitoring of the U.S. Department of Energy's (DOE) Colonie Interim Storage Site (CISS) began in 1984. This document describes the environmental surveillance program, results for 1992, and the compliance status of the site.

CISS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program established to identify and decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy.

1.1 SITE DESCRIPTION

CISS occupies approximately 4.5 ha (11 acres) in eastern New York within the Town of Colonie (Albany County), approximately 6.4 km (4.0 mi) northwest of downtown Albany (Figure 1-1).

The CISS property includes a large masonry manufacturing and office building, seven temporary trailers, a storage building, approximately 1.6 ha (4.0 acres) of paved surface, and approximately 1.6 ha (4.0 acres) of grassland (Figure 1-2). The property is fenced to restrict public access.

CISS is currently used for interim storage of waste materials contaminated with low-level radioactivity. The waste material, which was generated during removal actions at 53 vicinity properties, is stored inside the main building. The building is also used to store drums of mixed waste and hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA). Based on characterization activities and historical information, the site is contaminated above DOE guidelines for residual radioactivity. Except for one small area near the loading dock, all residual radioactivity in subsurface soil is west of the main building. The site is in an urban, industrialized setting (Figure 1-3).

The radiological history of CISS began in 1958, when the property was owned and operated by National Lead (NL) Industries, which produced uranium products under a license issued by the U.S. Atomic Energy Commission (AEC), a predecessor of DOE. Depleted and enriched uranium and natural thorium were used in operations at the facility. After the AEC license was terminated in 1968, NL Industries continued using depleted uranium metal to fabricate shielding components, counterweights, and projectiles.

When Congress passed the 1984 Energy and Water Development Appropriations Act, the property was assigned to DOE as part of a decontamination research and development project and became the responsibility of FUSRAP. In February 1984, DOE assumed ownership of the Colonie property, including land, buildings, equipment, and radioactively contaminated waste and residues. In 1985 property bordering CISS on the north and northwest (except for the active substation at the northern edge of CISS and the Town of Colonie property) was donated to DOE by Niagara Mohawk Power Corporation (Figure 1-2). The site was designated as a State Priority List site by New York State in 1989.

1.2 REGIONAL DEMOGRAPHY

Land use in the vicinity of the site is predominantly commercial/industrial and residential (Figure 1-4). The property is bordered by open land and an electrical substation to the northwest and west, various commercial properties to the north and east, and a Conrail Railroad right-of-way to the southwest and south with a residential area beyond.

The residential area nearest CISS is less than 30 m (100 ft) away; the residences are primarily single-family dwellings. According to 1990 census data, the total population of the area within an 80-km (50-mi) radius of CISS is approximately 775,000.

1.3 HYDROLOGIC SETTING

CISS is located in the Pine Bush sand plain area within the Mohawk-Hudson lowland, on relatively flat to gently rolling terrain (Dineen 1975). The area on the western side of the property is the site of the former Patroon Lake. This area now consists of an open drainage basin of an unnamed tributary, which is a dominant surface feature influencing surface water and groundwater flow.

1.3.1 Geology

CISS is underlain by approximately 60 m (200 ft) of unconsolidated Quaternary glacial lacustrine (lake) and fluvial sediments, the upper portion of which has been reworked by wind action and redeposited as dune deposits. Bedrock underlying the site is interpreted to be Snake Hills Shale at a depth in excess of 50 m (160 ft) below the surface (total depth of the deepest boring onsite).

The unconsolidated sediments that overlie the bedrock are composed of interbedded clay, silt, and sand. A thick section of lake clays in excess of 30 m (100 ft) forms the lower boundary of the near-surface aquifer system. The upper portion of the unconsolidated sediments has been divided into five lithologic units. These units (from bottom to top) are the lower sand, upper clay, upper sand, lake and dune sand, and Holocene channel fill deposits. The upper clay unit occurs discontinuously over the site area. This clay causes semiconfining groundwater conditions to exist in the lower sand unit. The upper sand and the lake and dune sand form a single surficial sedimentary unit that has high hydraulic conductivity characteristics because of a decrease in clay content upward to the surface.

This sedimentary sequence was subsequently eroded by a small stream that developed after the retreat of the glaciers from the area. The stream cut downward through the sedimentary section and breached the upper clay unit. This stream channel was subsequently filled with natural and man-made debris.

1.3.2 Surface Water

Surface water at CISS was significantly altered by the filling of Patroon Lake. The only surface evidence of this feature that can be seen today is a topographic low area in the western portion of the former lake. This low area is drained through a weir into a 1.2-m- (4-ft-) diameter underground culvert that traverses the western corner of CISS and exits south of the site. The unnamed stream flowing through the former lake area derives most of its flow from groundwater. Waters from this stream discharge into Patroon Creek 0.40 km (0.25 mi) south of the site.

1.3.3 Groundwater

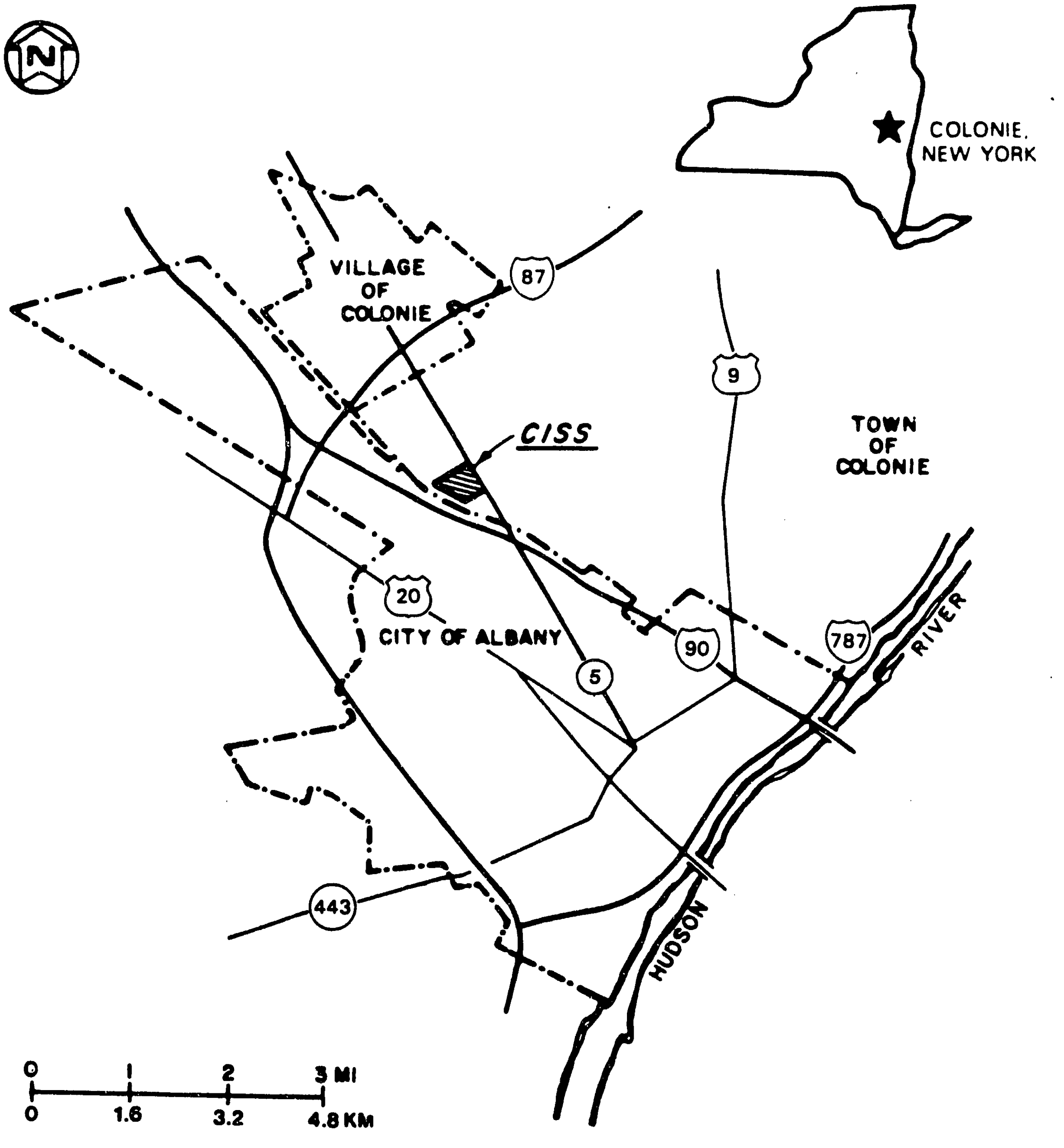
Groundwater occurs in near-surface unconsolidated sediments consisting of horizontal interbedded layers of sand, silt, and clay that were deposited in lake and dune environments. These sediments are underlain by a thick section of sediments deposited in glacial Lake Albany during the Pleistocene period. The surficial unconsolidated sediments at the site are a portion of the Pine Bush sand aquifer. Subsurface data from the site indicate that this aquifer is divided into two units in the local area. The upper unit is composed of lake and dune sands. The lower unit consists of lake sands and silt. These two units are separated by a discontinuous lake clay and silt deposit with variable thickness that has been removed by erosional scour in some areas. A Holocene-age channel downcuts through the sedimentary section and facilitates the interconnection between the upper and lower units.

Hydraulic conductivities for the upper sand unit average approximately 2.0×10^{-3} cm/s (5.8 ft/day). Numerical modelling indicates that the channel fill deposits have similar hydraulic conductivities. The groundwater flow gradient in the upper zone is approximately 0.02 with computed flow velocities of 0.03 m/day (0.1 ft/day). The channel fill deposits have a considerably higher flow velocity, computed to be 2.1 m/day (6.8 ft/day). The upper sand unit and the channel fill materials represent preferential flow pathways in the aquifer system. Hydrographs are presented in Appendix A.

1.4 CLIMATE

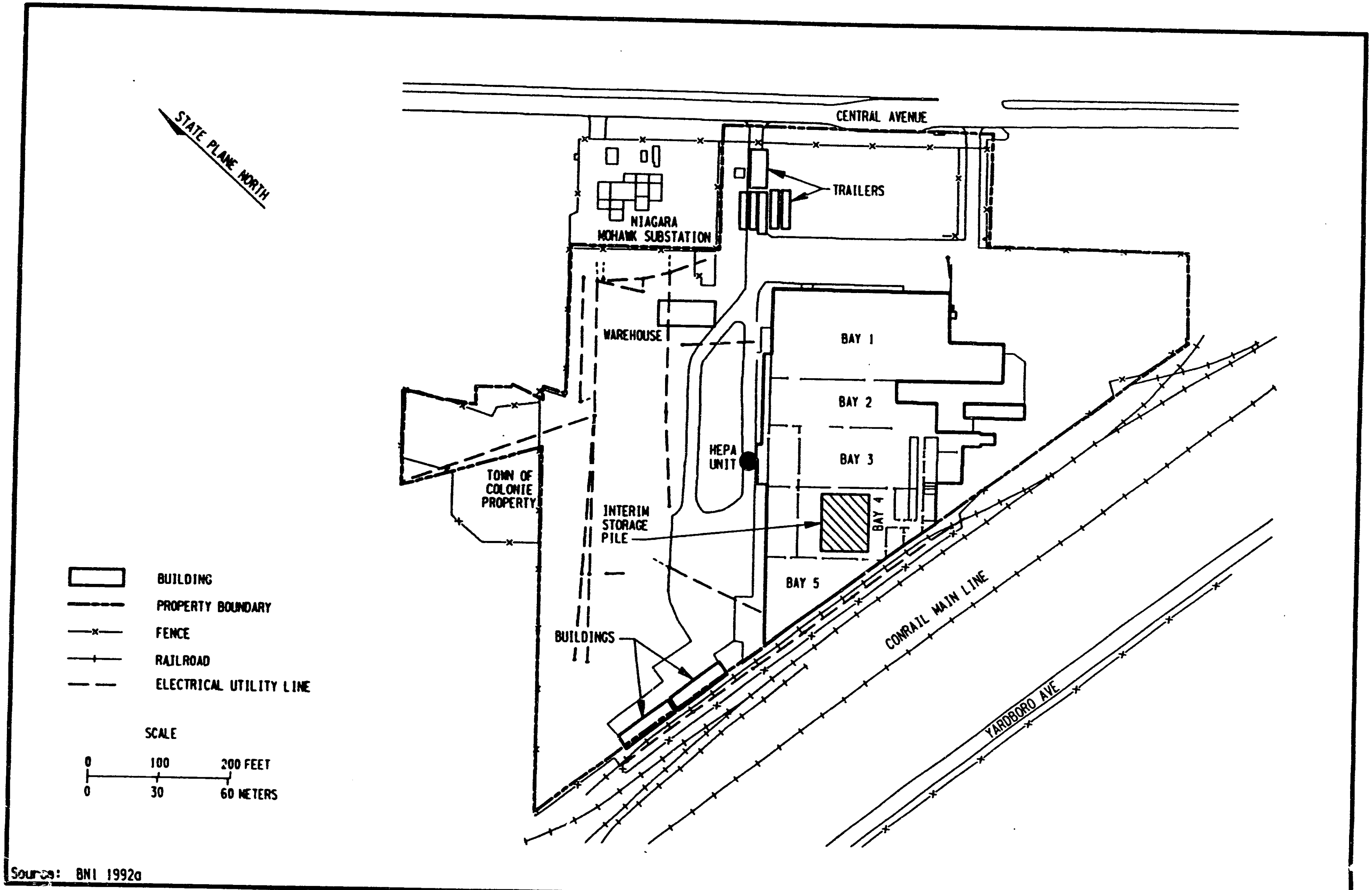
The climatological data from the National Oceanic and Atmospheric Administration (NOAA) for the Albany vicinity for 1992 show that monthly precipitation ranged from 3.3 to 11 cm (1.3 to 4.3 in.), and temperature extremes ranged from -19 to 32°C (-3 to 90°F). Average wind speed ranged from 12 to 16 km/h (7.5 to 10 mph), and the predominant resultant wind direction was from the west (NOAA 1993).

FIGURES FOR SECTION 1.0



Squrce: BNI 1992a.

Figure 1-1
Location of CISS



Source: BNI 1992a

R37 R37F005.DGN

Figure 1-2
Existing Structures and Interim Storage Area at CISS

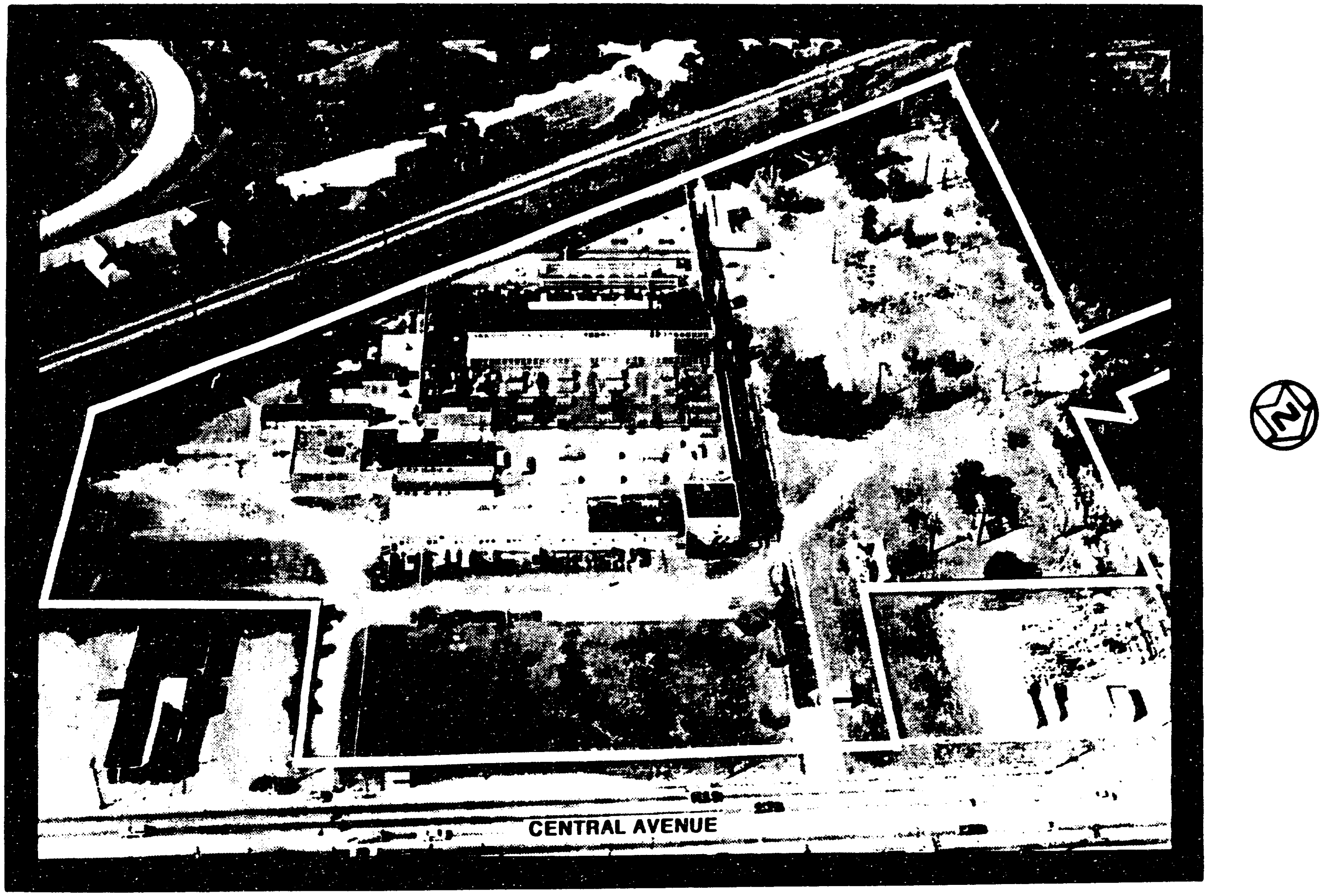
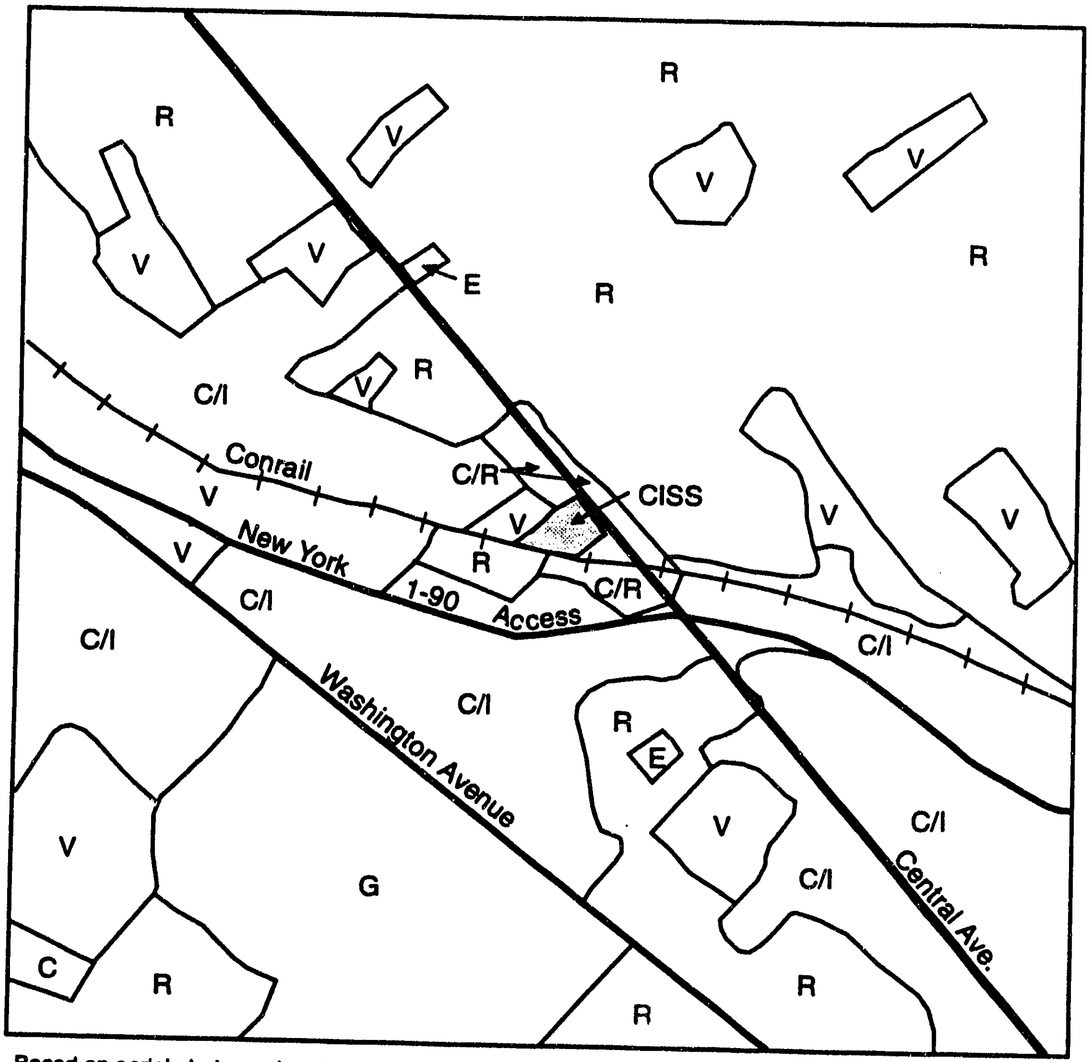


Figure 1-3
Aerial View of CISS



Based on aerial photographs, site visits, and USGS topographic map 1:24000 scale, Albany, NY quadrangle (Photo revised 1982)

C	Commercial	G	Government
C/I	Mixed Commercial and Industrial	R	Residential
C/R	Mixed Commercial and Residential	V	Vacant
E	Educational		

0 0.5 Mile
0 0.5 Kilometer

N

Source: BNI 1992a.

Figure 1-4
Generalized Land Use in the Vicinity of CISS

2.0 ENVIRONMENTAL PROGRAM INFORMATION

2.1 PERMIT ACTIVITIES

An interim status RCRA Part A permit application previously filed was terminated on November 8, 1992. CISS continues to be subject to the final closure plan requirements.

A permit was received from the Town of Colonie to connect the temporary trailers onsite to the town's sanitary sewer system.

A permit application for stormwater discharge was submitted to the New York State Department of Environmental Conservation (NYSDEC) on September 30, 1992. A decision by NYSDEC on the permit is pending.

2.2 EMISSIONS MONITORING

In addition to routine emissions monitoring discussed in Section 3.0, FUSRAP sites monitor unplanned contaminant releases. There were no environmental occurrences or unplanned contaminant releases during 1992. No reports under the Superfund Amendment and Reauthorization Act (SARA) (the Emergency Preparedness and Community Right-to-Know Act) Section 313 were required. FUSRAP sites were not subject to toxic chemical release reporting provisions under 40 CFR 372.22 in 1992. However, FUSRAP evaluates and inventories toxic chemicals used onsite, such as nitric acid, which is used in small quantities for sampling and other purposes.

2.3 ENVIRONMENTAL DOCUMENTATION

NEPA categorical exclusions were obtained for routine site maintenance, environmental monitoring, site characterization, removal and disposal of radioactively contaminated personal protective equipment, mixed waste and hazardous waste removal, and activities in support of waste removal and building decontamination.

2.4 SIGNIFICANT ENVIRONMENTAL ACTIVITIES

The site is being characterized to determine the nature and extent of contamination, as required by the Comprehensive Environmental Response, Compensation, and Liability Act, as amended by SARA.

2.4.1 Special Studies

Offsite Sampling

A field investigation was conducted June 16 through June 30, 1992, to characterize offsite, floodplain, surface water, and sediment locations to determine the possible influence of past operations at CISS. Two of the eight locations (sampling locations 6 and 8) were selected as background stations (see Figure 2-1). Results of radiological scans taken with a Geiger-Muller probe showed that levels of radioactivity in sediments at location 7 at depths of 0 to 0.46 m (1.5 ft) were 75 to 100 cpm, approximately double the background level; levels at depths of 0.46 to 0.76 m (1.5 to 2.5 ft) were higher (100 to 200 cpm). Background levels ranged from 25 to 55 cpm. Sediment samples were collected at sampling points where the radiological scans had the highest readings; results are provided in Table 2-1. The uranium-238 concentration (99.8 pCi/g) at location 7 exceeded the site-specific guideline of 35 pCi/g (DHOPH 1984). However, the concentration of uranium-238 at downgradient location 1 did not differ significantly from background.

Surface water results are listed in Table 2-2. Levels of radionuclides in surface water at all locations were well below the applicable derived concentration guides (DCGs). Samples for metal analyses were also collected from locations 5 and 8; results are given in Tables 2-3 and 2-4. All surface water results were below Environmental Protection Agency (EPA) and NYSDEC guidelines. There are no EPA or NYSDEC guidelines for metals in soils.

Soil Gas Survey

In response to past observations of volatile organic compounds (VOCs) in groundwater, a soil gas survey was conducted from August 11 to September 3, 1992, to help determine the sources and migration paths of the VOCs vinyl chloride, 1,2-dichloroethene (DCE), trichloroethene (TCE), and tetrachloroethene (PCE) found in routine groundwater samples from the southwestern and eastern areas of the site. These VOCs (halogenated volatiles) possibly originated from degreasers and cleansers used by the previous site owner. In media such as sand or soil, these VOCs readily pass from the liquid stage to the gaseous stage partly because of the greater surface area.

Soil gas samples were taken from each grid point (Figure 2-2) and analyzed onsite using a portable gas chromatograph. Ten percent of the samples were also analyzed in an offsite laboratory for correlation. On the basis of the analytical results of the soil gas samples, seven groundwater samples at depths of 1 to 2.4 m (3 to 8.0 ft) were also collected using the soil gas probe (Figure 2-2). Contour maps for the contaminants of concern are provided in Figures 2-3, 2-4, and 2-5.

The soil gas survey revealed elevated concentrations of PCE (Figure 2-3) and TCE (Figure 2-4) in the central portion of the parking area on the western side; lower concentrations were found on the eastern portion near the railroad. Vinyl chloride (Figure 2-5) was detected at one location only (G13). Concentrations of 1,2-DCE (total) were at or below the detection limits. Soil gas survey results are listed in Appendix B.

Based on the soil gas survey results, seven groundwater samples were collected at depths of 1 to 2.4 m (3 to 8.0 ft). Concentrations of TCE and PCE exceeded the EPA guideline of 5 μg/L at locations E16, G16a, and N13 and the guideline of 70 μg/L for 1,2-DCE (total) at location N13.

The preliminary screening identified two areas of contamination: the parking area on the western side, and the eastern area near the railroad. Because of the locations of the contamination, additional investigations are planned for south of the site. Because groundwater samples were collected at depths only to 2.4 m (8.0 ft), further investigation will be conducted to identify the areas of contamination at greater depths with a direct-push groundwater monitoring system.

2.4.2 Environmental Monitoring Changes

The environmental surveillance programs at FUSRAP sites are periodically evaluated and revised based on individual site conditions, program objectives, and data results. Revisions consist of changes in the number of sample collection points, frequency of sample collection, and parameters analyzed. This section summarizes changes in the CISS environmental surveillance program from 1991 to 1992 (BNI 1993a).

External Gamma Radiation

The number of monitoring locations was reduced from 15 to 13 in 1992; this number still provides adequate surveillance but at lower cost. In addition, stations were sampled semiannually instead of quarterly. Four dosimeters were placed at each station in January, and two of the four dosimeters were retrieved and analyzed in July to reveal changes that might have occurred at the site during the first six months of the year. The remaining two dosimeters were retrieved and analyzed during January 1993 and used for dose calculations. The dosimeters were removed in pairs to provide a duplicate measurement for each station.

Surface Water and Sediment

Based on an evaluation of past sampling results and historical data, one surface water sampling location was eliminated, and radium-226 analysis was deleted from the monitoring program. Because most of the wastes are in oxide form, they are relatively insoluble, and any soluble contaminants would have already migrated from the site during the past 30 years. Therefore, the frequency of sampling was changed from quarterly to semiannually.

Groundwater

The groundwater network consists of 22 wells from which samples have been collected and analyzed periodically from 1984 to 1991 for radiological and chemical constituents. Based on analysis of past results and to reduce costs, the scope of the monitoring program was reduced. Ten wells (B39W02S, B39W02M, B39W05S, B39W05M, B39W06S, B39W07S, B39W10S, B39W10M, B39W19S, and B39W15S) will be sampled quarterly. Fours wells (B39W08S, B39W08M, B39W14S, and B39W14M) will be sampled annually instead of quarterly. Three wells (B39W05M, B39W06S, and B38W15S) were added to the quarterly monitoring program to help define volatile contaminants onsite. Because sediments are believed to increase concentrations of metals in groundwater samples, several wells will be sampled, and filtered and unfiltered samples will be analyzed for selected metals. Because total uranium results were elevated, filtered and unfiltered samples will be collected from well B39W06S for radiological analysis. Based on past sampling results and other historical data, radium-226 analysis was eliminated from the groundwater monitoring program.

2.4.3 Response Actions

Remedial action activities included asbestos removal and packaging; thermal treatment and disposal of containerized RCRA Part A mixed waste; building cleanup; removal, packaging, and disposal of building electrical, mechanical, and nonstructural systems; and disposal of solidified, mixed waste.

2.5 ENVIRONMENTAL AWARENESS ACTIVITIES

FUSRAP is committed to minimizing the generation of waste at FUSRAP sites by giving preference to source reduction, material substitution, and recycling over treatment, control, and disposal of such wastes, where appropriate.

The development of waste minimization goals, waste generation information, and a process for continual evaluation of the program are primary elements of this philosophy.

Pollution prevention awareness is promoted and various waste minimization techniques are implemented as part of continuing employee training and awareness programs to reduce waste and meet the requirements for quality, safety, and environmental compliance. The 1992 annual report on waste generation and waste minimization progress for CISS is scheduled to be issued in 1993.

2.6 TRAINING

Site workers must complete a 40-h hazardous waste training program before beginning work and an 8-h refresher program every year thereafter to comply with Occupational Safety and Health Administration requirements in 29 CFR 1910.120. During their first three days onsite, workers also attend site-specific training sessions. Additional training includes but is not limited to fire extinguisher training, respirator training, self-contained breathing apparatus training, and weekly safety meetings.

2.7 SELF-ASSESSMENTS

A formalized self-assessment approach for all FUSRAP sites was approved on April 22, 1993, specifically addressing self-assessment activities for the program during the remainder of 1993 and 1994. During July 1992, Bechtel National, Inc. (BNI), the project management contractor for FUSRAP, conducted an RCRA/National Emission Standards for Hazardous Air Pollutants (NESHAPs) self-assessment at CISS focusing on the areas used for current and past storage of RCRA drums. Other activities included verifying the accuracy of information on hazardous waste labels, reviewing site files, and evaluating compliance with applicable regulations. Eleven observations were identified during the self-assessment; each was addressed before the annual NYSDEC RCRA audit was held on August 13, 1992.

As part of the self-assessment program, an environmental compliance assessment was conducted at CISS in September 1992 by the Oak Ridge National Laboratory. During this assessment, 15 findings were identified that apply specifically to CISS. All findings have been resolved.

FIGURES FOR SECTION 2.0

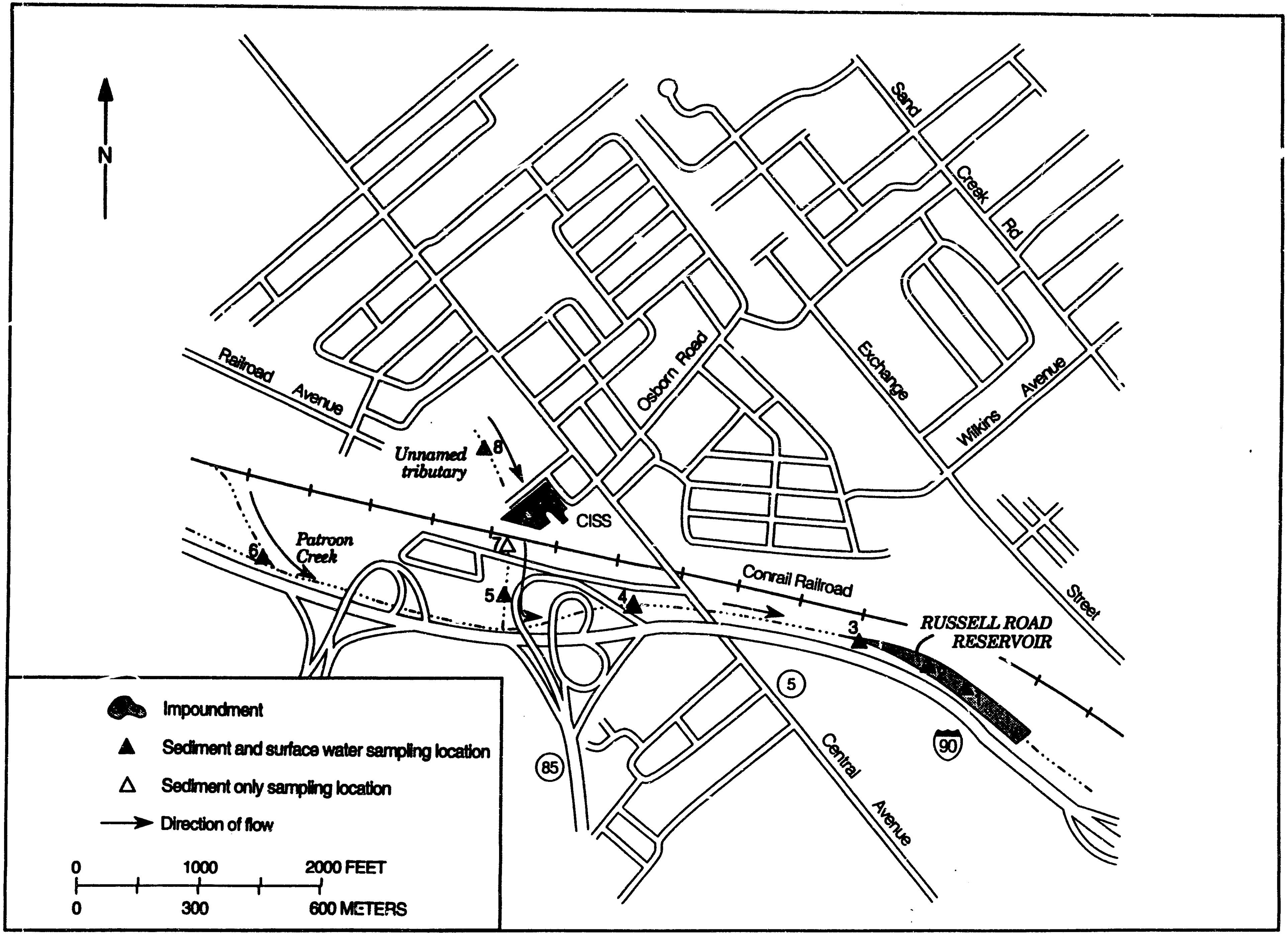
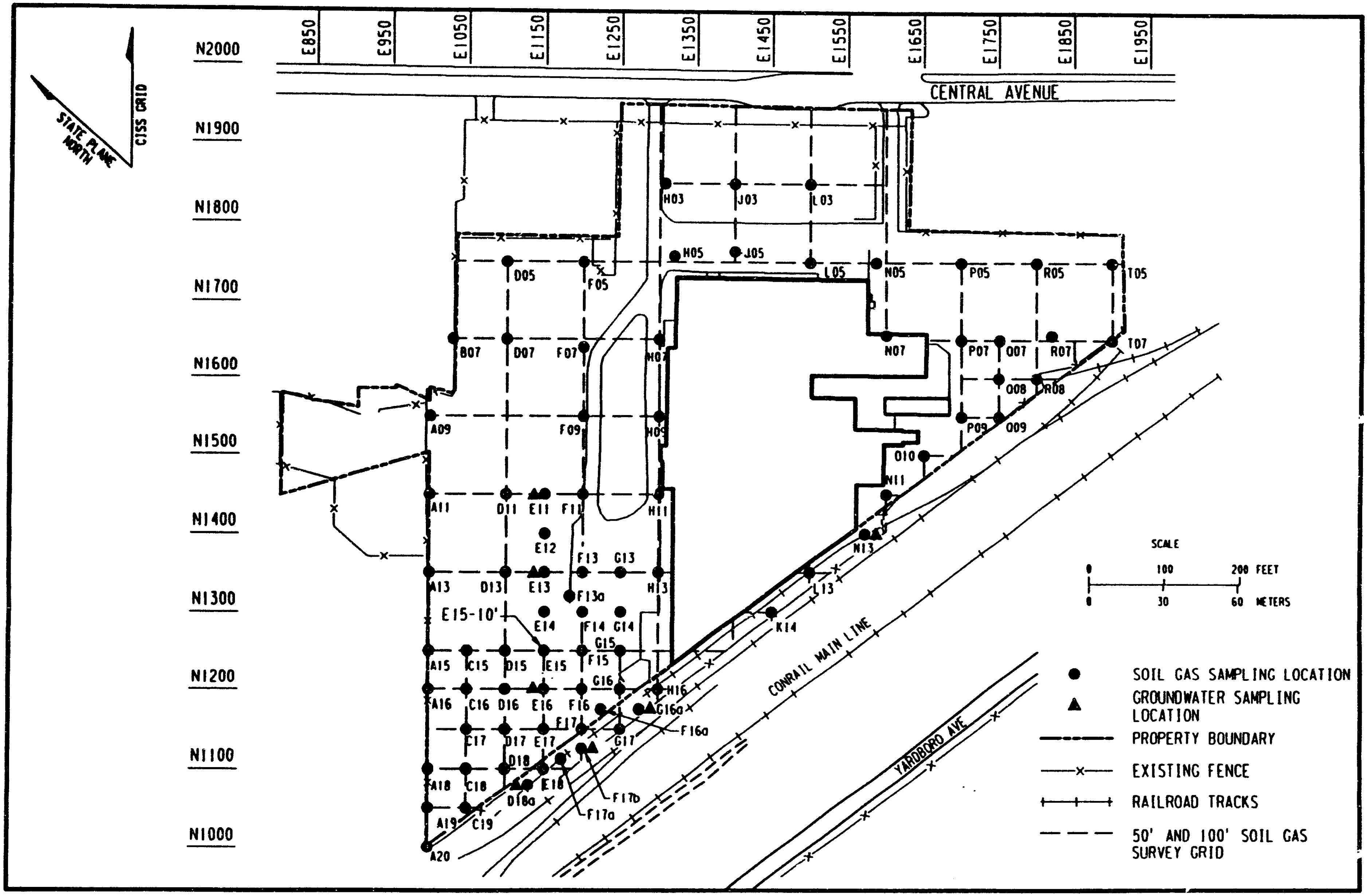


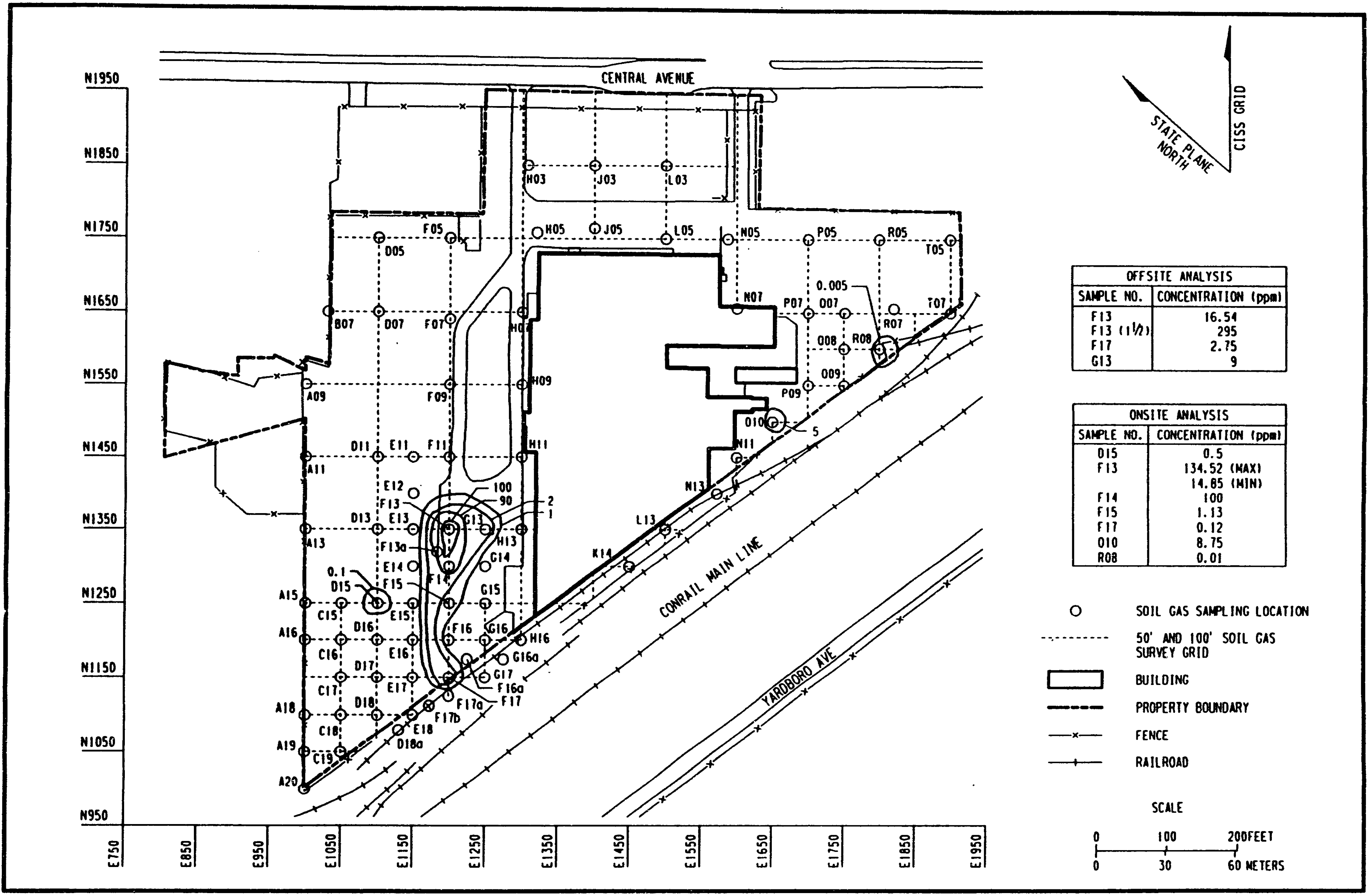
Figure 2-1
Sediment and Surface Water Sampling Locations at CISS

4.112 0831.1



R37 R37F006.DGN

Figure 2-2
Soil Gas and Groundwater Sampling Locations at CISS

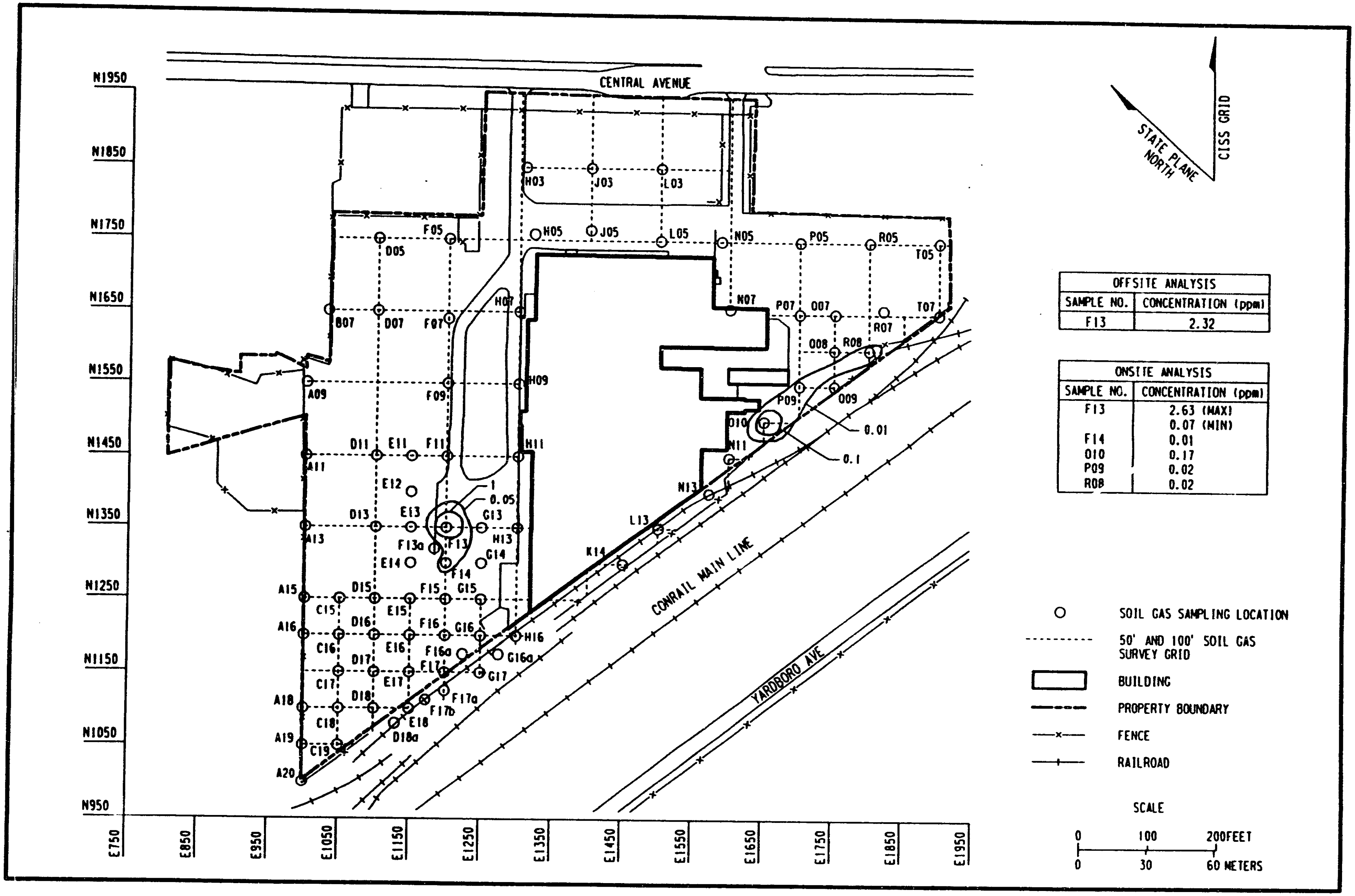


OFFSITE ANALYSIS	
SAMPLE NO.	CONCENTRATION (ppm)
F13	16.54
F13 (1½)	295
F17	2.75
G13	9

ONSITE ANALYSIS	
SAMPLE NO.	CONCENTRATION (ppm)
D15	0.5
F13	134.52 (MAX) 14.85 (MIN)
F14	100
F15	1.13
F17	0.12
010	8.75
R08	0.01

R37 R37F007.DGN

Figure 2-3
Contour map for Tetrachloroethene (PCE) Based on Soil Gas Survey at CISS

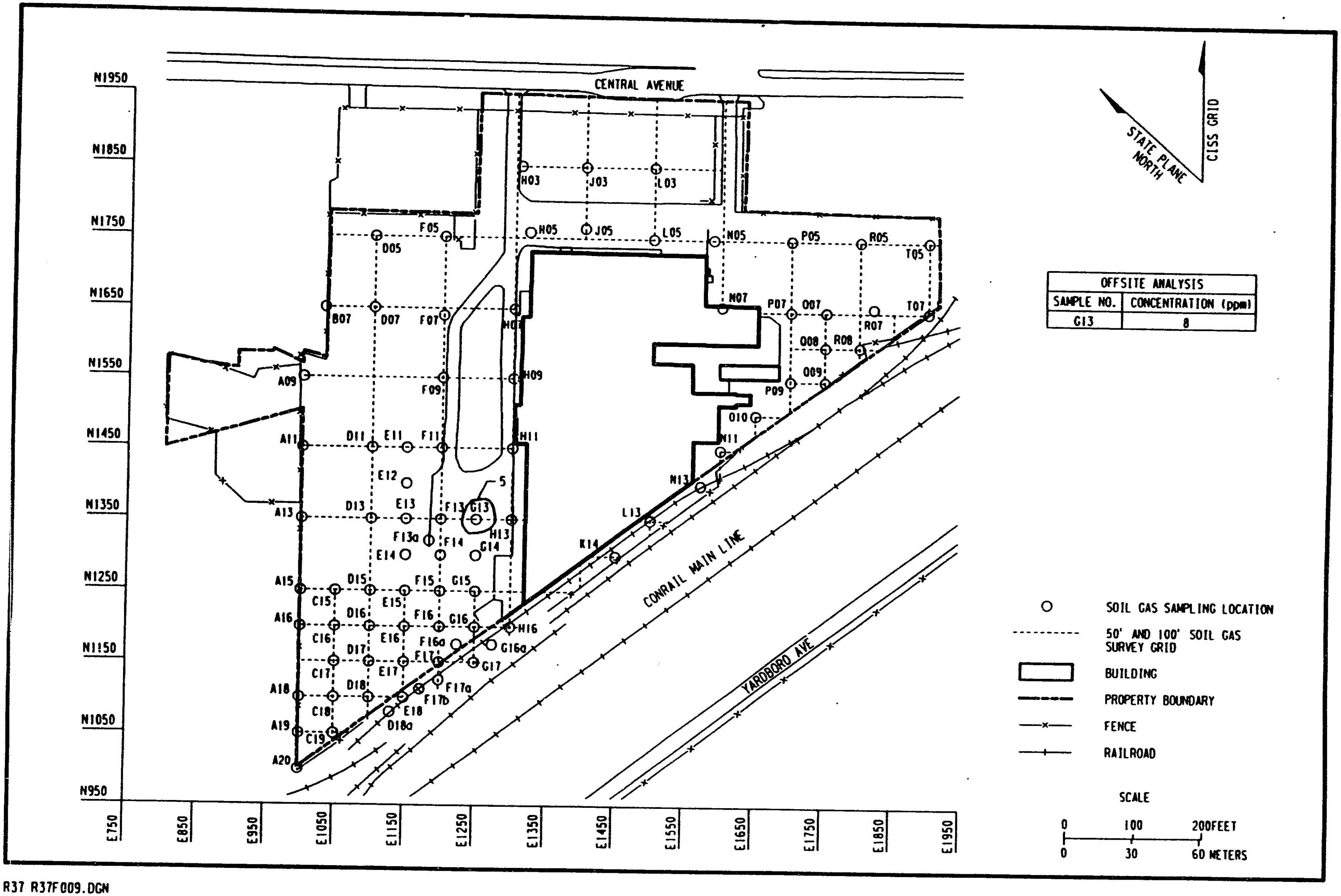


OFFSITE ANALYSIS	
SAMPLE NO.	CONCENTRATION (ppm)
F13	2.32

ONSITE ANALYSIS	
SAMPLE NO.	CONCENTRATION (ppm)
F13	2.63 (MAX) 0.07 (MIN)
F14	0.01
O10	0.17
P09	0.02
R08	0.02

R37 R37F008.DGN

Figure 2-4
Contour Map for Trichloroethene (TCE) Based on Soil Gas Survey at CISS



OFFSITE ANALYSIS	
SAMPLE NO.	CONCENTRATION (ppm)
G13	8

R37 R37F009.DGN

Figure 2-5
Contour Map for Vinyl Chloride Based on Soil Gas Survey at CISS

TABLES FOR SECTION 2.0

Table 2-1

Field Study Results for Radionuclides in Sediments

Sampling Locations[a]	Depth (ft)	Concentration[b] (pCi/g)[c]			
		Uranium-234	Uranium-235	Uranium-238	Thorium-232
1	0.5-1.5	1.64	0.04	2.4	0.69
2	3.5-4.5	2.54	0.23	12.8	0.39
3	1.5-2.5	0.99	0.09	3.81	0.44
4	0.5-1.5	0.31	0.04	0.9	0.38
5A[d]	0.5-1.5	1.6	0.02	5.8	0.65
5B[e]	0.5-1.5	13.10	0.80	19.6	0.69
7	1.5-2.5	26.60	1.90	99.8	1.8
Background					
6	0.5-1.5	0.62	0.02	1.04	0.44
8	0.0-0.5	0.97	0.09	2.8	0.66

[a] Sampling locations are shown in Figure 2-1.

[b] Measured background has not been subtracted.

[c] 1 pCi/g is equivalent to 0.037 Bq/g. The FUSRAP site-specific guideline for total uranium is 35 pCi/g above background for any 5-cm- (2-in.-) thick soil layer, and for thorium-232 is 5 pCi/g above background for the top 15 cm (6 in.) of soil.

[d] Center of stream bed.

[e] Edge of water.

Table 2-2

Field Study Results for Radionuclides in Surface Water

Sampling Location[a]	Concentration[b] (10^{-9} μCi/ml)[c]							
	Uranium-234		Uranium-235		Uranium-238		Thorium-232	
	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered
1	0.25	0.72	0.3	0.2	0.58	0.44	0.1	0.1
2	0.25	0.58	0.15	0.04	0.45	0.68	0.1	0.1
3	0.31	0.64	0.05	0.08	0.77	0.71	0.4	0.1
4	0.27	0.46	0.16	0.13	0.75	0.7	0.1	0.1
5	1.23	1.55	0.23	0.08	4.52	5.6	0.4	0.4
Background								
6	0.27	0.22	0.32	0.22	0.39	0.28	0.1	0.4
8	0.26	0.36	0.21	0.12	0.14	0.36	0.4	0.4

[a] Sampling locations are shown in Figure 2-1.

[b] Measured background has not been subtracted.

[c] 1×10^{-9} μCi/ml is equivalent to 1 pCi/L and 0.037 Bq/L. The DOE guidelines for total uranium and thorium-232 are 600×10^{-9} and 50×10^{-9} μCi/ml, respectively (DOE Order 5400.5).

Table 2-3

Field Study Results[a] for Metals in Sediments

	Sampling Location[b] (Depth)					
Metals (mg/kg)	5A[c] (0-1.5 ft)		5B[d] (0-1.5 ft)		8 (background) (0-0.5 ft)	
Antimony	15.6	U[e]	17.3	U	14.4	U
Arsenic	4.0	J[f]	3.5	J	2.6	J
Barium	51.9	U	57.8	U	47.8	U
Cadmium	1.4		1.4	U	1.2	U
Chromium	4.1		6.2		6.2	U
Copper	180	J	221	J	58.7	J
Lead	108		188		171	J
Magnesium	3,780	J	2,370	J	4,690	J
Mercury	0.13	U	0.14	U	0.12	U
Molybdenum	26	U	28.9	U	23.9	U
Nickel	10.4	U	11.6	U	9.6	U
Selenium	1.3	UJ	1.4	UJ	1.2	UJ
Silver	2.6	U	2.9	U	2.4	U
Thallium	2.6	U	2.9	U	2.4	UJ
Vanadium	13	U	14.5	U	12	U
Zinc	117		251		127	J

[a] Measured background has not been subtracted.

[b] Sampling locations are shown in Figure 2-1.

[c] Center of stream bed.

[d] Edge of water.

[e] U = result is below detection limit.

[f] J = result is estimated.

Table 2-4

Field Study Results[a] for Metals in Surface Water

Metals (µg/L)	Sampling Location[b]			
	5		8 (background)	
	Filtered	Unfiltered	Filtered	Unfiltered
Antimony	60 U[c]	60 U	60 U	60 U
Arsenic	10 U	10 U	10 U	10 U
Barium	200 U	200 U	200 U	200 U
Cadmium	5.0 U	5.0 U	5.0 U	5.0 U
Chromium	10 U	10 U	10 U	10 U
Copper	25 U	25 U	25 U	25 U
Lead	3 U	3 U	13.1	13.1
Magnesium	12,300	12,000	12,200	12,700
Mercury	0.2 U	0.2 U	0.2 U	0.2 U
Molybdenum	100 U	100 U	100 U	100 U
Nickel	40 U	40 U	40 U	40 U
Selenium	5.0 U	5.0 U	5.0 U	5.0 U
Silver	10 U	10 U	10 U	10 U
Thallium	10 U	10 U	10 U	10 U
Vanadium	50 U	50 U	50 U	50 U
Zinc	20 U	20 U	28.7	21.2

[a] Measured background has not been subtracted.

[b] Sampling locations are shown in Figure 2-1.

[c] U = result is below detection limit.

3.0 MONITORING NETWORKS AND RESULTS

CISS produces no processing effluents. The only possibilities for contamination to be released from the site are by migration or fugitive emissions from the main building during cleanup efforts in preparation for demolition and by contaminant migration in groundwater.

During 1992 asbestos was removed from the main building. Equipment to sample airborne particulates was stationed in the work areas during this operation. Also during 1992, some materials were treated and removed, and piping, conduits, and equipment were removed; because these activities generated contaminated dust, workers wore protective clothing and full-face respirators to minimize exposure. A high-efficiency particulate air (HEPA) filter was installed to filter the air from the building before it was released to the environment. Continuous air samples were collected each working day, held five days to allow the radon daughters to decay, and then analyzed to confirm that radioactive contaminants in excess of guidelines were not being released to the general public. The system is inspected daily and maintained in accordance with the manufacturer's instructions.

The adequacy of existing monitoring activities is assessed annually, and the results are used to identify changes in the program. These may result from changing site conditions or regulatory requirements or from newly identified data needs to support the remedy selection process for the site. Additionally, as monitoring data are accumulated, decisions may be made to adjust monitoring requirements. Future site environmental reports will reflect these changes.

Based on knowledge of contaminants historically present at CISS, characterization results, and remedial investigation data, environmental monitoring in 1992 included sampling for:

- Radioactivity in exhaust from the HEPA filter
- External gamma radiation exposure
- Total uranium and thorium-232 concentrations in surface water, sediment, and groundwater

- VOCs and selected metal concentrations in groundwater

Readers not familiar with radiation units may benefit from reviewing Appendix C.

The monitoring systems included onsite, site boundary, and offsite stations to provide sufficient information on the potential effects of the site on human health and the environment. The analytical methods used for each matrix are listed in Appendix D.

This section of the report contains the radiological and chemical data for each sampling point (where applicable) and trend information. The methodology for calculating the results is provided in Appendix E. The results are compared with standards listed in Appendix G. All quarterly data are reported as they were received from the laboratory; however, the averages and expected ranges are reported using the smallest number of significant figures from the quarterly data (e.g., 3.2 and 32 both have two significant figures). Where appropriate, data are presented using powers of ten (e.g., $0.32 = 3.2 \times 10^{-1}$).

The following subsections discuss the monitoring program, results for 1992, and any possible radioactive contaminant migration indicated by the results. In each monitoring network section, trend tables summarize the analytical results for 1992 and the preceding five years and present the statistical expected range for each monitoring location.

3.1 AIR AND EXPOSURE MONITORING

Routine air monitoring at CISS consists of nonintrusive, cumulative measurement of external gamma radiation rates in the air at onsite and offsite locations.

3.1.1 Radon/Thoron Monitoring

The materials processed at CISS consisted of depleted uranium and small amounts of enriched uranium and natural thorium. Only small amounts of radium-226 (the parent radionuclide of radon) and thorium-232 (the parent radionuclide of thoron) are present at the site. Therefore, monitoring for radon and thoron was not conducted.

3.1.2 HEPA Exhaust Monitoring

Subpart H of NESHAPs, "National Emission Standards for Emissions of Radionuclides other than Radon from DOE Facilities," states that emissions of radionuclides to the ambient air should not exceed amounts that would cause any member of the public to receive an effective dose equivalent of 10 mrem/yr (40 CFR 61.92).

A ventilation system was installed at CISS on June 3, 1992, to provide adequate ventilation to support work activities and reduce the quantity of respirable and nonrespirable ambient air particulates within the work area. The ventilation system flow rate design maintains a negative pressure within the facility during work activities. The filter train associated with the ventilation system consists of a moisture separator, prefilters, and nuclear-grade HEPA filters. The system was di-n-octyl-phthalate (DOP) tested before use and whenever the HEPA filter was changed out. Continuous monitoring of airborne radionuclide particulates from the ventilation system is conducted daily.

A calibrated regulated air sampler (RAS-1) uses an in-line flow calibrator to ensure a sample flow rate from 40 to 60 L/min. After a five-day decay period, air filter samples are analyzed for alpha particulates by alpha scintillation. Sample activity calculated for alpha particulates is listed in Appendix F. The total alpha activity released from June 3 to December 30, 1992, was 1.3 μCi. The total alpha activity was used in calculating the dose rate to the hypothetical maximally exposed individual and to the total population.

3.1.3 External Gamma Radiation

External gamma radiation exposure rates are measured as part of the routine environmental surveillance program to confirm that direct radiation from CISS is not significantly increasing radiation levels above natural background and to ensure compliance with environmental regulations. Dosimeters are placed 1 m (3 ft) above the ground (approximately at gonad level) to represent exposure to the critical organ closest to the contamination.

Although the tissue-equivalent thermoluminescent dosimeters (TETLDs) used for monitoring are state-of-the-art, the dosimeter accuracy is approximately ±10 percent at exposure rates between 100 and 1,000 mR/yr and ±25 percent at rates between 0 and 100 mR/yr.

The external gamma radiation background value is not constant for a given location or from one location to another, even over a short time, because the value is affected by a combination of both natural terrestrial and cosmic radiation sources and factors such as the location of the dosimeter in relation to surface rock outcrops, stone or concrete structures, or highly mineralized soil. Dosimeters are also influenced by site altitude, annual barometric pressure cycles, and the occurrence and frequency of solar flare activity (Eisenbud 1987). Thus, external gamma radiation exposure rates at the boundary could be less than the background rates measured some distance from the site, and rates onsite could be lower than at the boundary.

External gamma radiation monitoring locations are shown in Figures 3-1 and 3-2. The dosimeters were removed and analyzed in the middle and end of 1992, yielding the data listed in Table 3-1. The annual average exposure rate at CISS was 19 mR/yr onsite and 21 mR/yr at the site boundary; these values do not include a measured background value of 50 mR/yr. Rates for TETLDs collected from background station 14, which is in an area under construction at the Albany Airport, averaged 43 mR/yr after 6 months and 44 mR/yr after 12 months. Because the average of the two background stations is subtracted from the readings for site stations, the low reading at one of the two background stations may have skewed the results for the site. In addition, background station 13, which had a consistently higher exposure rate than other background stations, was deleted from the program. Therefore, although most locations have higher readings this year, this is not an indication of a trend. Information on public exposure can be found in Section 4.0.

For comparison, Table 3-2 shows the annual average external gamma radiation exposure rates for locations onsite, at the site boundary, and across the nation. Based on these data, the radioactively contaminated soil at CISS does not present a threat to the public from external gamma radiation exposure because the rates are so low and access to the material is restricted.

3.2 SURFACE WATER AND SEDIMENT MONITORING

Surface water monitoring is conducted to ensure compliance with environmental regulations and to determine whether runoff from CISS degrades the quality of the surface water in the area. Sediment monitoring is conducted to determine whether contaminants are collecting in onsite and/or offsite sediment and to ensure compliance with environmental regulations.

3.2.1 Monitoring Network

The surface water and sediment sampling program was modified in 1992; samples were collected semiannually at locations 1, 2, 3, and 5 (shown in Figure 3-3) and at an additional offsite surface water location (shown in Figure 3-2). Samples were analyzed for total uranium, thorium-232, and the indicator parameters pH and specific conductance.

3.2.2 Surface Water Results

The results for the radiological analyses of surface water for 1992 showed no elevated levels above DCGs for uranium and thorium [600×10^{-9} μCi/ml (22 Bq/L) and 50×10^{-9} μCi/ml (1.9 Bq/L), respectively] at downstream sampling locations potentially affected by the site (Table 3-3). There were no unusual findings from the indicator parameter readings.

3.2.3 Sediment Results

Currently, there are no DCGs for radionuclides in sediment; therefore, concentrations were compared with FUSRAP site-specific soil guidelines (Appendix G). No concentrations were above these guidelines (Table 3-4).

3.3 GROUNDWATER MONITORING

Groundwater monitoring is conducted to provide information on potential contaminant migration of radionuclides and chemicals through the groundwater system and to ensure compliance with NYSDEC groundwater standards and EPA standards for drinking water.

3.3.1 Well Network

Based on the current understanding of flow conditions, two water-bearing systems (upper and lower) have been identified as primary potential groundwater pathways at CISS. The upper and lower groundwater systems represent the surficial aquifer at the site. The systems consist mainly of sand and are partially isolated from each other over most of the site by a discontinuous clay barrier. In areas where the clay barrier is not present, vertical flow occurs between systems; therefore, both systems are considered potential pathways for contaminant migration. Monitoring well locations are shown in Figures 3-4 and 3-5. Groundwater in the upper and lower system is sampled and analyzed for radiological and chemical parameters.

A Holocene channel located under the former Patroon Lake influences flow and contaminant migration from an area formerly used for burial. While the facility was operating, this channel was filled with debris and waste materials. Water level maps and hydrologic flow models based on site data indicate that there is a preferential flow pathway having high hydraulic conductivity values associated with the channel system. The base of the channel downcuts through the upper clay semiconfining unit. This erosional feature provides a pathway for enhanced vertical flow between the upper and lower portions of the shallow aquifer system. Sampling locations were selected to maximize interception of contaminants in groundwater. Sampling frequency is based on calculations of contaminant transport velocities.

Upper Groundwater System

Sampling locations are shown in Figure 3-4. In the upper groundwater system, baseline conditions are determined from data collected from well B39W02S. B39W14S and B39W08S are upgradient locations but are included to monitor contamination at the upgradient property boundaries. B39W05S, B39W06S, B39W07S, B39W10S, B39W15S, and B39W19S are wells that monitor potential contaminant migration. Well B39W10S is in an offsite downgradient location.

Lower Groundwater System

Five wells are currently used to monitor the lower groundwater system (Figure 3-5). B39W02M is the baseline well, and B39W10M and B39W05M are downgradient wells. B39W14M and B39W08M are upgradient locations and are sampled once a year to monitor groundwater quality. The current well arrangement does not provide adequate coverage to detect contaminant migration through the lower groundwater system; two additional downgradient monitoring wells will be added in the areas shown in Figure 3-5 to provide a larger area of downgradient coverage. The exact locations of these new wells will be determined after screening samples are collected from temporary well points.

During characterization studies, B39W05M, B39W06S, and B39W15S were sampled. After the first round of samples were evaluated, it was determined that a confirmatory sample would be needed. B39W05M, B39W06S, and B39W15S showed elevated levels of organic contaminants in excess of Safe Drinking Water Act (SDWA) standards and NYSDEC groundwater standards. Radioactive contaminants in excess of DCGs were detected in B39W06S. Additional groundwater sampling onsite and offsite will be performed with a direct-push groundwater sampling system to determine the extent of contamination in area groundwater, and the data will be used in the remedial design process.

3.3.2 Results

Groundwater samples were collected at frequencies identified in the environmental surveillance program and analyzed for radiological and chemical constituents. Results of radiological analyses are compared with DCGs to determine whether guidelines are exceeded. Table 3-5 presents the concentrations of uranium and thorium-232 in groundwater. Table 3-6 presents a five-year summary of average annual concentrations of uranium and thorium-232. Chemicals that exceeded the detection limits are listed in Table 3-7. The reported chemical concentrations are compared with appropriate EPA and NYSDEC (Class GA) guidelines in Table 3-8.

The indicator parameters total organic carbon (TOC) and total organic halides (TOX) were used to determine the presence of organic compounds. These parameters have no regulatory limit and only indicate the presence of organic compounds in the groundwater. Because sampling for a selected suite of organic compounds is currently performed, TOC and TOX sampling will be discontinued in 1993.

Uranium and Thorium-232

Table 3-5 presents 1992 sampling results for total uranium and thorium-232 in groundwater at CISS. The 1992 results are consistent with past data except for B39W06S results. Average 1992 concentrations of total uranium and thorium-232 in the remaining wells approximate the range of natural background concentrations. Table 3-6 compares 1992 data with data available for the previous five years. Results for samples from B39W06S show significant radioactive contamination exceeding the DCG for uranium [600 × 10^{-9} μCi/ml (22 Bq/L)] but not for thorium-232 [50 × 10^{-9} μCi/ml 1.9 Bq/L)]. B39W06S is located in a loading dock adjacent to a suspected source of uranium. After the initial sampling of B39W06S was performed in April 1992, an additional sample was collected to confirm the results and determine the soluble fraction of uranium in the groundwater. Results show that most of the uranium was filtered out with a 0.45 micron filter (unfiltered sample: 2,400 × 10^{-9} μCi/ml; filtered sample: 8 × 10^{-9} μCi/ml). This indicates that most of the uranium is attached to particulate material larger than 0.45 microns.

Data are not sufficient to determine the extent of uranium contamination in the groundwater. The fine-grained material present at the site will act as a mechanical filter inhibiting the movement of particulates in the aquifer. Numerical modeling of the aquifer indicates that contaminants would move in the groundwater in a narrow plume southward away from the source.

Volatile Organic Compounds

Analytical results show concentrations of halogenated VOCs significantly above SDWA maximum contaminant levels (MCLs) (Table 3-8). These include PCE, TCE, and 1,2-DCE(T), which are solvents used as degreasers and are common groundwater contaminants at industrial sites. PCE was probably the major solvent used at the site. PCE degrades to TCE, 1,2-DCE(T), and vinyl chloride. A soil gas survey was conducted in June 1992 to determine the source of these VOCs (see Subsection 2.4.1). A drilling program is planned to determine the extent of VOCs in the local groundwater both on and offsite.

Analytical results presented in Table 3-7 show concentrations of PCE significantly above federal groundwater standards. PCE was detected in B39W05S, B39W15S, B39W06S, B39W07S, and B39W19S, with the highest concentrations in B39W06S and B39W15S. PCE concentrations in B39W15S during the fourth quarter of 1992 exceeded 10,000 μg/L. The highest concentration found in B39W06S was 5,700 μg/L. These wells are on opposite sides of the building (Figure 3-4) and are believed to represent separate plumes with separate sources. Because these wells were not included in the environmental surveillance program until 1992, no historic data are available to determine whether concentrations are increasing or decreasing. PCE, TCE, and 1,2-DCE(T) are denser than water and sink in the aquifer. Low concentrations of TCE (at the detection limit) have been detected in the deep aquifer in B39W10M offsite, indicating that TCE may have penetrated the clay barrier separating the upper and lower groundwater systems.

TCE was detected above SDWA standards (5 μg/L) in B39W05S, B39W06S, B39W07S, and B39W15S during each quarter in 1992. The highest value reported for 1992 is 1400 μg/L during the fourth quarter, in B39W15S. Of the wells in which TCE was detected in 1992, only B39W07S was sampled for VOCs before 1992. Since 1989, reported TCE concentrations in B39W07S have consistently been above 10 μg/L.

1,2-DCE(T) was detected in B39W05S, B39W06S, B39W07S, and B39W15S. Only B39W05S and B39W15S exceeded the SDWA standard of 70 μg/L, with a maximum of 120 μg/L in both wells during the third quarter of 1992. Historically, B39W07S and B39W19S have had 1,2-DCE values below SDWA standards.

Other VOC analysis shows the presence of methyl chloride, acetone, and chloroform at or below SDWA MCLs. These constituents could be the result of laboratory contamination. Ethylbenzene, toluene, and xylene were detected in B39W06S and B39W05M below SDWA standards (Table 3-8). The VOC 1,1,1-trichloroethane (TCA) has been detected at low levels in B39W08S since chemical analysis was initiated in 1989. The SDWA MCL for TCA is 70 μg/L. TCA is a degradation product of carbon tetrachloride, which was once used as a cleaner for electrical equipment. The adjacent Niagara-Mohawk electrical substation may have contributed to the presence of TCA in B39W08S. The presence of vinyl chloride in B39W05S and B39W15S cannot be confirmed because laboratory detection limits are higher than the SDWA MCL for vinyl chloride.

In summary, the 1992 VOC data indicate a significant presence of halogenated hydrocarbons in the groundwater. Although 1992 results do not show contaminants in the offsite well, TCE was reported at 5 μg/L (SDWA MCL of 5 μg/L) during one quarter in B39W10M in 1990, which indicates that contaminants may have moved offsite and into the lower groundwater system.

Metals

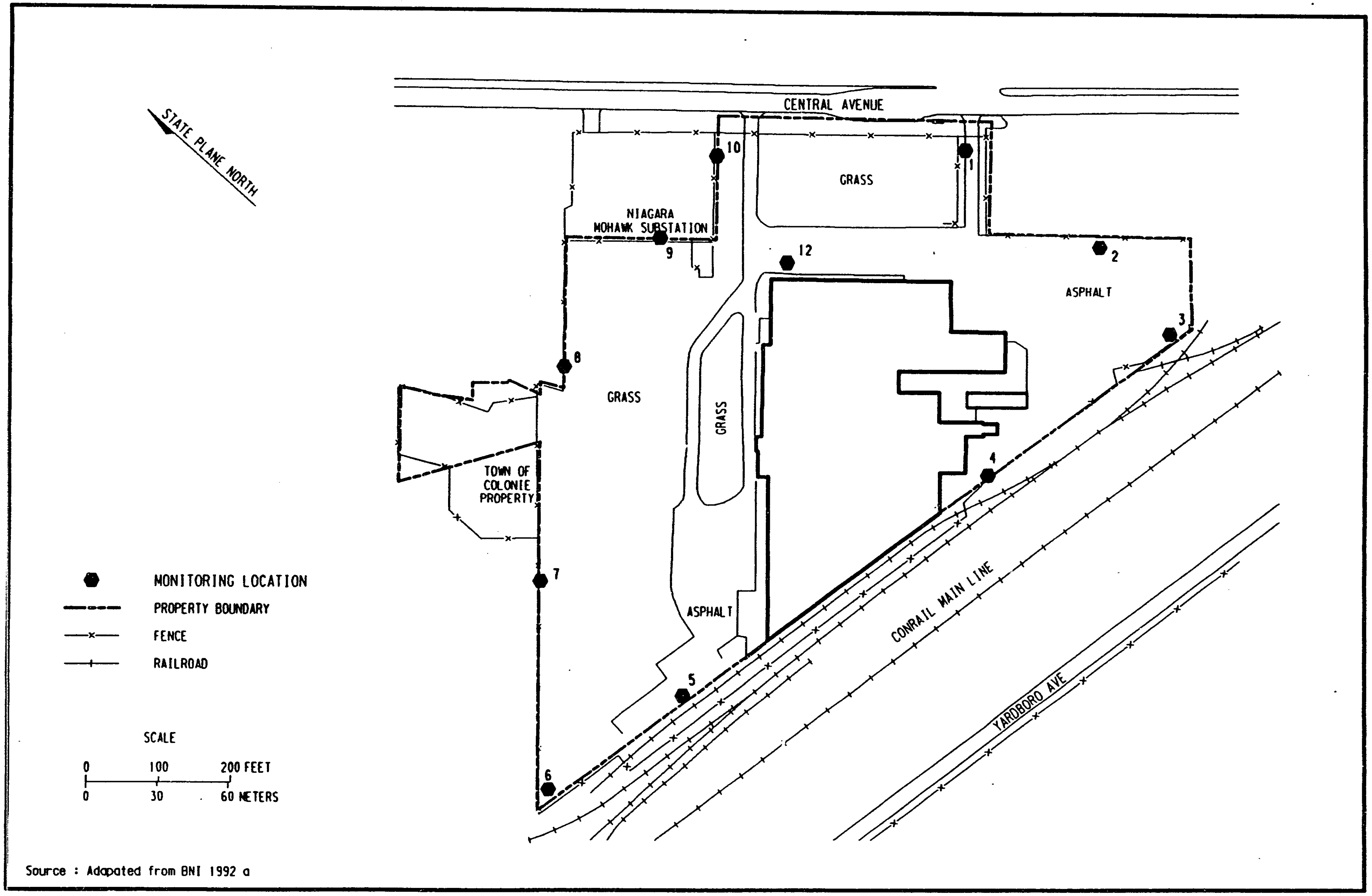
As directed by the CISS environmental monitoring plan, analyses for 20 metals were run on all wells sampled in 1992. Analyses were performed on unfiltered samples for total metals. Detection limits are presented in Appendix D, drinking water guidelines used for comparison are presented in Table 3-8, and analytical results for metals above detection limits are presented in Table 3-7. Metal concentrations significantly exceeding baseline values were reported for samples from wells completed in the lower unit. Water quality data collected from these wells indicate that a significant particulate fraction is present in the unfiltered samples; the analytical results therefore do not accurately represent dissolved concentrations in the groundwater. Both filtered and unfiltered samples will be collected from selected wells during the 1993 monitoring program to confirm this supposition.

Antimony, barium, lead, nickel, and zinc were detected in onsite well samples (including background samples) in excess of SDWA MCLs or NYSDEC (Class GA) guidelines. These high concentrations of metals may be a result of sediments in the groundwater sample. Antimony was detected only in B39W19S in excess of SDWA MCLs at 13.7 μg/L. Barium was detected in B39W02M above SDWA standards at 2,870 μg/L and at lower concentrations in B39W05M, B39W06S, B39W08M, and B39W14M. Lead exceeded SDWA MCLs in B39W02M, B39W05M, B39W08M, B39W14M, and B39W19S, with a maximum concentration of 127 μg/L in B39W02M. Lead was detected at lower concentrations in B39W05S, B39W06S, B39W07S, and B39W10M. Nickel exceeded SDWA MCLs in B39W02M and B39W14M, with the highest concentration detected in B39W14M at 117 μg/L. Zinc was detected in excess of NYSDEC (Class GA) guidelines in B39W19S at 1,740 μg/L. Zinc was detected in all other wells tested except for B39W14S.

Metals detected below EPA or NYSDEC guidelines were arsenic, chromium, and copper. Arsenic was detected in B39W02M, B39W05M, B39W08M, B39W10S, B39W10M, and B39W14M, with a maximum concentration of 29.1 μg/L in B39W14M. Boron has no regulatory guideline but was detected in moderately high concentrations in B39W05S, B39W06S, B39W07S, B39W08S, B39W10M, and B39W19S, with a maximum concentration of 1,110 μg/L in B39W06S. Chromium was not detected in excess of drinking water guidelines; however, concentrations above detection limits were reported for B39W02M, B39W05M, B39W06S, and B39W08M, with the highest concentration of 25.5 μg/L detected in B39W06S. Copper was detected in samples from B39W02M, B39W05M, B39W08M, B39W10M, B39W14M, and B39W19S, with the highest concentration of 231 μg/L in B39W14M.

In summary, most metals in excess of guidelines were found in the lower groundwater system, except in B39W06S and B39W19S. The areas containing these wells may be sources of metals exceeding guidelines.

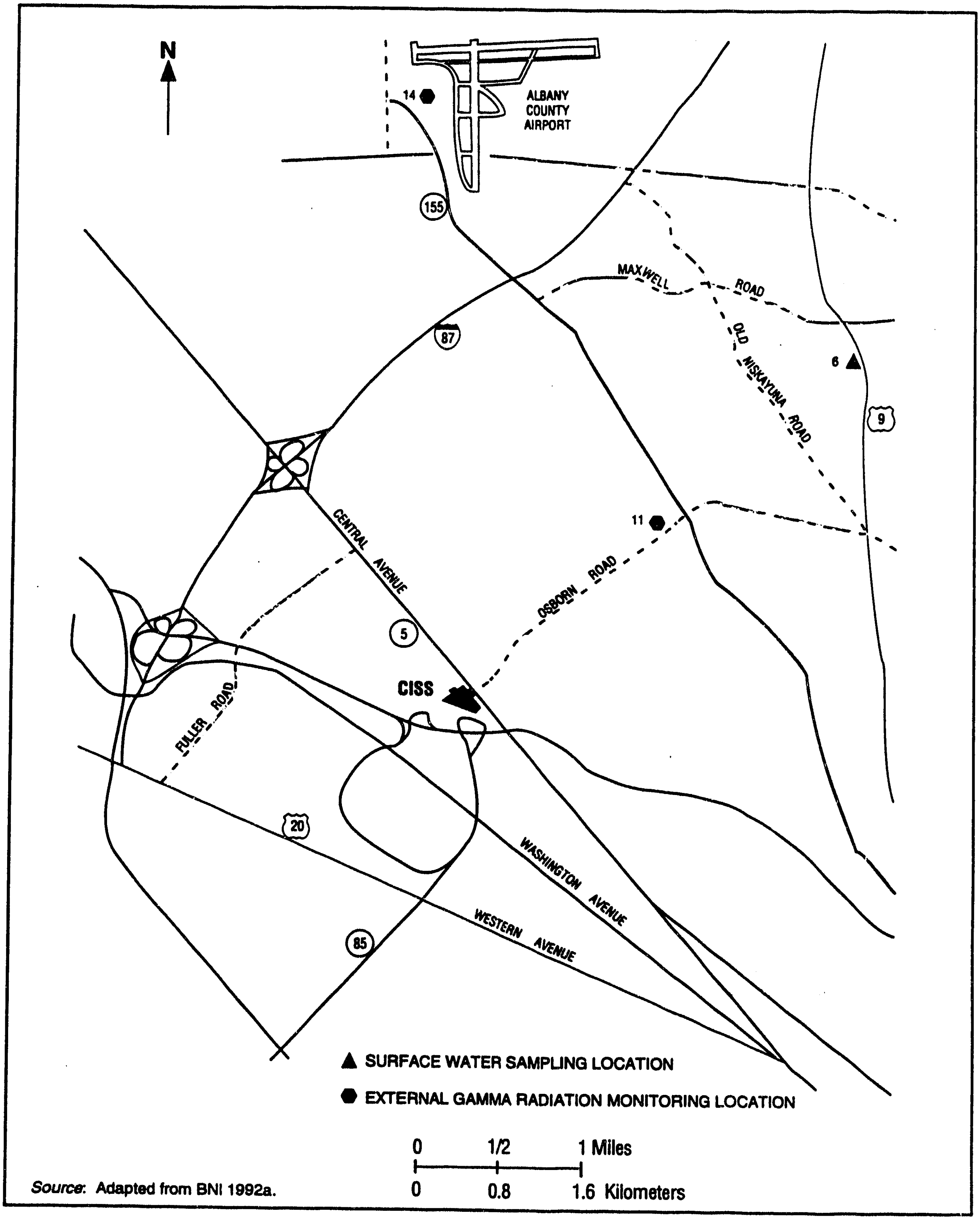
FIGURES FOR SECTION 3.0



Source : Adapted from BNI 1992 a

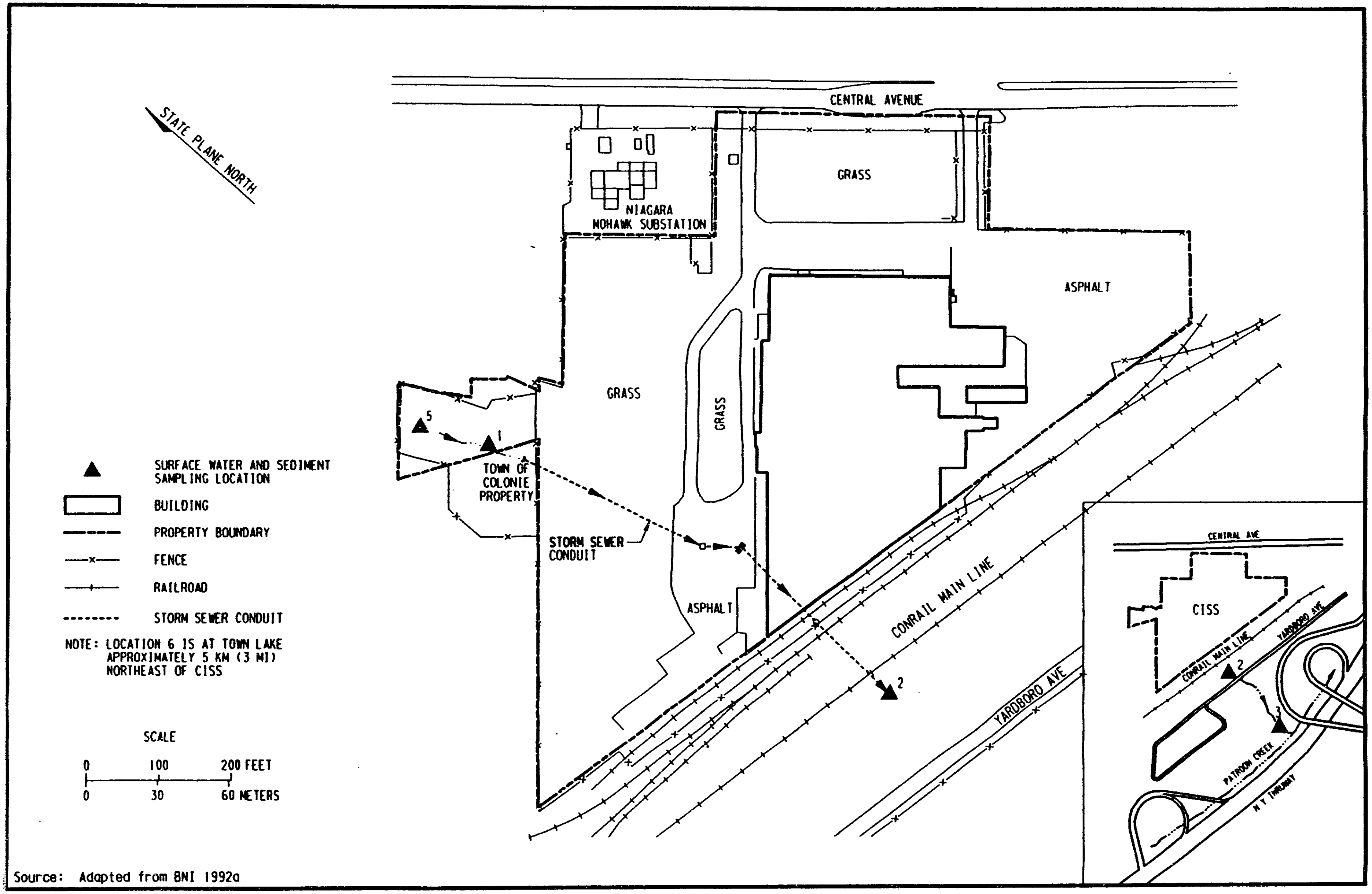
R37 R37F010.DGN

Figure 3-1
Onsite and Boundary External Gamma Radiation
Monitoring Locations at CISS



Source: Adapted from BNI 1992a.

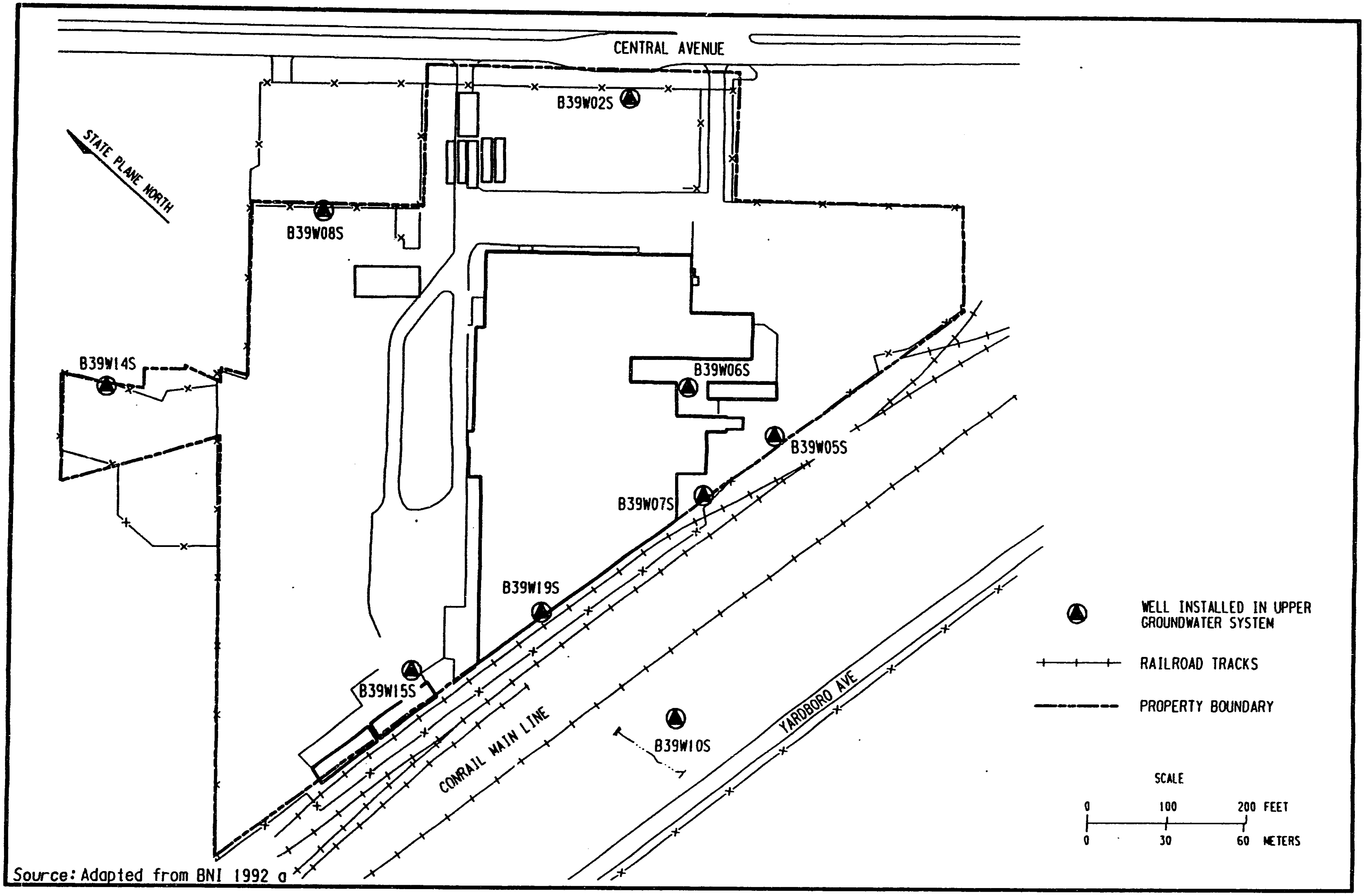
Figure 3-2
Background External Gamma Radiation
and Surface Water Monitoring Locations at CISS



Source: Adapted from BNI 1992a

R37 R37F011.DGN

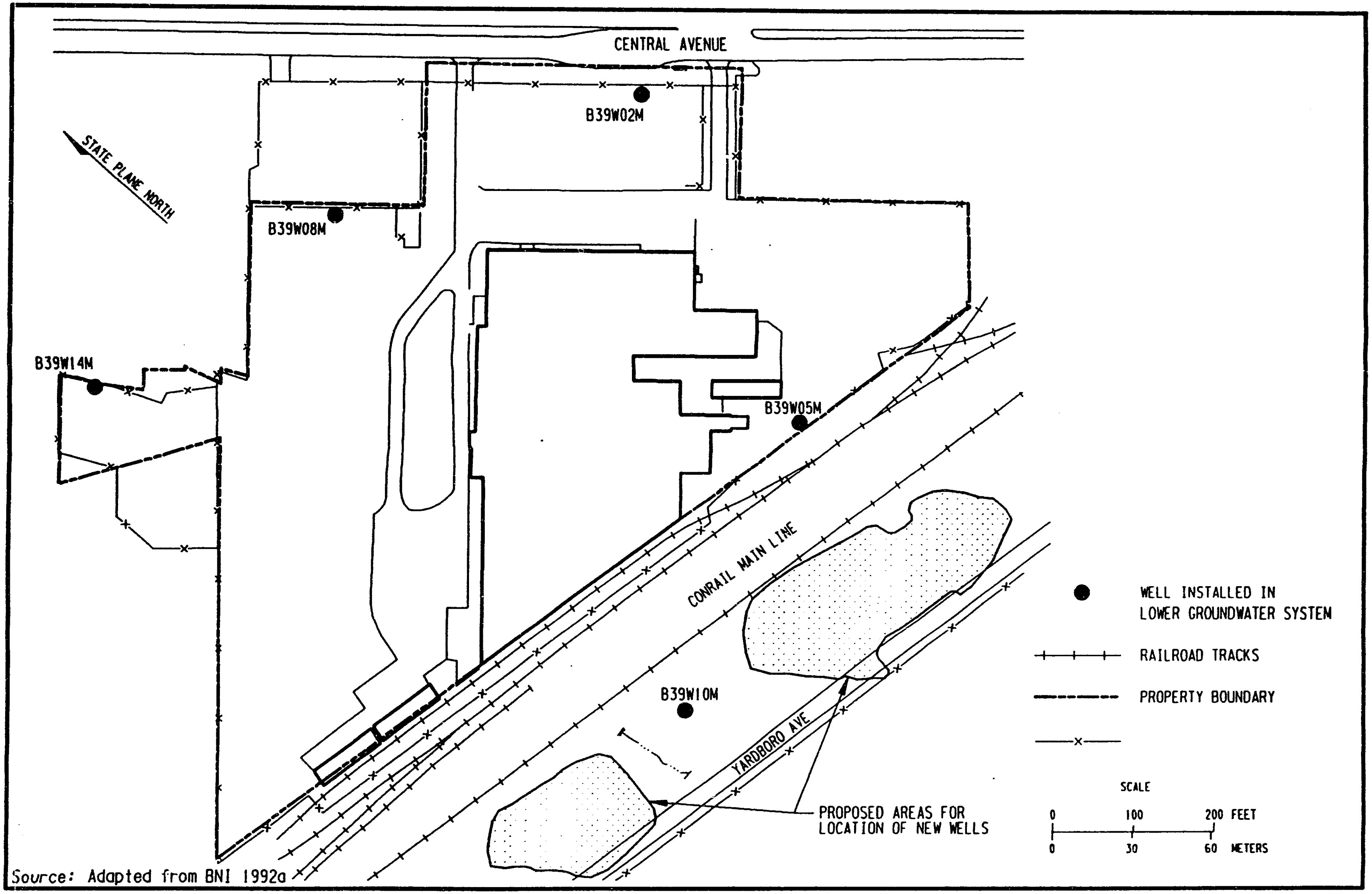
Figure 3-3
Surface Water and Sediment Sampling Locations in the Vicinity of CISS



Source: Adapted from BNI 1992 a

R37 R37F012.DGN

Figure 3-4
Upper Groundwater System Wells Used for Radiological and Chemical Sampling



Source: Adapted from BNI 1992a

R37 R37F013.DGN

Figure 3-5
Lower Groundwater System Wells Used for Radiological and Chemical Sampling

TABLES FOR SECTION 3.0

Table 3-1

Trend Analysis for External Gamma Radiation Exposure Rates[a] at CISS, 1987-1992

Page 1 of 2

Sampling Location[b]	Average Annual Rate					Expected Range[c]	Average Annual[d] Rate
	1987	1988	1989	1990	1991	($\bar{x} \pm 2s$)	1992
			(Rates are in mR/yr)				
Property Line (measured background subtracted)[e]							
1	0[f]	13	4	1	5	0 - 15	0
2	5	10	2	0.3	0	0 - 10	18
3	21	21	9	7	13	0 - 30	34
4	26	28	21	18	22	1 - 31	36
5	15	34	19	11	20	15 - 37	40
6	0	4	0	0	0	0 - 4	12
7	25	8	5	1	6	0 - 30	25
8	7	20	8	8	10	0 - 20	30
9	1	7	1	0	0	0 - 8	16
10	0	5	1	1	2	0 - 6	0
Onsite (measured background subtracted)[e]							
12	17	26	22	14	14	8.1 - 29	19
Background							
11[g]	63	70	56	50	55	43 - 74	54
13[h]	--	--	74	73	74	73 - 75	--
14[i]	--	--	64	57	66	53 - 72	44
15[h]	--	--	52	53	57	49 - 59	--
						Average	50

Source for 1987-1991 data: BNI 1992a.

[a] 1 mR is equivalent to 1 mrem. The DOE guideline is 100 mrem/yr above background from all sources.

Table 3-1

(continued)

Page 2 of 2

---

[b] Sampling locations are shown in Figures 3-1 and 3-2.

[c] Average value ±2 standard deviations (approximately 95 percent confidence level).

[d] The dosimeters were removed in pairs to provide a duplicate measurement for each station. The table lists the above-background average for the station.

[e] The average measured background value has been subtracted from the onsite and property-line readings.

[f] A zero value indicates a measurement that is not distinguishable from the annual average measured background rate.

[g] Located at Fuller Place, Albany, approximately 2.4 km (1.5 mi) northeast of CISS.

[h] Deleted from program in 1992.

[i] Located at the Albany County Airport, approximately 5.6 km (3.5 mi) north of CISS; established March 31, 1988.

Table 3-2

External Gamma Radiation Exposure Rates for Comparison

Location	Average Rate (mR/yr) 1991	Average Rate (mR/yr) 1992
CISS boundary	71[a]	71[a]
CISS onsite	77[a]	69[a]
CISS vicinity	63	50
U.S. background[b]	103	
Grand Central Station[c]	525	
Statue of Liberty base[c]	325	

[a] Includes background.

[b] Shleien 1989.

[c] Appendix C.

Table 3-3

Trend Analysis for Total Uranium and Thorium-232 Concentrations[a,b] in Surface Water in the Vicinity of CISS, 1987-1992

Page 1 of 2

Sampling Location[c]	Average Annual Concentration 1987	1988	1989	1990	1991	Expected Range[d] ($\bar{x} \pm 2s$)	Average Annual Concentration 1992
			(Concentrations are in 10^{-9} μCi/ml)				
			Total Uranium[e]				
1	73	39	135	124	4	0 - 190	0.6
2	9.3	7	8	7.5	6.9	6 - 10	13
3	7.1	6	9	5	6	4 - 10	7
5	5.2	2	5	2	2	0 - 7	2
Background							
6[f]	--	2	2	2	2	2 - 2	0.4
			Thorium-232[g]				
1	--	--	--	0.1	0.2	0 - 0.3	0.1
2	--	--	--	0.2	0.2	0.2 - 0.2	0.1
3	--	--	--	0.1	0.1	0.1 - 0.1	0.06
5	--	--	--	0.1	0.2	0 - 0.3	0.2
Background							
6[f]	--	--	--	0.1	0.3	0 - 0.5	0.2

Source for 1987-1991 data: BNI 1992a.

[a] 1×10^{-9} μCi/ml is equivalent to 0.037 Bq/L and 1 pCi/L. DOE guidelines for total uranium and thorium-232 are 600×10^{-9} μCi/ml and 50×10^{-9} μCi/ml, respectively.

[b] Measured background has not been subtracted.

[c] Sampling locations are shown in Figures 3-2 and 3-3.

Table 3-3

(continued)

Page 2 of 2

---

[d] Average value ±2 standard deviations (approximately 95 percent confidence level).

[e] Total uranium concentrations were determined by fluorometric analysis during 1986 through 1990 and the first three quarters of 1991 and by kinetic phosphorescence analysis during the fourth quarter of 1991 and in 1992.

[f] Located at Town Hall Lake, Newtonville, approximately 5 km (3 mi) northeast of CISS; established in 1988.

[g] Thorium-232 analysis began in 1990.

Table 3-4

Trend Analysis for Total Uranium and Thorium-232 Concentrations[a,b] in Sediment in the Vicinity of CISS, 1987-1992

Sampling Location[c]	Average Annual Concentration					Expected Range[d]	Average Annual Concentration
	1987	1988	1989	1990	1991	($\bar{X} \pm 2s$)	1992
(Concentrations are in pCi/g)							
Total Uranium[e]							
1	42	127	278	49	43	0 - 310	6
2	13	10.5	7.7	12	9	6 - 15	12
3	10	10.8	9.1	5.8	8.5	5 - 13	6
5	--[f]	--	--	3.9	3	2 - 5	2
Thorium-232[g]							
1	--	--	--	0.7	0.6	0.5 - 0.8	0.8
2	--	--	--	0.5	0.7	0.3 - 0.9	0.7
3	--	--	--	0.5	0.5	0.5 - 0.5	0.9
5	--	--	--	0.6	0.6	0.6 - 0.6	0.4

Source for 1987-1991 data: BNI 1992a.

[a] 1 pCi/g is equivalent to 0.037 Bq/g. The FUSRAP site-specific soil guideline for total uranium is 35 pCi/g above background for any 5-cm- (2-in.-) thick soil layer, and for thorium-232 is 5 pCi/g above background for the top 15 cm (6 in.) of soil.

[b] Measured background has not been subtracted.

[c] Sampling locations are shown in Figure 3-3.

[d] Average value ±2 standard deviations (approximately 95 percent confidence level).

[e] Total uranium concentrations were determined by summing the concentrations of uranium-234, uranium-235, and uranium-238 in 1987 through 1991. In 1992 total uranium concentrations were determined by kinetic phosphorescence analysis.

[f] (--) = No data are available.

[g] Thorium-232 analysis began in 1990.

Table 3-5

Concentrations[a,b] of Total Uranium, Radium-226, and Thorium-232 in Groundwater at CISS, 1992

Page 1 of 2

Sampling Location[c]	Quarter				
	1	2	3	4	Avg
(Concentrations are in 10^{-9} μCi/ml)					
Total Uranium					
B39W05S[d]	0.25	--[e]	2.06	1.6	1.3
B39W05M[d,f]	--	--	--	1.55	1.6
B39W06S[d,g]	--	--	3,979.7	2,398.4	3,200.0
B39W06S[f] (Filtered)				8.4	8.4
B39W07S[d]	0.1	--[e]	0.68	0.3	0.4
B39W08S[h]	0.13	--	2.46	--	1.3
B39W08M[h]	1.93	2.63	0.37	--	1.6
B39W10S[d]	0.06	--[e]	4.27	7.6	4.0
B39W10M[d]	0.76	2.67	0.64	0.09	1.0
B39W14S[h]	--	--	0.07	--	0.07
B39W14M[h]	--	2.07	1.45	--	1.8
B39W15S[d,f]	--	--	--	0.16	0.2
B39W19S[d]	0.77	--[e]	1.08	2.3	1.4
Background					
B39W02S[d]	--[i]	0.22	0.37	5.23	1.9
B39W02M[d]	--[i]	4.82	0.15	2.37	2.4
Thorium-232					
B39W05S[d]	<0.22	--[e]	1.44	-0.03	0.5
B39W05M[d,f]	--	--	--	0.32	0.3
B39W06S[d,g]	--	--	0.14	0.07	0.1
B39W06S[f] (Filtered)				0.07	0.1
B39W07S[d]	<0.15	--[e]	0.7	0	0.3
B39W08S[h]	<0.15	--	1.1	--	0.6
B39W08M[h]	2.49	<0.6	0.02	--	1.0

Table 3-5

(continued)

Page 2 of 2

Sampling Location[b]	Quarter 1	2	3	4	Avg
Thorium-232 (cont'd)					
B39W10S[d]	<0.45	--[e]	0.47	0.28	0.4
B39W10M[d]	0.63	1.06	0.07	0	0.4
B39W14S[h]	--	--[e]	0.09	--	0.1
B39W14M[h]	--	2.14	0.61	--	1.4
B39W15S[d,f]	--	--	--	-0.03	-0.03
B39W19S[d]	0.2	--[e]	0.21	-0.02	0.1
Background					
B39W02S[d]	--[i]	<0.1	0.18	-0.02	0.1
B39W02M[d]	--[i]	<0.84	0.09	1.5	0.8

[a] 1×10^{-9} µCi/ml is equivalent to 0.037 Bq/L and 1 pCi/L. The DOE guidelines for total uranium and thorium-232 are 600×10^{-9} µCi/ml and 50×10^{-9} µCi/ml, respectively.

[b] Measured background has not been subtracted.

[c] Sampling locations are shown in Figures 3-4 and 3-5.

[d] Sampled quarterly.

[e] Well not properly purged, data invalid.

[f] Sampling begun fourth quarter.

[g] Sampling begun third quarter.

[h] Not sampled every quarter.

[i] Because wells B39W08S and B39W08M are polyvinyl chloride wells, during the second quarter these wells were replaced as background wells with B39W02S and B39W02M, which are stainless steel.

Table 3-6

Trend Analysis for Total Uranium and Thorium-232 Concentrations[a,b] in Groundwater at CISS, 1987-1992

Sampling Location[c]	Average Annual Concentration					Expected Range[d]	Average Annual Concentration
	1987	1988	1989	1990	1991	($\bar{X} \pm 2s$)	1992
			(Concentrations are in 10^{-9} µCi/ml)				
			Total Uranium[e]				
B39W05S[f]	2.5	3	--	--	--	2 - 4	1.3
B39W07S[g]	--	--	2.6	3	2	2 - 4	0.4
B39W08S[h]	2.2	3	2.2	2	2	2 - 3	1.3
B39W08M[h]	2.8	3	2.2	3	3	2 - 4	1.6
B39W10S[g]	--	--	2.1	2	2	2 - 2	4
B39W10M[g]	--	--	2.5	3	2	2 - 4	1
B39W14S[g,h]	--	--	2.1	3	3	2 - 4	0.1
B39W14M[g,h]	--	--	2.2	3	--[i]	2 - 4	1.8
B39W15S[f]	2.4	3	--	--	--	2 - 4	0.2
B39W19S[g]	--	--	5.5[j]	4	3	2 - 7	1.4
Background							
B39W02S[h]	--	--	--	--	--	--	1.9
B39W02M[h]	--	--	--	--	--	--	2.4
			Thorium-232[k]				
B39W05S	--	--	--	--	--	--	0.5
B39W07S	--	--	--	0.3	0.6	0 - 0.9	0.3
B39W08S[h]	--	--	--	0.1	0.4	0 - 0.7	0.6
B39W08M[h]	--	--	--	9	9.8	8 - 11	1.0
B39W10M	--	--	--	3	1	0 - 5	0.4
B39W10S	--	--	--	1	4.5	0 - 8	0.4
B39W14S[h]	--	--	--	0.6	0.9	0.3 - 1	0.1
B39W14M[h]	--	--	--	1	--[i]	--	1.4
B39W19S	--	--	--	0.3	0.1	0 - 0.5	0.1

Table 3-6

(continued)

Page 2 of 2

Sampling Location[c]	Average Annual Concentration 1987	1988	1989	1990	1991	Expected Range[d] ($\bar{x} \pm 2s$)	Average Annual Concentration 1992
			Thorium-232[k]				
Background							
B39W02S[h]	--	--	--	--	--	--	0.1
B39W02M[h]	--	--	--	--	--	--	0.8

Source for 1987-1991 data: BNI 1992a.

[a] 1×10^{-9} µCi/ml is equivalent to 0.037 Bq/L and 1 pCi/L. The DOE guidelines for total uranium and thorium-232 are 600×10^{-9} µCi/ml and 50×10^{-9} µCi/ml, respectively.

[b] Measured background has not been subtracted.

[c] Sampling locations are shown in Figures 3-4 and 3-5.

[d] Average value ±2 standard deviations (approximately 95 percent confidence level).

[e] Total uranium concentrations were determined by fluorometric analysis during 1987 through 1990 and the first three quarters of 1991 and by kinetic phosphorescence analysis during the fourth quarter of 1991 and in 1992.

[f] Dropped from the monitoring program in 1989 because new wells were added; added back to the program in 1992.

[g] New monitoring well; sampling initiated in 1989.

[h] Upgradient well.

[i] Water was frozen and riser casing was damaged; sampling equipment could not be inserted.

[j] Includes samples only from the last two quarters of 1989.

[k] Thorium-232 analysis began in the second quarter of 1990.

Table 3-7

Concentrations[a,b] of Chemicals at CISS that Exceeded the Detection Limits, 1992

Page 1 of 5

Well Location[c]	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Detection Limit[d]
(Concentrations are in μg/L)[e]					
B39W05S					
TOC[f]	NS[g]	RR[h]	7.2	NS	0.5
TOX	NS	RR	NS	134	5.0
Boron	637	RR	546	633	100
Lead	3.4	RR	--[i]	--	3
Magnesium	15,800	RR	13,900	14,000	5,000
Zinc	21.3	RR	53.4	37.5	20
1,2-Dichloroethene(T)	37	RR	120	50	5
Tetrachloroethene	79	RR	190	83	5
Trichloroethene	10	RR	44	20	5
B39W05M					
TOX	NS	RR	NS	40.2	5.0
Arsenic	NS	RR	NS	12	10
Barium	NS	RR	NS	208	200
Chromium	NS	RR	NS	13.2	10
Copper	NS	RR	NS	73.1	25
Lead	NS	RR	NS	27.4	3
Magnesium	NS	RR	NS	71,400	5,000
Zinc	NS	RR	NS	169	20
B39W06S					
TOX	NS	RR	NS	531	5.0
Barium	NS	RR	NS	400	200
Boron	NS	RR	NS	1,110	100
Chromium	NS	RR	NS	25.5	10
Lead	NS	RR	NS	3.9	3
Magnesium	NS	RR	NS	9,280	5,000
Nickel	NS	RR	NS	83.7	40
Zinc	NS	RR	NS	34.2	20
1,2-Dichloroethene(T)	NS	RR	10	--	5
Tetrachloroethene	NS	RR	5,700	1,110	5
Trichloroethene	NS	RR	120	48	5

Table 3-7

(continued)

Page 2 of 5

Well Location[c]	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Detection Limit[d]
B39W07S					
TOC[f]	NS	RR	6.5	NS	0.5
TOX	NS	RR	NS	108	5.0
Boron	253	RR	224	250	100
Lead		RR	5.9	--	3
Magnesium	14,700	RR	13,000	12,900	5,000
Zinc	21.4	RR	25	66.9	20
Tetrachloroethene	64	RR	98	110	5
Trichloroethene	6	RR	9	12	5
B39W08S					
TOC[f]	NS	RR	1.2	NS	0.5
Boron	202	RR	164	NS	100
Magnesium	10,800	RR	11,100	NS	5,000
Zinc	28.1	RR	--	NS	20
B39W08M					
TOC[f]	NS	RR	1.1	NS	0.5
Arsenic	24.4	RR	23.2	NS	10
Barium	229	RR	310	NS	200
Chromium	21.9	RR	15.1	NS	10
Copper	112	RR	153	NS	25
Lead	27.7	RR	30.3	NS	3
Magnesium	99,200	RR	112,000	NS	5,000
Nickel	42.1	RR	30.3	NS	40
Zinc	160	RR	173	NS	20
B39W10S					
TOC[f]	NS	RR	1.4	NS	0.5
TOX	NS	RR	NS	7.8	5.0
Arsenic	--	RR	--	10.9	10
Magnesium	7,220	RR	7,480	7,420	5,000
Zinc	33.9	RR	--	--	20

Table 3-7

(continued)

Page 3 of 5

Well Location[c]	Quarter				Detection Limit[d]
	1	2	3	4	
B39W10M					
TOC[f]	NS	1.6	1.4	NS	0.5
TOX	NS	8.8	NS	31.6	5.0
Arsenic	11.1	19.8	14.8	13	10
Boron	100	--	--	131	100
Chromium	--	33.6[j]	--	--	10
Copper	25.7	113	72.7	32.1	25
Lead	3.7	29.3[j]	14.4	4.5[j]	3
Magnesium	18,800	13,600	56,200	17,500	5,000
Nickel	--	68.1[j]	--	--	40
Zinc	49.8	265	101	44.5	20
Methylene chloride	--	7	--	--	5
B39W14S					
TOC[f]	NS	NS	1.3	NS	0.5
Magnesium	NS	RR	11,500	NS	5,000
B39W14M					
TOC[f]	NS	NS	1.3	NS	0.5
Arsenic	NS	29.1	19	NS	10
Barium	NS	840	238	NS	200
Chromium	NS	69.8[j]	--	NS	10
Copper	NS	231	140	NS	25
Lead	NS	47.9[j]	18.6	NS	3
Magnesium	NS	189,000	61,200	NS	5,000
Nickel	NS	117	--	NS	40
Zinc	NS	400	119	NS	20
Methylene chloride	NS	7	--	NS	5

Table 3-7

(continued)

Page 4 of 5

Well Location[c]	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Detection Limit[d]
B39W15S					
TOX	NS	RR	NS	3,750	5.0
Boron	NS	RR	NS	218	100
Magnesium	NS	RR	NS	17,800	5,000
Zinc	NS	RR	NS	45.4	20
Acetone	NS	RR	NS	13	10
1,2-Dichloroethene(T)	NS	RR	120	170[j]	5
Tetrachloroethene	NS	RR	3,200	10,000	5
Trichloroethene	NS	RR	260	1,400	5
B39W19S					
TOC[f]	NS	RR	22.8	NS	0.5
TOX	NS	RR	NS	29.3	5.0
Antimony	--	RR	13.7	--	10
Boron	462	RR	400	413	100
Copper	49.6	RR	47.9	29.5	25
Lead	49.2	RR	108	72.2[j]	3
Magnesium	14,400	RR	15,800	15,000	5,000
Zinc	1,650	RR	1,740	1,500	20
BACKGROUND					
B39W02S					
TOC[f]	NS	1.3[j]	1.2	NS	0.5
TOX	NS	20.9[j]	NS	--	5.0
Magnesium	NS	18,600	12,800	13,200	5,000
Zinc	NS	--	--	26.4	20
B39W02M					
TOC[f]	NS	190[j]	42.1	NS	0.5
TOX	NS	8.6[j]	NS	24.6	5.0
Arsenic	NS	17.5[j]	12.6	27	10

Table 3-7

(continued)

Page 5 of 5

Well Location[c]	Quarter 1	2	3	4	Detection Limit[d]
B39W02M (cont.)					
Barium	NS	2,870	340	524	200
Chromium	NS	173[j]	12.4	20.1	10
Copper	NS	764[j]	83.1	152	25
Lead	NS	127[j]	9.1	32.3	3
Magnesium	NS	428,000	12,800	87,600	5,000
Nickel	NS	305[j]	44.8	49.1	40
Zinc	NS	885[j]	123	179	20
Acetone	NS	--	--	29	10

[a] Groundwater samples were not filtered before analysis.

[b] Measured background has not been subtracted.

[c] Sampling locations are shown in Figures 3-4 and 3-5.

[d] Detection limits can vary.

[e] $\mu g/L$ = ppb.

[f] TOC concentrations are in mg/L (ppm).

[g] NS = not sampled.

[h] RR = rejected based on improper purging procedure.

[i] -- = Below detection limit.

[j] Estimated.

Table 3-8

EPA and NYSDEC Guidelines as Action Levels for Water Media

Page 1 of 2

Constituent	EPA[a] Concentration (μg/L)	NYSDEC[b] (Class GA) Maximum Allowable Concentration (μg/L)
Antimony	6[c,d]	--[e]
Arsenic	50[e]	25
Acetone	4,000	--
Barium	2,000[f]	1,000
Benzene	5[f]	0.7
Cadmium	5[f]	10
Copper	1,300[g]	200
Chromium (VI)	50[f]	50
Carbon tetrachloride	5[f]	5
Chloroform	6	7
Carbon disulfide	4,000	--
Ethylbenzene	700[f]	--
Lead	15[g]	25
Manganese	--	300[h]
Methylene chloride	5	--
Nickel	100[c]	--
pH	--	--[i]
Selenium	50[f]	10
Styrene	100[f]	5
Tetrachloroethene	5[f]	--
Thallium	2[c,d]	--
Toluene	1,000[f]	--
cis-1,2-Dichloroethlene	70[f]	--
Trichloroethene	5[f]	--
1,1,1-Trichloroethane	200[f]	--
1,1,2-Trichloroethane	5[c,d]	--
Vinyl chloride	2[f]	2
Xylene (total)	10,000[f]	--
Zinc	--	300

Table 3-8

(continued)

Page 2 of 2

---

[a] EPA 1990.

[b] NYSDEC 1991.

[c] EPA 1992.

[d] Effective January 17, 1994.

[e] (--) = no standards available.

[f] Maximum contaminant level.

[g] EPA 1991.

[h] Combined concentration for iron and manganese is 500 μg/L.

[i] pH should not be less than 6.5 nor more than 8.5.

4.0 ESTIMATED DOSE

The information in Section 3.0 was evaluated as described in Appendix F to estimate the potential radiation doses to the general public and to a hypothetical maximally exposed individual from the radioactive surface soils and the HEPA system exhaust at CISS.

Doses can come from either external or internal exposures. Exposures to radiation from radionuclides outside the body are called external exposures; exposures to radiation from radionuclides deposited inside the body are called internal exposures. The distinction is important because external exposures occur only when a person is near the external radionuclides, but internal exposures continue as long as the radionuclides reside in the body.

To assess the potential health effects from CISS, radiological exposure pathways were evaluated, and radiation doses were calculated for a hypothetical maximally exposed individual and for the population within 80 km (50 mi) of the site. The combined effects from all pathways (surface water, groundwater, air, and direct gamma radiation) from all DOE sources were considered and then compared with the DOE guidelines. All doses presented in this section are estimated and do not represent actual doses. A summary is provided in Table 4-1.

4.1 HYPOTHETICAL MAXIMALLY EXPOSED INDIVIDUAL

4.1.1 Direct Gamma Radiation Pathway

The hypothetical maximally exposed individual is assumed to live in a house 69 m (230 ft) south of the southwestern property line. This is a realistic approach because houses are located approximately 69 m (230 ft) from this property line. The calculated dose does not account for any shielding provided by the housing materials.

The calculated yearly dose to this individual was determined by using the average of the annual average exposure rates (30.5 mR/yr above background; see Table 3-1) for the TETLDs along this fenceline (locations 3, 4, 5, and 6). The dose received by the hypothetical maximally exposed individual from exposure to direct gamma radiation was calculated to be 0.34 mrem/yr (3.4 × 10^{-3} mSv/yr), well below the DOE guideline of 100 mrem/yr. This approach assumes that the individual is at the house 100 percent of the year. This dose was determined using the equation given in Appendix F for this pathway.

4.1.2 Drinking Water Pathway

Only one water pathway, either groundwater or surface water, is used to determine the committed dose to the hypothetical maximally exposed individual. The individual would obtain 100 percent of his or her drinking water from either surface water or groundwater in the vicinity of the site.

Concentrations of total uranium and thorium-232 at downstream discharge points into Patroon Creek and in downgradient groundwater sampling wells in the vicinity of CISS are barely distinguishable from normal background levels. Because the only downgradient surface water source is Patroon Creek, which is not a drinking water source, the dose contribution from surface water to this individual would be negligible.

There are no drinking water wells within a 1.6-km (1-mi) radius of the site, and except in well B39W06S, radionuclide concentrations in groundwater wells near CISS are below regulatory levels of concern; therefore, the dose contribution from groundwater to a hypothetical maximally exposed individual is also negligible. Well B39W06S is an upgradient well in an area known to be radioactively contaminated. Downgradient wells show no sign that this contamination is moving offsite.

4.1.3 Air Pathway

To calculate a realistic dose to the hypothetical maximally exposed individual, the individual was assumed to live 69 m (230 ft) south of the site. The effective dose equivalent to this individual from the air pathway was determined using the results of the Clean Air Act Assessment Package-1988 (CAP88) PC computer model of the release of radionuclides from the contaminated surface soils and HEPA system exhaust. Based on the CAP88-PC calculations, the effective dose equivalent to this individual would be 0.06 mrem/yr (6.0×10^{-5} mSv/yr).

4.1.4 Total Dose

The total dose for the hypothetical maximally exposed individual is the sum of the 50-yr committed effective dose equivalent and the external effective dose equivalent, based on the total from all pathways. When these doses are added together, the total dose is 0.4 mrem/yr (4.0×10^{-4} mSv/yr) for the hypothetical maximally exposed individual in 1992. This dose is less than the dose an individual would receive from a 1-h flight in an airplane at 12,000 m (39,000 ft) because of greater amounts of cosmic radiation at higher altitudes (see Appendix C).

4.2 GENERAL POPULATION

The collective dose that the general population living within 80 km (50 mi) of the site would receive was also calculated using CAP88-PC.

4.2.1 Direct Gamma Radiation Pathway

Distance from CISS to the nearest residential area and the presence of intervening structures reduce direct gamma radiation exposure from the site. Because of this additional shielding and the low dose calculated for the hypothetical maximally exposed individual, it is reasonable to assume that there is no detectable gamma exposure to the general public above variations in normal background levels.

4.2.2 Drinking Water Pathway

No drinking water wells are located within 1.6 km (1 mi) downgradient of the site, and Patroon Creek is not a drinking water supply (this creek is used for fishing and other recreational purposes). Because the hypothetical maximally exposed individual would receive no significant dose commitment from radionuclides in drinking water, it is reasonable to assume that the general public would not receive a committed dose from drinking water.

4.2.3 Air Pathway

The CAP88-PC model, Version 1.0, provides an effective dose equivalent for contaminants transported through the air pathway at different distances from the site. Using these effective dose equivalents and the population density, the collective dose for the general population within 80 km (50 mi) of the site was calculated to be 3.95 person-rem/yr (3.95×10^{-2} person-Sv/yr).

4.2.4 Total Population Dose

The total population dose is the sum of the doses from all exposure pathways. The collective population dose [3.95 person-rem/yr (3.95×10^{-2} person-Sv/yr)] is extremely small when compared with the collective population dose from natural background gamma radiation in the area [3.9×10^{4} person-rem/yr (3.9×10^{2} person-Sv/yr)].

TABLE FOR SECTION 4.0

Table 4-1

Summary of Calculated Doses[a] for CISS, 1992

Exposure Pathway	Dose for Hypothetical Maximally Exposed Individual (mrem/yr)[b]	Collective Dose for Population Within 80 km of Site (person-rem/yr)[b]
Direct gamma radiation[c]	0.34	--[d]
Drinking water	--[d]	--[d]
Ingestion	--[d]	--[d]
Inhalation[e] - HEPA system	0.005	0.2
- Surface soils	0.048	3.7
Total	0.4[f]	3.95
Background[g]	50	3.9×10^{4}[h]

[a] Does not include radon.

[b] 1 mrem/yr = 0.01 mSv/yr; 1 person-rem/yr = 0.01 person-Sv/yr.

[c] Does not include contribution from background.

[d] Exposure from this pathway is negligible.

[e] Calculated using EPA's CAP88-PC model (Version 1.0, Appendix F). NESHAPs guideline for inhalation is an effective dose equivalent of 10 mrem/yr.

[f] DOE guideline for total exposure to an individual is 100 mrem/yr (DOE 1990).

[g] Direct gamma radiation exposure only.

[h] Calculated by the following: (50 mrem/yr) (7.8×10^{5} people).

5.0 QUALITY ASSURANCE

5.1 INTRODUCTION

This section summarizes the quality assurance (QA) assessment of environmental activities at the site, which were conducted to ensure that onsite contamination does not pose a threat to human health or the environment. Using this criterion, the overall project data quality objective (DQO) for the environmental surveillance program is to provide data of sufficient quality to allow reliable detection and quantitation of potential release of contaminated material from the site. DQO requirements are assessed annually during review of the environmental monitoring plan (BNI 1993a) and are updated based on historical information, trends identified, and changes in environmental regulations.

5.2 PROCEDURES

The *Quality Assurance Program Plan for the U.S. DOE FUSRAP* (BNI 1992b) addresses the quality requirements for work being performed under FUSRAP. This plan requires all subcontractors to implement a compatible plan for QA or use the DOE plan. This is done to ensure compatibility with all requirements to maintain protection of human health and the environment.

QA procedures are detailed in project procedures and project instructions and are implemented for all field activities. Sampling techniques have been derived from several documents, including *A Compendium of Superfund Field Operations Methods* (EPA 1987) and the EPA Region II QA manual. Laboratory QA procedures are derived from applicable EPA methods to ensure compatibility of the results. Also, activities such as data reviews, calculation checks, and data evaluations are incorporated into procedures to monitor results and prevent or identify quality problems.

5.3 QUALITY ASSURANCE SUMMARY

QA/quality control (QA/QC) activities are an integral part of all environmental monitoring activities at the site. The specific methods, definitions, and formulas used to evaluate the QA/QC program are described in the *Quality Assurance Document for Site Environmental Reports* (BNI 1993b). This document also discusses precision, accuracy, representativeness, comparability, and completeness (PARCC). For informational purposes, brief definitions or explanations will be given throughout this chapter for terms and processes used during the QA/QC evaluation.

The QA/QC program satisfies the requirements of DOE Orders 5400.1, 5400.5, and 5700.6C. The programmatic controls in place for the environmental surveillance program are discussed in project instruction guides.

5.3.1 Data Usability

To determine data usability, a verification process is used that evaluates items such as holding times and results for method blanks, spike recoveries, and duplicates. This information is then used to verify whether the data are of sufficient quality to serve as the basis for decisions about the site. During this process, two qualifiers are associated with the data if there is any question concerning their usability: "J" — the data result is estimated and should be used with discretion, and "R" — the data result is rejected and should not be used.

The data are then evaluated using the PARCC parameters to determine whether the information is sufficient to make decisions concerning the site. Any major problems encountered are documented as nonconformances or observation reports and are tracked to ensure correction.

The results of the PARCC evaluation are presented as a percentage that met requirements. The formula used is:

$$\frac{\text{number of results that met EPA requirements}}{\text{total number of results}} \times 100 = \text{percent acceptable}$$

For Tables 5-1 through 5-5, a generic 80 percent has been used as an acceptable level. Representativeness and comparability cannot have a percentage applied; see Subsections 5.3.4 and 5.3.5 for definitions and discussions of these two parameters.

5.3.2 Precision

Precision is defined as a measurement of the agreement of a set of replicate results among themselves without assumption of any prior information about the true result. Precision is assessed through the use of duplicate or matrix spike (MS) and matrix spike duplicate (MSD) results. MSs and MSDs are usually used with organic analytes; inorganic analytes are generally run as a true duplicate and a single matrix spike. Field duplicates are also used to assess field precision and are presented separately from the laboratory duplicates. Table 5-1 lists the results for laboratory precision All results met the requirements for acceptability.

Table 5-2 provides the results for field duplicates. TOX and TOC failed the 80 percent criterion for chemical results. Only one pair of duplicates was analyzed for these parameters, and the results were outside of the 20 percent precision range. For thorium-232 and total uranium, two sets of duplicates were analyzed. Results for one of the duplicates failed because of the low activities involved; one result was slightly above the detection limit, and one result was below the detection limit. Because of the limited number of duplicates for the failed parameters, there is no impact on the associated data.

Table 5-3 gives the results for the laboratory radiochemical duplicates. Results for thorium-232 failed the 80 percent criterion. The result was 66 percent; as shown in Table 5-1, this is because of the small number of duplicates. The use of 20 percent relative percent difference (RPD) for radiochemical duplicates was derived from *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA 1988).

5.3.3 Accuracy

Accuracy is defined as the nearness of a result or the mean of a set of results to the true, known, or reference value. The assessment of accuracy may be determined through standard reference materials, MSs, laboratory control samples, and surrogate spikes.

Table 5-4 gives the results for the chemical spikes. All results were above the 80 percent level, except for metals results, which were at 69 percent. The problem encountered was low recovery of the MSs. This gives a strong indication of a matrix interference that the laboratory cannot overcome. Results for radiological spikes, provided in Table 5-5, were all acceptable. The use of recovery windows of 75 to 125 percent for radiological spikes was derived from *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA 1988).

5.3.4 Representativeness

Field sampling and laboratory analytical representativeness expresses the degree to which the data accurately and precisely represent the matrix from which the samples were obtained. The term representativeness generally expresses the extent to which the data generated define an environmental condition.

To ensure field sampling representativeness, controls were used during sampling, including the use of dedicated bladder pumps and trip blanks for volatiles.

To ensure representativeness in the laboratory, constraints are placed on analytical methodology. Method blanks are prepared for each parameter analyzed, both organic and inorganic, with an associated frequency of 1 per batch of no more than 20 samples. A method or preparation blank is used to determine whether contaminants are present in the laboratory that could affect the samples associated with that method blank. The presence of contaminants can indicate the potential for false positive results.

The possibility of false negative results can also be reduced through the use of sample preservatives and holding times. All samples were preserved at the time of sampling by adding required chemicals and/or using refrigeration. The use of preservatives limits biological and chemical degradation that would bias sample results.

Table 5-6 lists the contaminants and their concentrations in trip blanks and laboratory method blanks. The method and trip blank contamination was acetone, methylene chloride, 2-hexanone, chloroform, and TOX. EPA has recognized that certain analytes may be present in the laboratory, and some contamination should be expected. The rules governing these contaminants allow up to five times the quantitation or detection limit of these analytes. All the results were below this requirement.

5.3.5 Comparability

Comparability expresses the confidence with which data are compared with each other. Comparability also takes into account the use of equivalent instrumentation and methodology. The laboratories follow approved procedures that are consistent with EPA and industry-accepted practices, and comparability is maintained.

5.3.6 Completeness

Completeness measures the amount of usable data resulting from the data collection activities compared with the total data possible. Subsection 5.3.1 discussed data rejected during the verification process and the resulting impact on acceptability percentages.

Table 5-7, which summarizes the acceptability rate for all analytes, shows that all analytes meet the 80 percent criterion.

5.3.7 Interlaboratory Programs

The radiochemistry laboratory participates in the Environmental Measurements Laboratory's Quality Assessment Program, EPA's Cross Check Program, and the Nuclear Fuel Services' Interlab Quality Control Comparison. The chemical laboratory participates in EPA's water supply and water pollution programs and analyzes quarterly, single-blind samples submitted by FUSRAP. Results for these programs are submitted to FUSRAP. Repeated failure of an analyte for consecutive periods results in the suspension of that analyte until corrective actions have been taken. Table 5-9 provides the radiochemistry laboratory results from the DOE Quality Assessment Program. Table 5-10 gives the results from the EPA Intercomparison Program.

TABLES FOR SECTION 5.0

Table 5-1

Results[a] for Laboratory Duplicates

Parameters	Percent Acceptable	Meets Established DQOs
Metals	95	Yes
Volatiles	100	Yes
TOX	100	Yes
TOC	100	Yes

[a] Rejected QA/QC results are not included.

Table 5-2

Results[a] for Field Duplicates[b]

Parameters	Percent Acceptable	Meets Established DQOs
Metals	98	Yes
Volatiles	96	Yes
TOC	0	No
TOX	0	No
Thorium-232[c]	50	No
Total uranium[c]	50	No

[a] Rejected QA/QC results are not included.

[b] Acceptability is based on a 20 percent RPD.

[c] Duplicates failed because of low activities.

Table 5-3

Results[a] for Laboratory Radiochemical Duplicates

Parameters	Percent Acceptable	Meets Established DQOs
Thorium-232[b]	66	No
Total uranium	100	Yes

[a] Acceptability is based on a 20 percent RPD.

[b] Duplicates failed because of low activity.

Table 5-4

Results[a] for Chemical Spike Recoveries

Parameters	Percent Acceptable	Meets Established DQOs
Metals[b]	69	No
Volatiles	100	Yes
TOX	100	Yes
TOC	100	Yes

[a] Rejected QA/QC results are not included.

[b] Indications are that metal recoveries failed because of matrix interference.

Table 5-5

Results[a] for Radiological Spike Recoveries

Parameters	Percent Acceptable	Meets Established DQOs
Thorium-232	100	Yes
Total uranium	100	Yes

[a] Acceptablity is based on 75 to 125 percent recovery.

Table 5-6

Results for Laboratory Blanks

Parameters	Maximum Concentration (μg/L)
Acetone	30
Methylene chloride	14
2-Hexanone	8
Chloroform	2
TOX	7.6

Table 5-7

Usability Rate for Each Analyte[a]

Page 1 of 2

Parameters	Percent Acceptable	Meets Established DQOs
Metals		
Antimony	100	Yes
Arsenic	100	Yes
Barium	100	Yes
Boron	100	Yes
Cadmium	100	Yes
Chromium	100	Yes
Copper	97	Yes
Lead	100	Yes
Magnesium	100	Yes
Nickel	100	Yes
Selenium	95	Yes
Thallium	100	Yes
Zinc	100	Yes
TOX	100	Yes
TOC	100	Yes
Volatiles		
Chloromethane	100	Yes
Bromomethane	100	Yes
Vinyl chloride	100	Yes
Chloroethane	100	Yes
Methylene chloride	100	Yes
Acetone	100	Yes
Carbon disulfide	100	Yes
1,1-Dichloroethene	100	Yes
1,1-Dichloroethane	100	Yes
1,2-Dichloroethene (total)	100	Yes
Chloroform	100	Yes
1,2-Dichloroethane	100	Yes
2-Butanone	100	Yes
1,1,1-Trichloroethane	100	Yes
Carbon tetrachloride	100	Yes
Bromodichloromethane	100	Yes
1,2-Dichloropropane	100	Yes
cis-1,3-Dichloropropene	100	Yes
Trichloroethene	100	Yes

Table 5-7

(continued)

Parameters	Percent Acceptable	Meets Established DQOs
Volatiles (cont'd)		
Dibromochloromethane	100	Yes
1,1,2-Trichloroethane	100	Yes
Benzene	100	Yes
trans-1,3-Dichloropropene	100	Yes
Bromoform	100	Yes
4-Methyl-2-pentanone	100	Yes
2-Hexanone	100	Yes
Tetrachloroethene	100	Yes
Toluene	100	Yes
1,1,2,2-Tetrachloroethane	100	Yes
Chlorobenzene	100	Yes
Ethyl benzene	100	Yes
Styrene	100	Yes
Xylenes (total)	100	Yes
2-Chloroethylvinylether	100	Yes
Acrolein	100	Yes
Acrylonitrile	100	Yes
Vinyl acetate	100	Yes
Radiological		
Thorium-232	100	Yes
Total uranium	100	Yes

[a] Based on 3 quarters of data.

Table 5-8

Radiochemistry Laboratory Performance on DOE Quality Assessment Program Samples in 1992

Sample Media	Radionuclides	Number of Results Reported	Number Within Control Limits
Air filters	Uranium (mass)	1	1
Soil	Potassium-40 Strontium-90 Cesium-137 Uranium (mass)	4	3
Vegetation	Potassium-40 Strontium-90 Cesium-137	3	3
Water	Tritium Manganese-54 Cobalt-60 Cesium-134 Cesium-137 Cerium-144 Plutonium-238 Plutonium-239 Americium-241 Uranium (mass)	10	9

Table 5-9

Radiochemistry Laboratory Performance on EPA Intercomparison Program Samples in 1992

Sample Media	Radionuclides	Number of Results Reported	Number Within Control Limits
Water	Alpha Beta Zinc-65 Cobalt-60 Ruthenium-106 Cesium-134 Cesium-137 Barium-133	26	24
Water	Radium-226 Radium-228 Plutonium-239 Uranium (natural)	16	16
Water	Strontium-89 Strontium-90	7	6
Water	Tritium	2	2
Air filters	Alpha Beta Strontium-90 Cesium-137	7	5

REFERENCES

Bechtel National, Inc. (BNI), 1991. *Waste Minimization and Pollution Prevention Awareness Plan*, Oak Ridge, Tenn. (June).

BNI, 1992a. *Colonie Interim Storage Site Annual Environmental Report for Calendar Year 1991*, DOE/OR/21949-341, Oak Ridge, Tenn. (September)

BNI, 1992b. *Quality Assurance Program Plan for the U.S. DOE FUSRAP*, Oak Ridge, Tenn. (December 11).

BNI, 1993a. *Environmental Monitoring Plan for the Colonie Interim Storage Site* (Draft), 139-EMP-Rev. 0, Oak Ridge, Tenn. (February).

BNI, 1993b. *Quality Assurance Document for Site Environmental Reports*, DOE/OR/21949-362, Oak Ridge, Tenn. (March).

Cember, H., 1983. *Introduction to Health Physics*, Pergamon Press, Oxford.

Department of Energy (DOE), 1987. "Guidelines for Residual Radioactive Material at Formerly Utilized Sites Remedial Action Program and Surplus Facilities Management Program Sites," Revision 2 (March).

DOE, 1988. Order 5400.1, "General Environmental Protection Program" (January 9).

DOE, 1989. A *Manual for Implementing Residual Radioactive Material Guidelines*, ANL/ES-160, DOE/CH/8901.

DOE, 1990. Order 5400.5, "Radiation Protection of the Public and the Environment" (February 5).

Department of Health, Education, and Welfare (HEW), 1970. *Radiological Health Handbook*, Rockville, Md. (January).

Department of Health, Office of Public Health (DHOPH), 1984. Letter from William J. Condon to Lowell Campbell (DOE), "Proposed Criteria for Decontamination Around the NL Site" (February 9).

Dineen, R. J., 1975. *Geology and Land Uses in the Pine Bush, Albany County, New York*, N.Y. State Museum Science Services Circular 47, Albany, N.Y.

Eisenbud, M., 1987. *Environmental Radioactivity*, Viking Press, New York.

Environmental Protection Agency (EPA), 1987. *A Compendium of Superfund Field Operations Methods*, Vol. 2, EPA/540/P-87/001b (August).

EPA, 1988. *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (Draft) (July 1).

EPA, 1990. "Maximum Contaminant Levels (MCLs) Promulgated Under the Safe Drinking Water Act (42 U.S.C. Section 300f)" (July 27).

EPA, 1991. "Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule," 40 CFR Parts 141 and 142 (June 7).

EPA, 1992. "Drinking Water; National Primary Drinking Water Regulations—Synthetic Organic Chemicals and Inorganic Chemicals" (57 FR 31776), CFR Parts 141 and 142 (July 17).

New York State Department of Environmental Conservation (NYSDEC), 1991. "Water Quality Regulations for Surface Waters and Groundwaters," 6 NYCRR Parts 700-705 (September 1).

National Oceanic and Atmospheric Administration (NOAA), 1993. Local Climatological Data, Albany County Airport, Albany, N.Y.

Shleien, B., 1989. *The Health Physics and Radiological Health Handbook*, Santa, Inc., Silver Spring, Md.

APPENDIX A Hydrogeologic Details

HYDROGEOLOGIC DETAILS

CISS is situated in the Pine Bush surficial sand aquifer (as described in Subsection 1.3). Site exploration data indicate that the aquifer is divided into two zones. The upper zone is composed of wind-blown (dune) and lake (upper sand) sands. The lower zone is composed of lake and silt (lower sand). The two zones are separated by lake clay and silt (upper clay), which is of variable thickness and may have been removed by erosional scour in some areas of the site. Underlying the lower zone is a thick sequence of lake clay and silty clay (lower clay). Superimposed on this simplified geologic system is a Holocene stream channel (Figure A-1), which erosionally truncates the upper zone sediments and partially or completely penetrates the upper clay. The channel has been backfilled with contaminated waste, building rubble, and other debris.

Boring B39G09 (same location as well B39W19M, Figure A-2) was drilled through the lower clay to locate the Colonie Channel buried-valley aquifer. The boring was terminated in the glacial till unit, which immediately overlies bedrock, without encountering the stratified drift deposits that comprise the buried-valley aquifer. The absence of the aquifer at this borehole and the small area of the site relative to the area of the Colonie Channel indicate that the aquifer is probably not present beneath CISS.

Borings have not been drilled into the Snake Hill Shale aquifer at CISS. Thus, the depth to or the configuration of this aquifer at CISS cannot be determined.

GROUNDWATER LEVELS

Groundwater levels have been measured routinely in CISS monitoring wells since 1988 (Figure A-3). Variations in groundwater levels with time are evaluated by plotting groundwater level elevations (measured in a monitoring well) versus time to create a hydrograph. Spatial variations are evaluated by plotting groundwater level elevations from different monitoring wells taken over a short interval of time (typically less than 2 days), and contouring the data to create a potentiometric surface map. These two data presentation techniques are typically used together to evaluate groundwater level data. Hydrographs are examined to determine when groundwater levels are at their maximum or minimum elevations. Groundwater elevations measured during these periods are used to prepare potentiometric surface contour maps to represent these two data extremes.

Hydrographs of two monitoring wells, B39W02M (lower zone) and B39W02S (upper zone), are presented in Figures A-4 and A-5; B39W10M (lower zone) and B39W10S (upper zone) are shown in Figures A-6 and A-7. Hydrographs of well pairs monitoring the upper and lower zones are plotted on the same graph. The hydrographs were evaluated for both seasonal (one-year period) and long-term (multiple-year period) trends in groundwater levels. The sample hydrographs (Figures A-4 and A-6) show that groundwater levels in the upper and lower monitoring zones generally respond similarly. Groundwater elevations in the upper zone are typically 0.2 to 0.6 m (0.5 to 2 ft) above groundwater elevations in the lower zone. The sample hydrographs in Figures A-5 and A-7 exhibit typical seasonal trends, with maximum groundwater elevations in the spring and minimum elevations in the late summer or fall. The typical change in groundwater elevations over a year, observed in monitoring wells at CISS, ranges from 0.6 to 0.9 m (2 to 3 ft). These hydrographs show periodic, abrupt declines and increases in groundwater levels in response to precipitation events, giving the hydrographs a "sawtooth" appearance. The abrupt drop in water level is caused by purging during groundwater sampling activities at the well. A long-term trend of decline in groundwater levels is observed on the hydrographs from 1990 to 1992. This trend is probably associated with a decline in precipitation because precipitation is the source of recharge for the groundwater system.

Potentiometric surface maps for the upper and lower monitoring zones of the surficial sand aquifer were prepared for time intervals representing seasonal high and low groundwater elevations in 1992. Figures A-8 and A-9 are potentiometric surface maps for the upper zone, and Figures A-10 and A-11 are potentiometric surface maps for the lower zone. In the upper zone, groundwater generally flows toward the southwest or south. A secondary flow component toward the east is present on the western edge of the site. These flow directions represent a deviation from the regional groundwater flow direction, which is toward the south. This deviation appears to be associated with the backfilled Holocene channel. The hydraulic gradient (head loss divided by flow distance) determined from the upper zone potentiometric surface maps does not vary significantly spatially or with seasonal groundwater level changes. The hydraulic gradient in the upper monitoring zone is approximately 0.02. Groundwater flow in the lower monitoring zone is generally toward the south-southwest in the eastern half of the site and toward the south-southeast in the western half of the site. The lower monitoring zone does not appear to be influenced by the backfilled Holocene channel; however, the lack of lower zone monitoring wells in the area west of the CISS main building may prevent this influence from being detected. Hydraulic gradients in the lower zone vary spatially across the site. The lower zone hydraulic gradient is approximately 0.02 (the same as for the upper zone) in the eastern half of the site, but in the western portion the hydraulic gradient increases to approximately 0.03. The hydraulic gradient does not appear to vary significantly with seasonal variations in groundwater levels. Radiological and chemical results are presented in Tables A-1 through A-6.

FIGURES FOR APPENDIX A

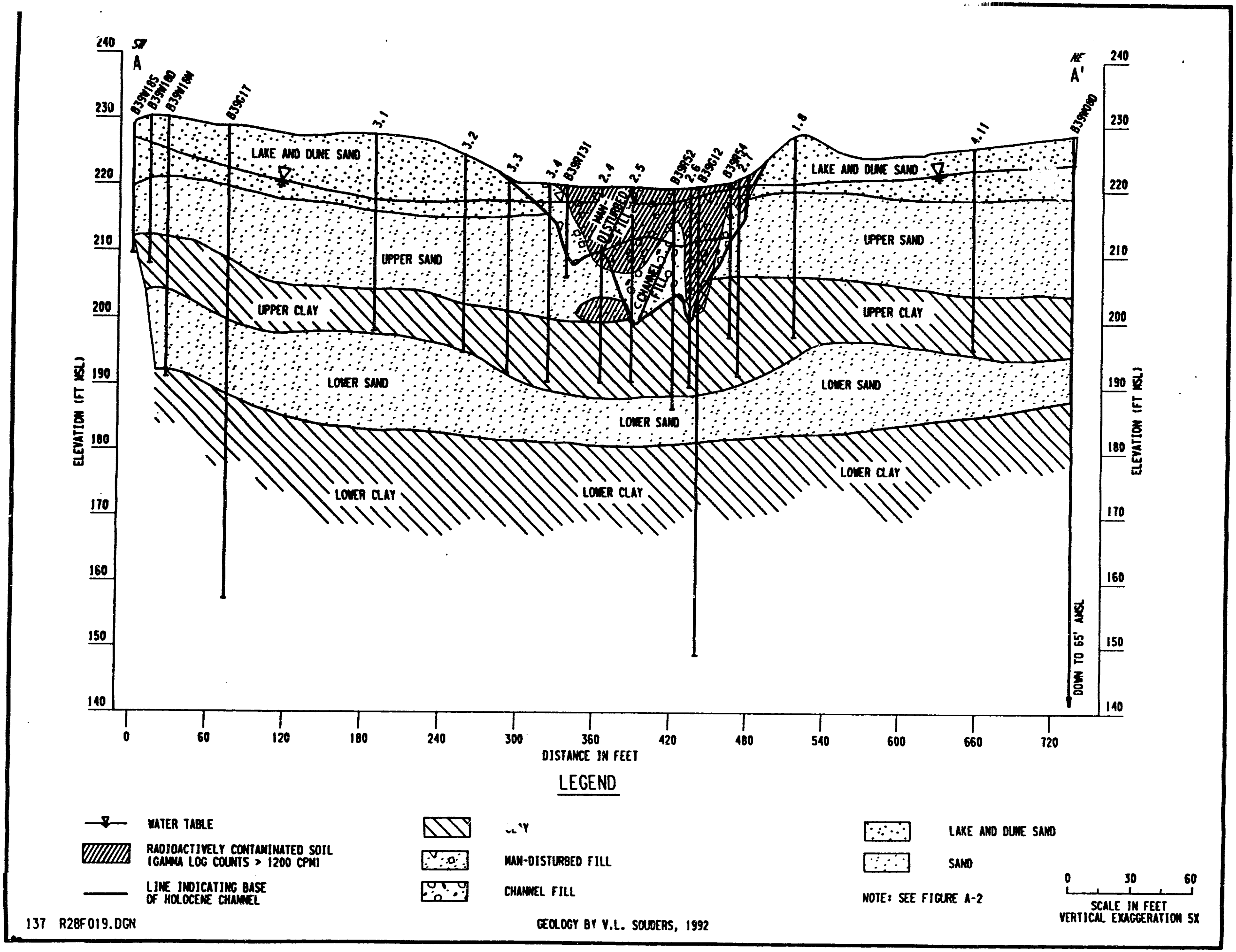
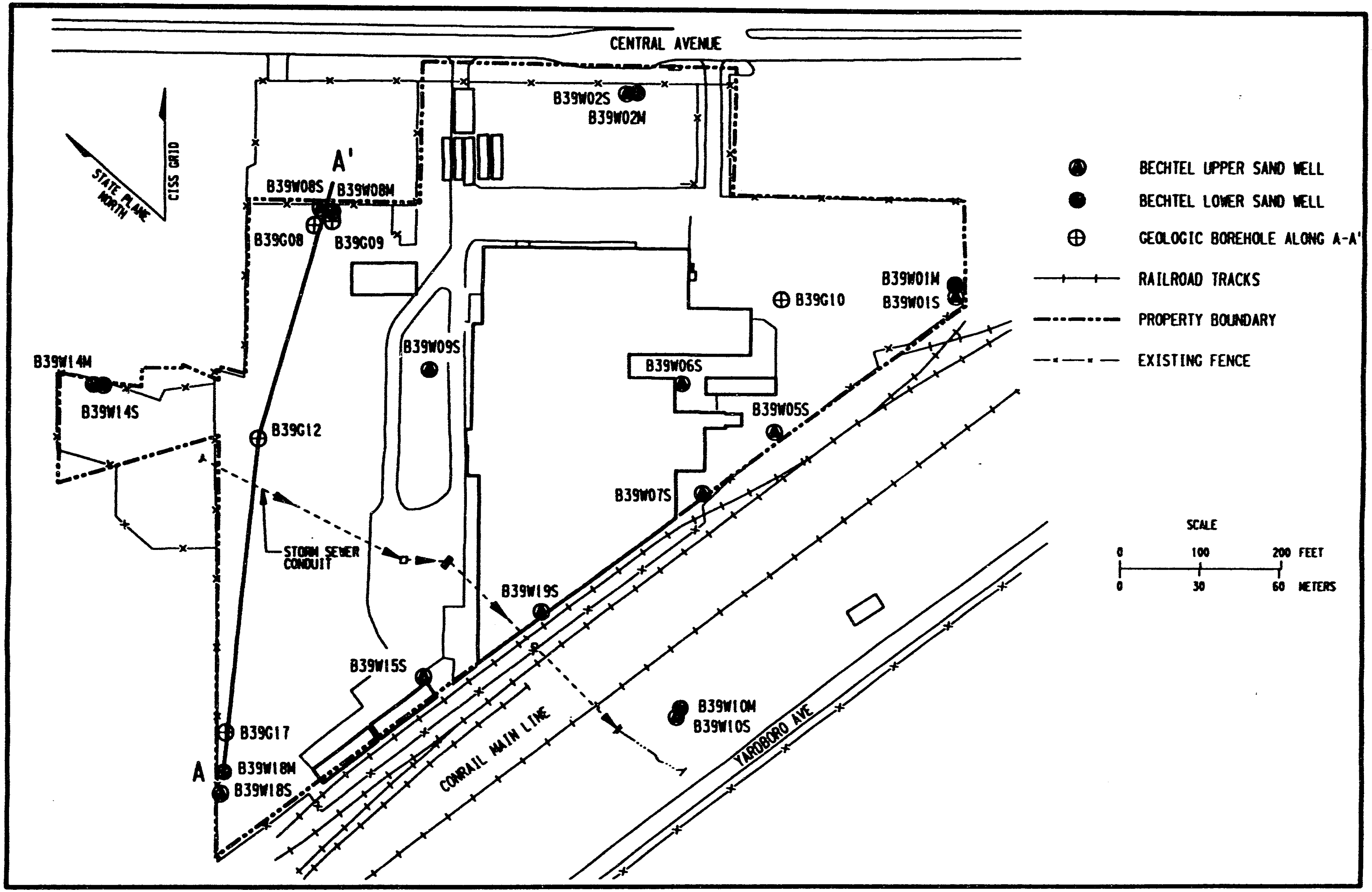
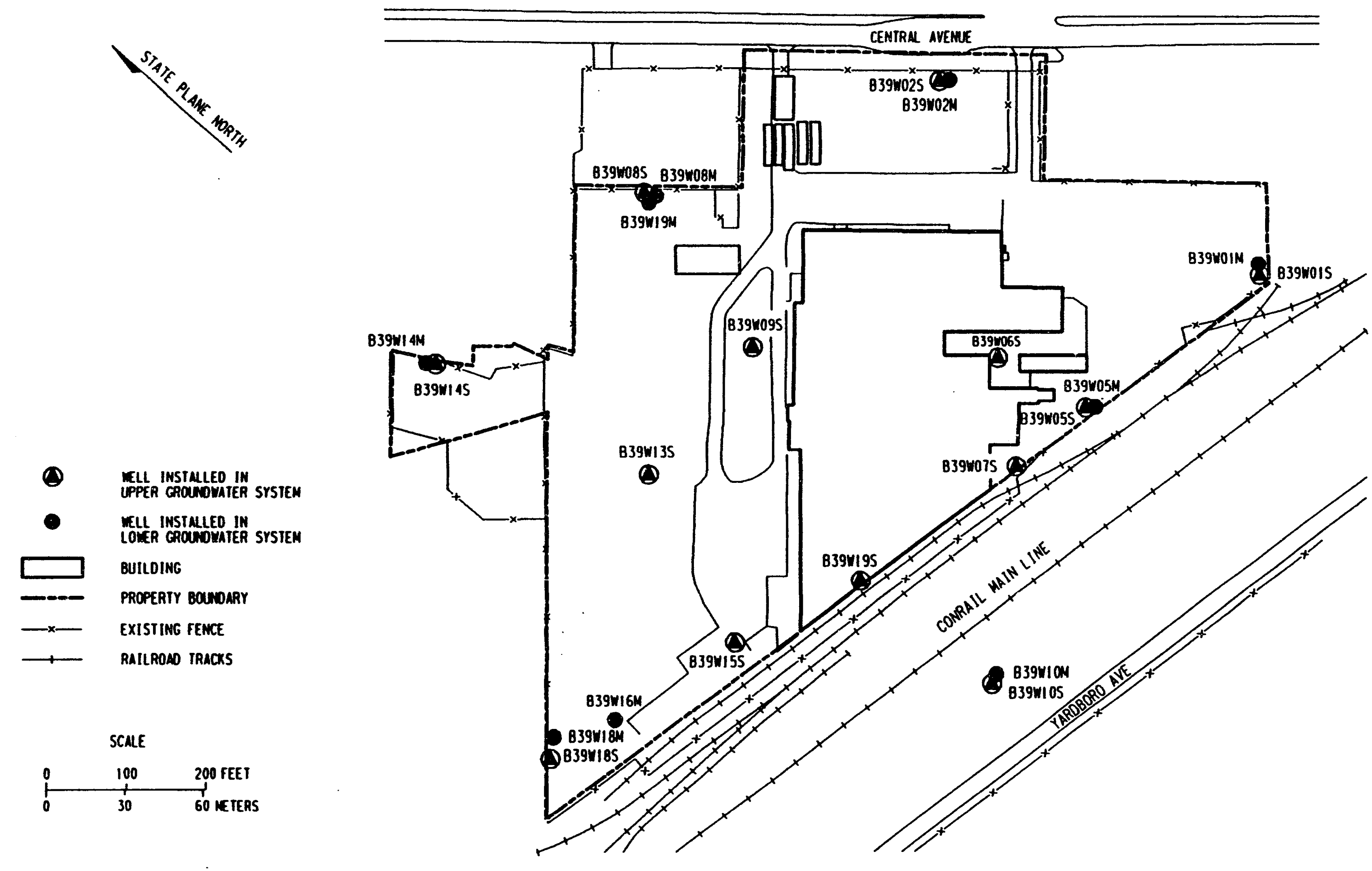


Figure A-1
Geologic Cross Section A-A'



R37 R37F021.DGN

Figure A-2
Location Map Showing Cross Section A-A'



Source: Adapted from BNI 1992a

R37 R37F015.DGN

Figure A-3
Wells Used for Water Level Measurements

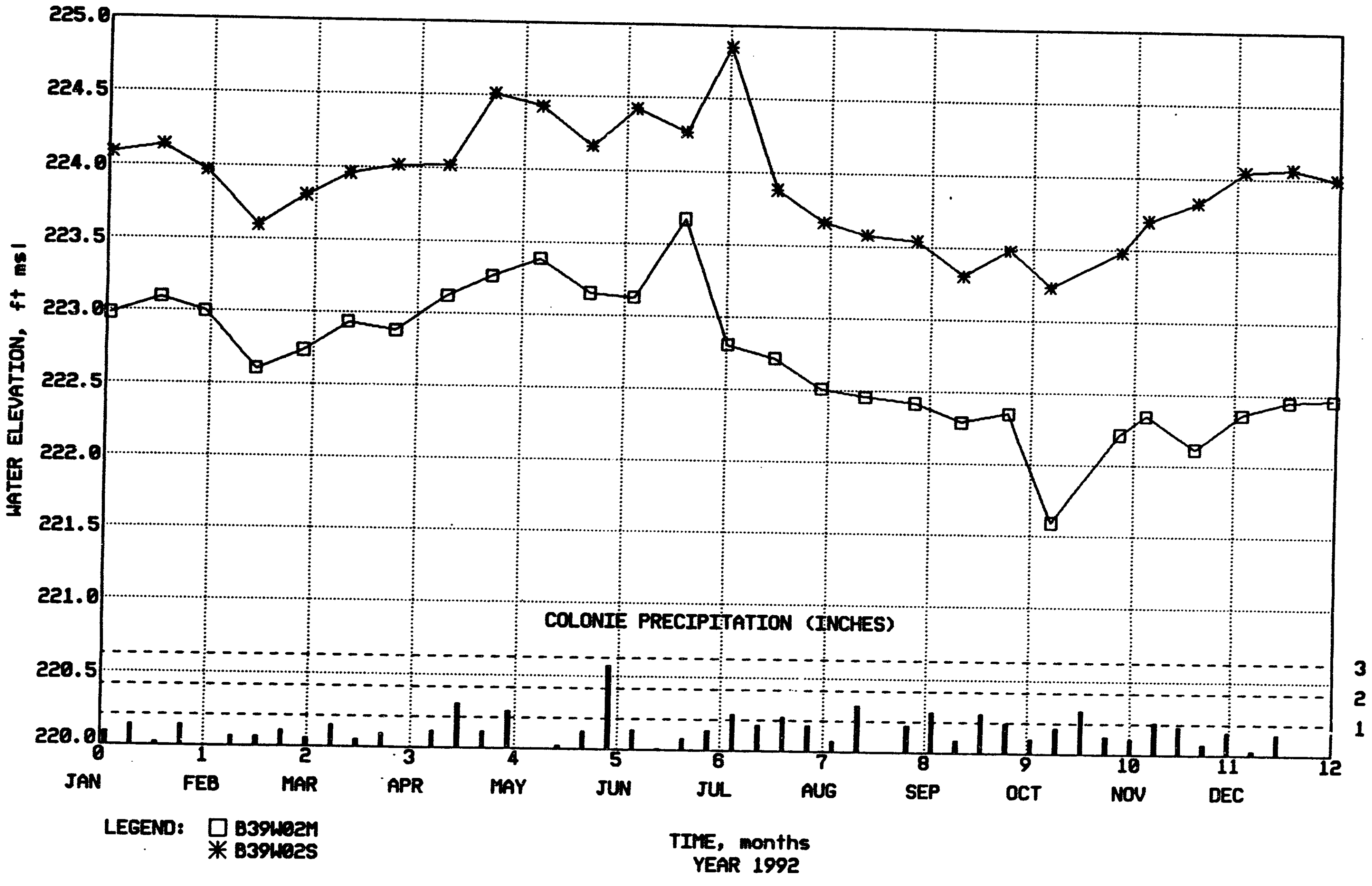


Figure A-4
Hydrograph for Wells B39W02M AND B39W02S (1992)

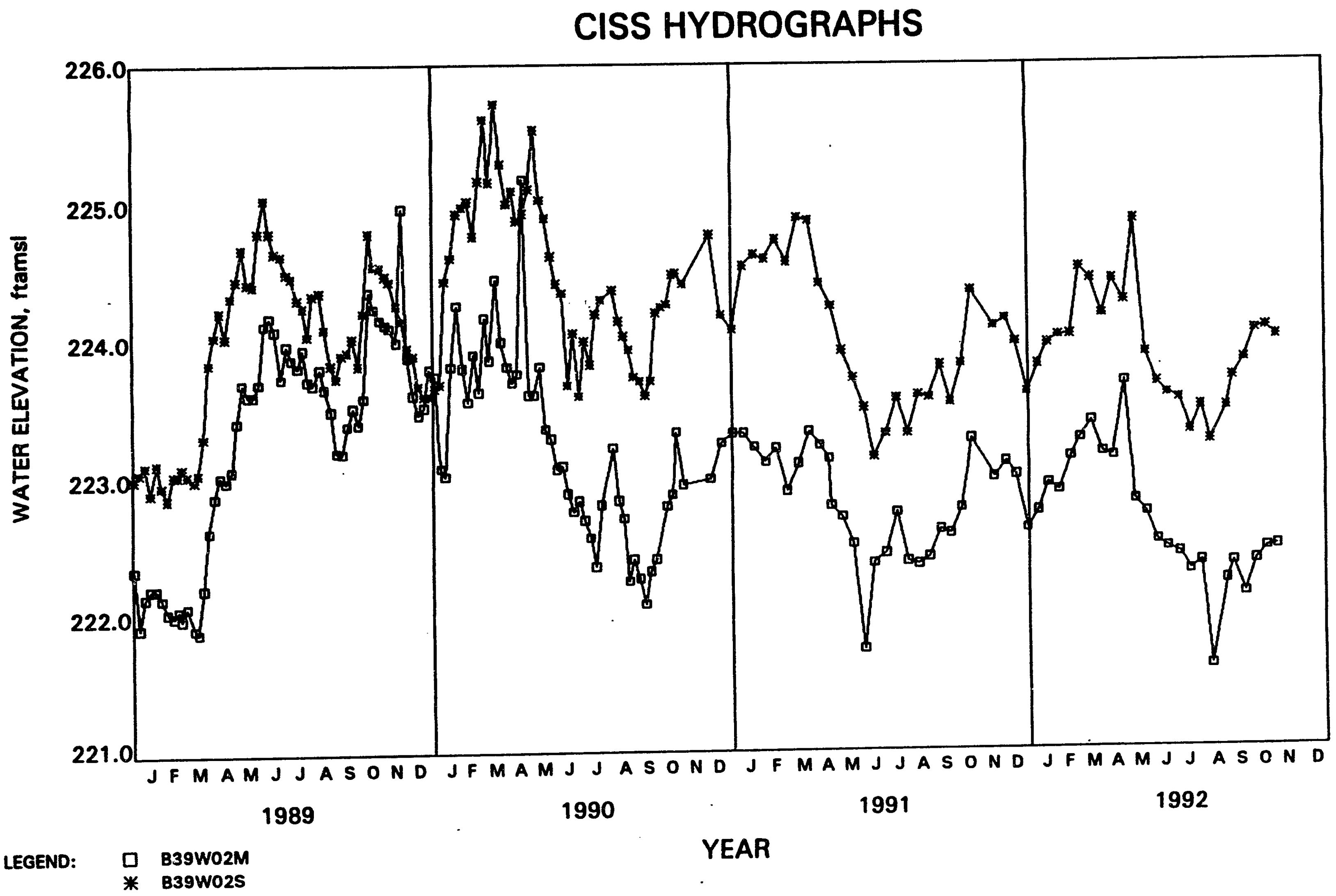


Figure A-5
Hydrograph for Wells B39W02M and B39W02S (1989-1992)

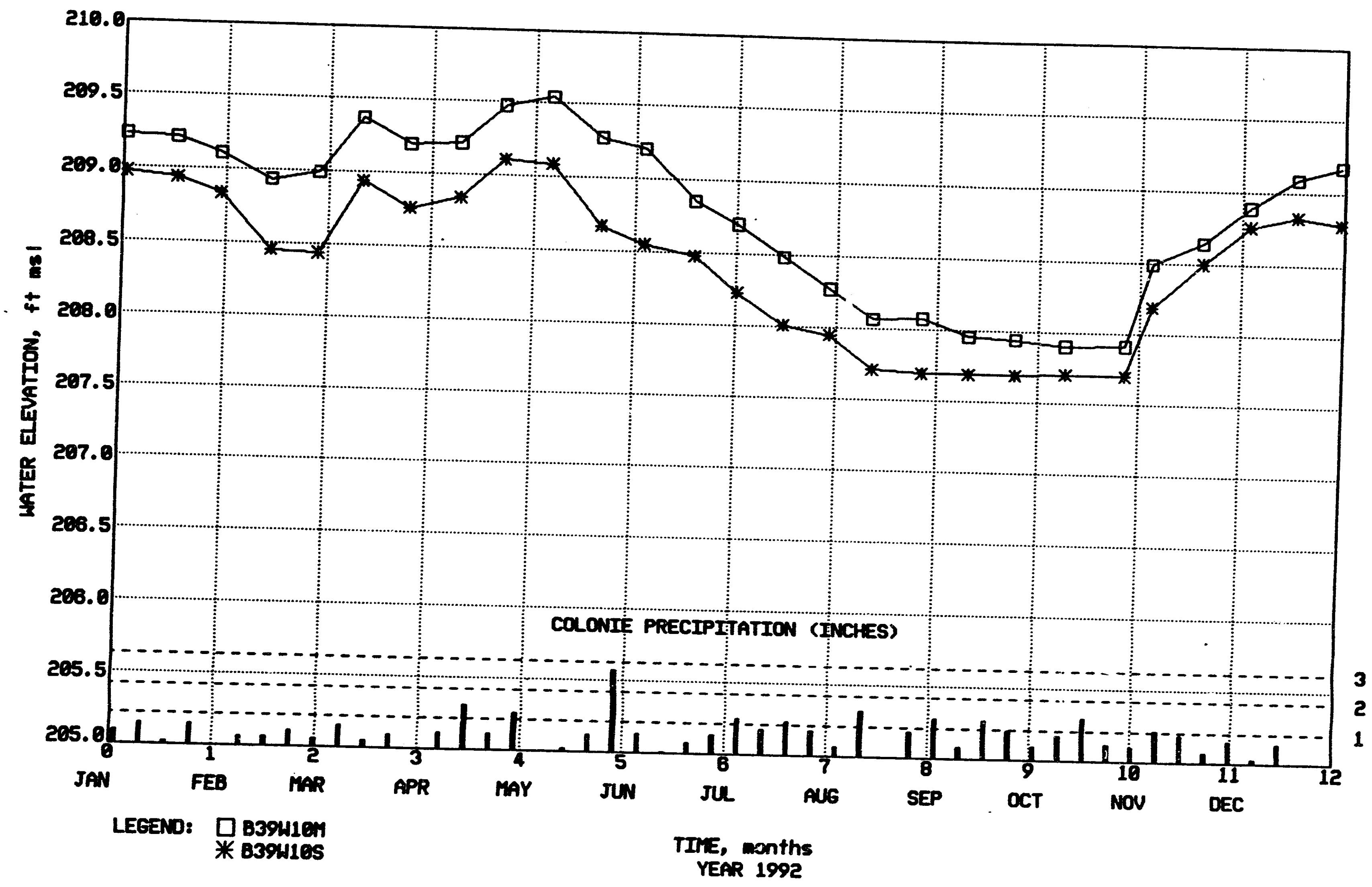


Figure A-6
Hydrograph for Wells B39W10M and B39W10S (1992)

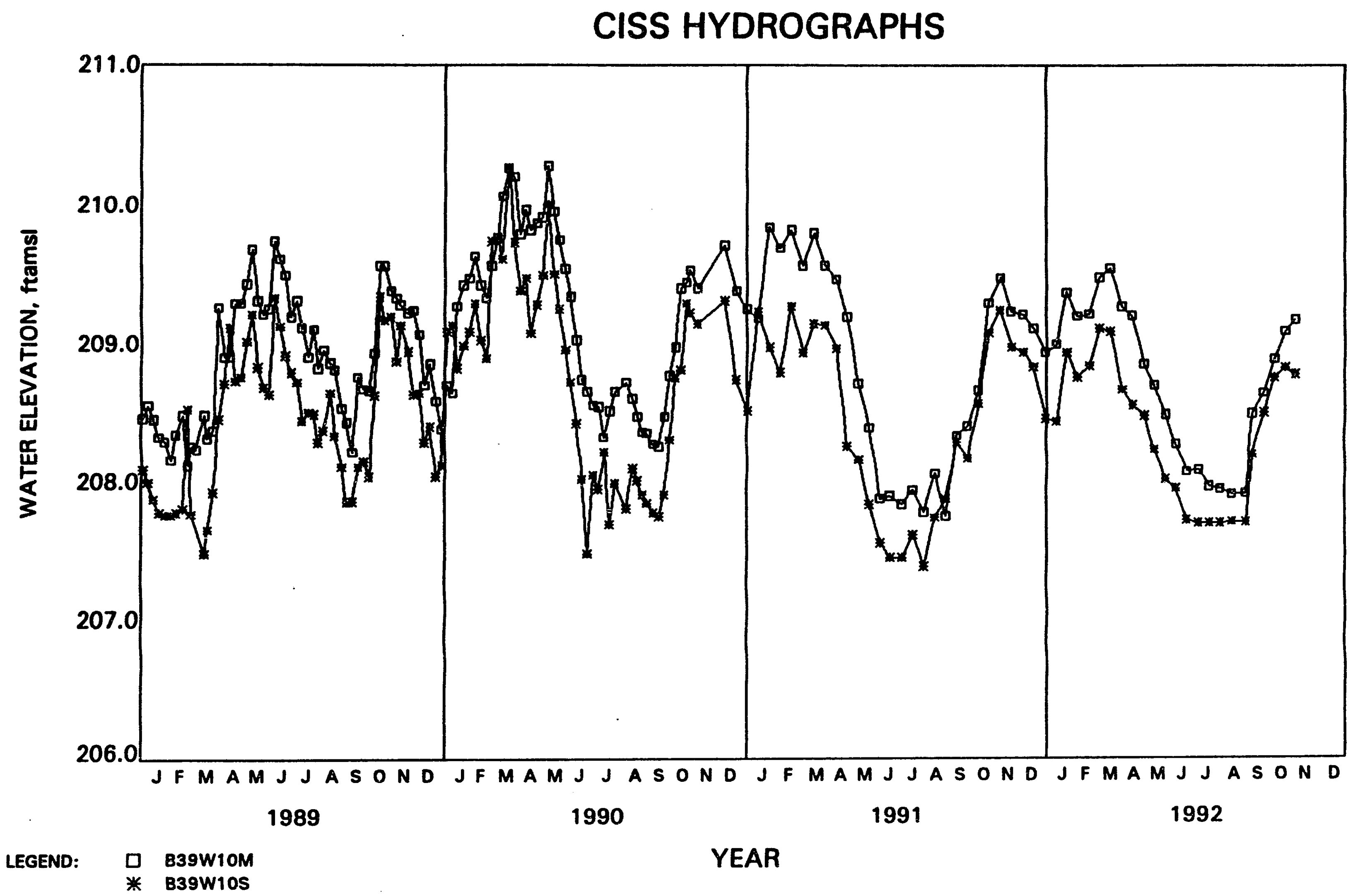
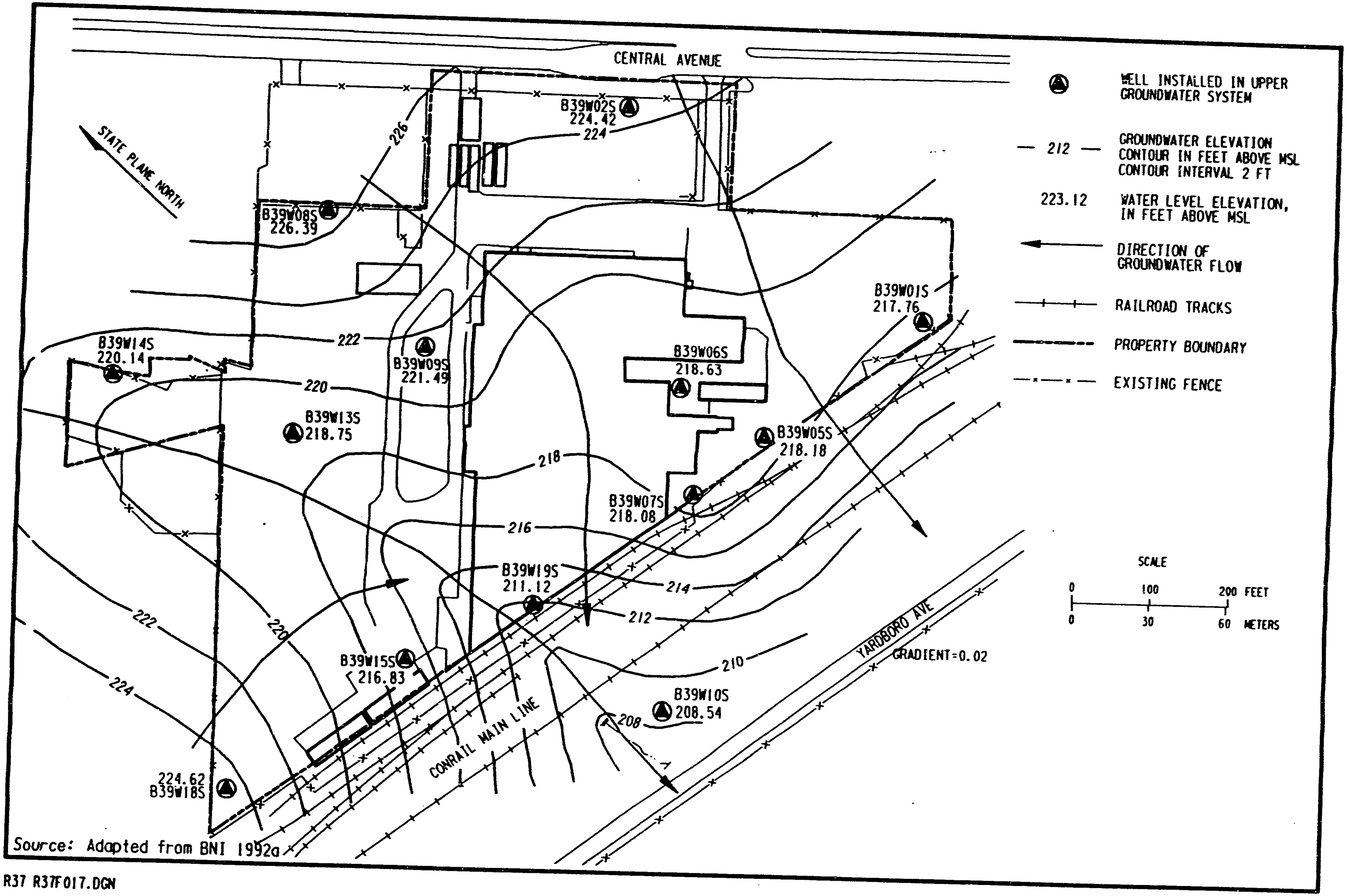


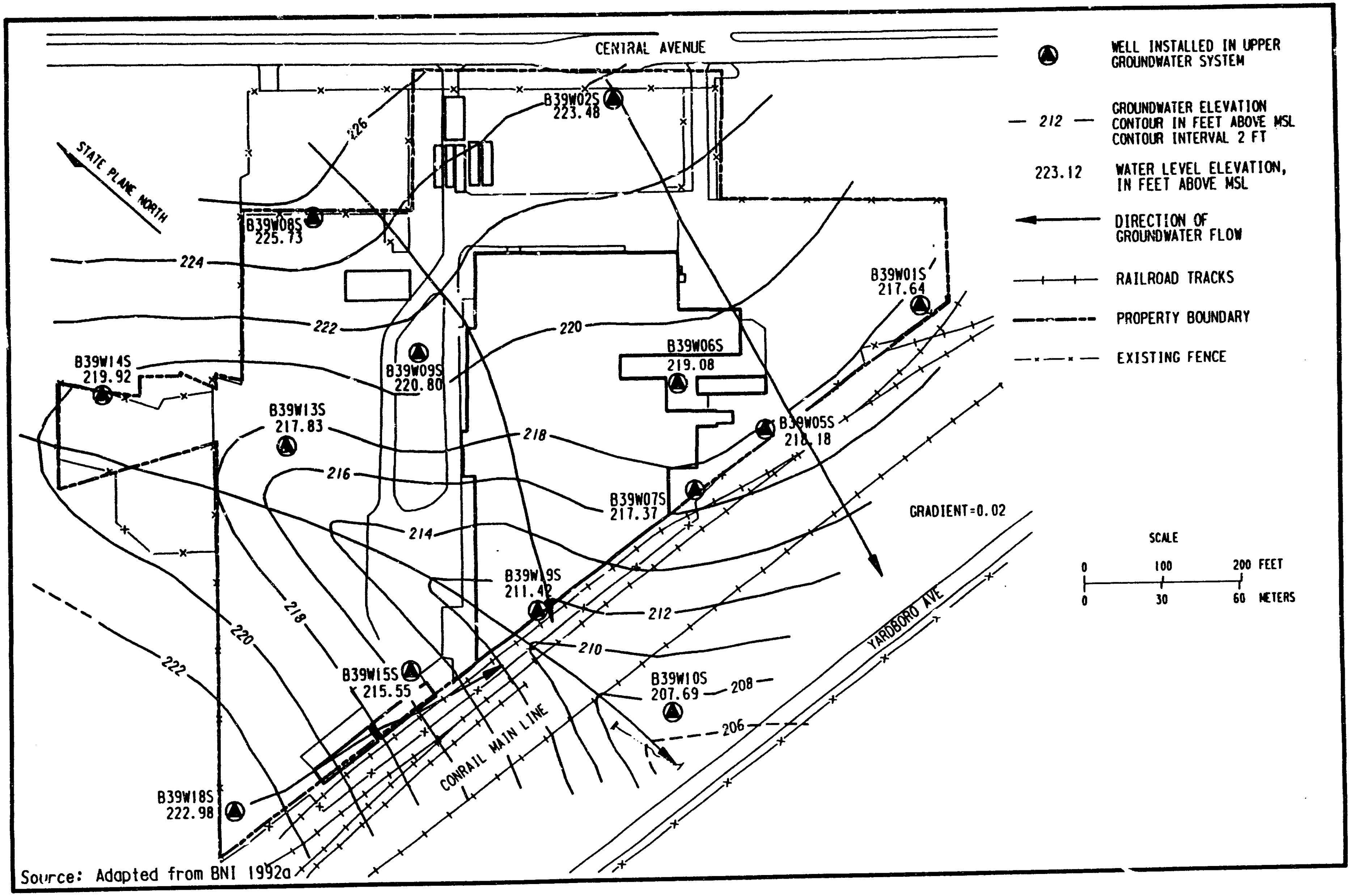
Figure A-7
Hydrograph for Wells B39W10M and B39W10S (1989-1992)



Source: Adapted from BNI 1992a

R37 R37F017.DGN

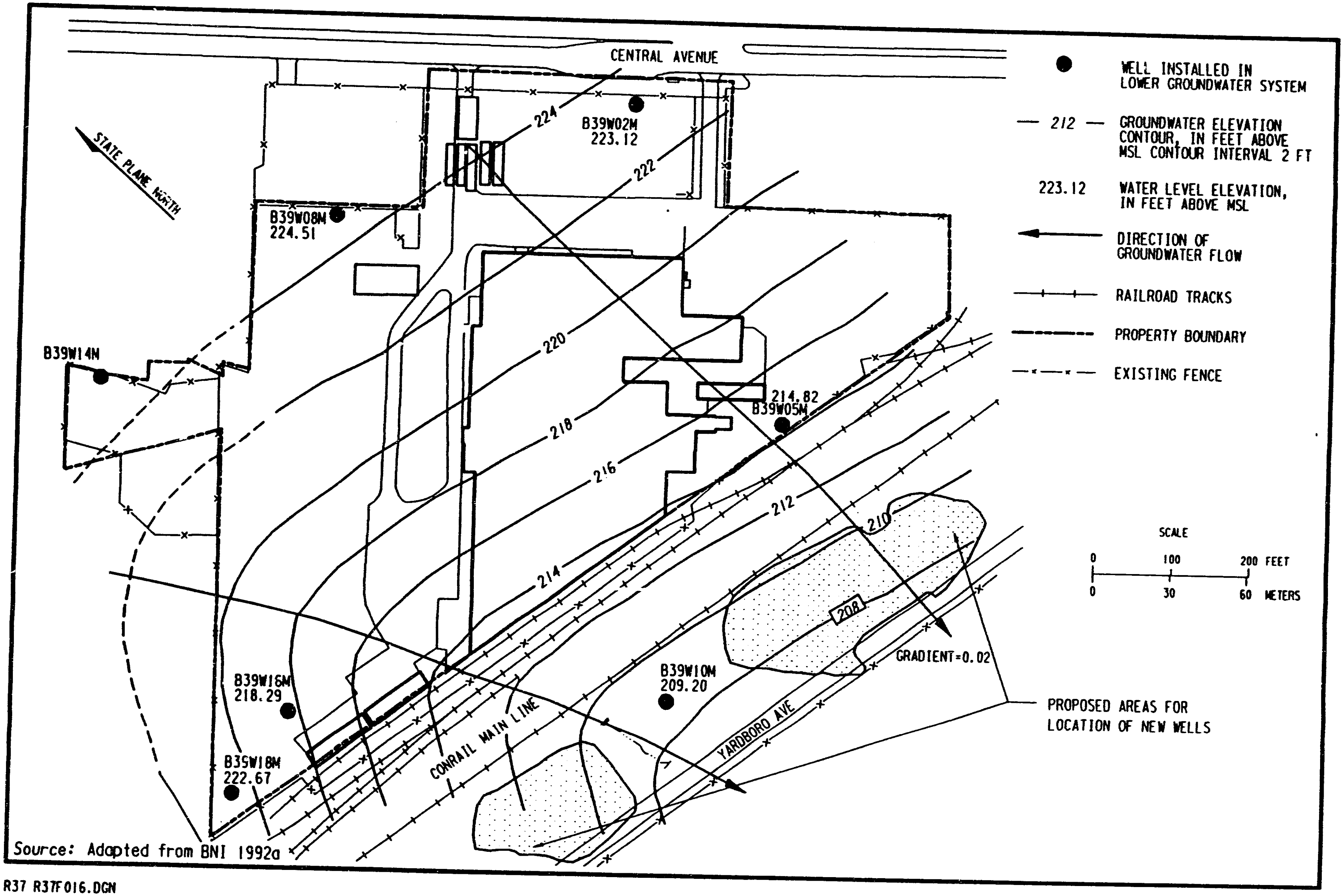
Figure A-8
Upper Groundwater System Wells (6/4/92)



Source: Adapted from BNI 1992a

R37 R37F019.DGN

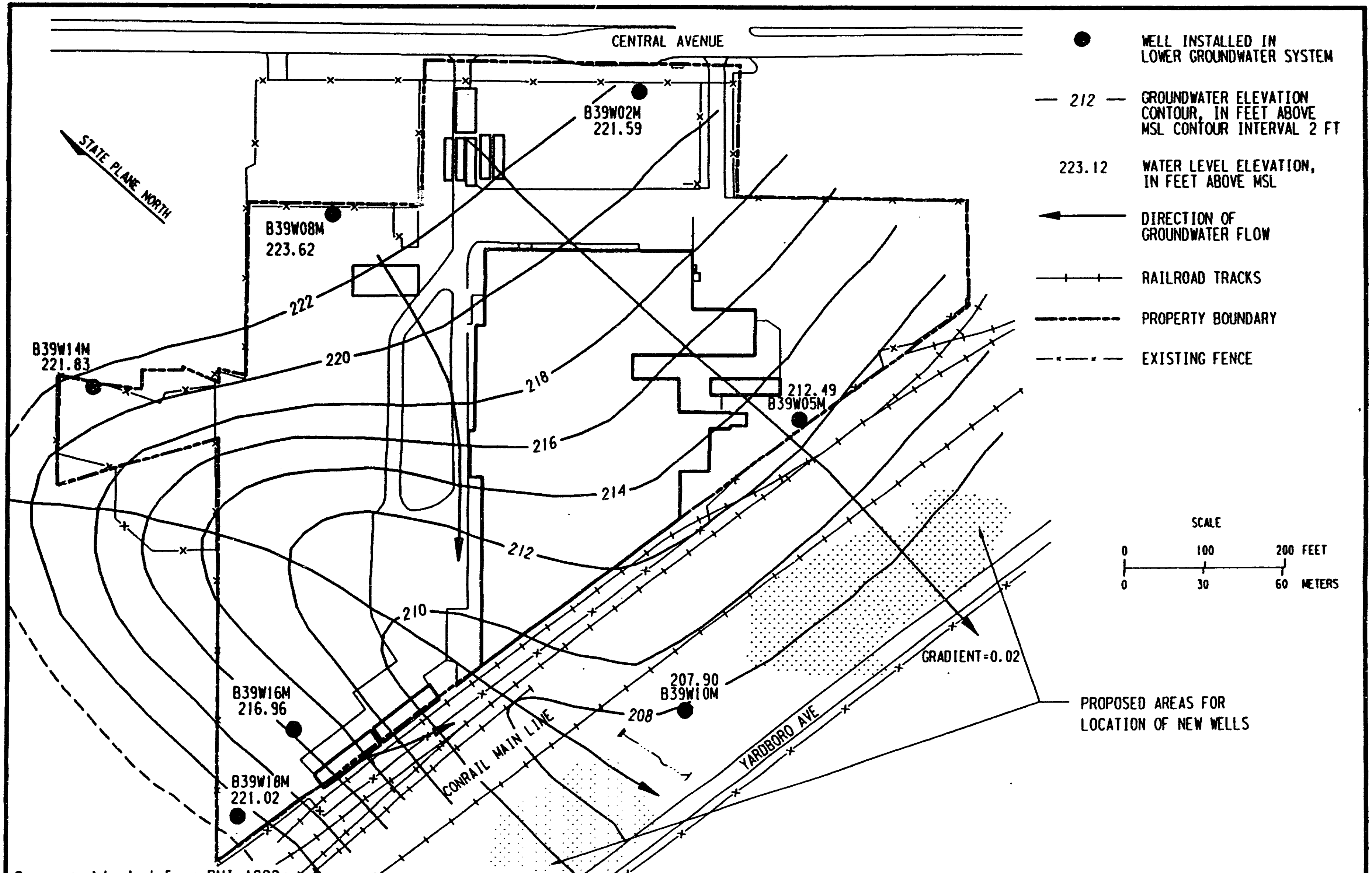
Figure A-9
Upper Groundwater System Wells (9/24/92)



Source: Adapted from BNI 1992a

R37 R37F016.DGN

Figure A-10
Lower Groundwater System Wells (6/4/92)



Source: Adapted from BNI 1992a

R37 R37F018.DGN

Figure A-11
Lower Groundwater System Wells (10/10/92)

TABLES FOR APPENDIX A

Table A-1
Colonie Interim Storage Site
Radionuclide Results
1992

WELL NO.	YEAR – QTR	TH-232 Total pCi/L	SIGMA ERROR	TH-232 Dissolved pCi/L	SIGMA ERROR	FILTERED URANIUM µg/L	SIGMA ERROR	TOTAL URANIUM µg/L	SIGMA ERROR
2M	1992 – 2nd	0.84	0					11.2	1.49
	1992 – 3rd	0.09	0.13					0.35	0.04
	1992 – 4th	1.54	0.78					5.5	0.57
2S	1992 – 2nd	0.1	0					0.5	0.05
	1992 – 3rd	0.18	0					0.85	0.09
	1992 – 4th	−0.02	0.04					4.8	0.49
5M	1992 – 4th	0.32	0.3					3.6	0.36
5S	1992 – 1st	0.22	0					0.58	0.06
	1992 – 3rd	1.44	0.64					4.78	0.5
	1992 – 4th	−0.03	0.06					3.8	0.38
6S	1992 – 3rd	7.26	1.59					10,370.	1197
	1992 – 4th	0.07	0.29	0.07	0.18	19.6	2.3	5,578.0	558.8
7S	1992 – 1st	0.15	0					0.24	0.02
	1992 – 3rd	0.7	0.11					1.59	0.16
	1992 – 4th	0	0	−0.06	0.09	0.69	0.07	0.7	0.07
8M	1992 – 1st	2.49	1.53					4.48	0.46
	1992 – 3rd	0.02	0.07					0.87	0.09
8S	1992 – 1st	0.15	0					0.3	0.03
	1992 – 3rd	1.1	0.88					5.71	0.6
10M	1992 – 1st	0.63	0.41					1.76	0.18
	1992 – 2nd	1.06	0.8					6.22	0.7
	1992 – 3rd	0.07	0.18					1.49	0.15
	1992 – 4th	0	0					0.21	0.02
10S	1992 – 1st	0.45	0					0.15	0.02
	1992 – 3rd	0.47	0.55					9.94	1.07
	1992 – 4th	0.28	0.3					17.7	2
14M	1992 – 2nd	2.14	1.04					4.81	0.54
	1992 – 3rd	0.61	0.35					3.37	0.35
14S	1992 – 3rd	0.09	0					0.16	0.02
15S	1992 – 4th	−0.04	0.09	−0.05	0.10	1.7	0.17	0.37	0.04
19S	1992 – 1st	0.2	0.27					1.78	0.18
	1992 – 3rd	0.21	0					2.50	0.26
	1992 – 4th	−0.02	0.03					5.3	0.54

Table A-2
Colonie Interim Storage Site
Chemical Results – Inorganics
1992

WELL	DATE – QTR	Ca µg/L	Mn µg/L	K µg/L	Na µg/L	Alkalinity mg/L	Bicarb mg/L	Cl mg/L	NO_4 mg/L	SO_4 mg/L	TDS mg/L	TOC mg/L
2M	07/21/92 – 3rd	32600	630	52600	58600	1180	1080	5 U	1.80	9.3	488	42.1
2S	07/21/92 – 3rd	66300	305	5000 U	33100	160	160	69.9	0.061	48.9	344	1.2
5S	07/22/91 – 3rd	95000	512	9890	28700	290	290	24.9	0.034 J	22.5	410	7.2
7S	07/22/92 – 3rd	69200	994	5000 U	46500	230	230	57.9	0.043 J	19.4	427	6.5
8M	07/21/92 – 3rd	368000	4100	5000 U	14000	120	120	5 U	0.018	5.4	147	1.1
8S	07/21/92 – 3rd	73200	300	5000 U	33700	170	170	66.0	2.10	32.6	349	1.2
10M	07/22/92 – 3rd	193000	1990	5000 U	45200	105	85.0	10.4	0.036 J	27.8	176	1.4
10S	07/22/92 – 3rd	38700	82.4	5000 U	7410	110	110	10.1	0.031 J	9.9	158	1.4
14M	07/21/92 – 3rd	205000	2240	5000 U	19800	280	280	5 U	0.011	8.1	152	1.3
14S	07/21/92 – 3rd	81000	423	5000 U	54300	160	160	97.4	0.041	58.0	435	1.3
19S	07/22/92 – 3rd	89200	734	5000 U	75400	240	240	123	0.016 J	9.0	497	22.8

NOTES:
U = Below detection limit.
J = Estimated value.

Table A-3
Key to Parameter Abbreviations

METALS

Aluminum	Al
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Boron	B
Cadmium	Cd
Calcium	Ca
Chromium	Cr
Cobalt	Co
Copper	Cu
Iron	Fe
Lead	Pb
Lithium	Li
Magnesium	Mg
Manganese	Mn
Mercury	Hg
Molybdenum	Mo
Nickel	Ni
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Thallium	Tl
Vanadium	V
Zinc	Zn

Table A-3
(continued)

VOLATILE ORGANICS

Acetone	ACE
Acrolein	ACRL
Acrylonitrile	ACRN
Benzene	BZ
Bromodichloromethane	BDCME
Bromoform	TBME
Bromomethane	BRME
2-Butanone	BU2
Carbon Disulfide	CDS
Carbon Tetrachloride	CTCL
Chlorobenzene	CLBZ
Chloroethane	CLEA
2-Chloroethylvinylether	CEVETH
Chloroform	TCLME
Chloromethane	CLME
Cis-1,3-Dichloropropene	DCP13C
Dibromochloromethane	DBCME
1,1-Dichloroethane	DCA11
1,2-Dichloroethane	DCA12
1,2-Dichloroethylene (Total)	DCE12_T
1,1-Dichloroethylene	DCE11
1,2-Dichloropropane	DCPA12
Ethylbenzene	EBZ
2-Hexanone	HX02
Methylene Chloride	MTLNCL
4-Methyl-2-Pentanone	ME4PEOH2
Styrene	STY
1,1,2,2-Tetrachloroethane	PCA
Tetrachloroethylene	PCE
Toluene	BZME
Trans-1,3-Dichloropropene	DCP13T
1,1,1-Trichloroethane	TCA111
1,1,2-Trichloroethane	TCA112
Xylenes (Total)	XYLENE_T
Trichloroethylene	TCE
Vinyl Acetate	VA
Vinyl Chloride	VC

Table A-4
Colonie Interim Storage Site
Chemical Results – Metals 1992
(All units are µg/L)

WELL NO.	YEAR/ QUARTER	TOTAL Sb	TOTAL As	TOTAL Ba	TOTAL B	TOTAL Cd	TOTAL Cr	TOTAL Cu	TOTAL Pb	TOTAL Mg	TOTAL Ni	TOTAL Se	TOTAL Tl	TOTAL Zn
B39W02M	1992 – 2nd	60 U	17.5	2870	100 U	5 U	173	764	127	428000	305	5 U	10 U	885
	1992 – 3rd	10 U	12.6	340	100 U	5 U	12.4	83.1	9.1	12800	44.8	5 U	10 U	123
	1992 – 4th	10 U	27	524	100 U	5 U	20.1	152	32.3	87600	49.1	5 U	10 U	179
B39W02S	1992 – 2nd	60 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	18600	40 U	5 U	10 U	20 U
	1992 – 3rd	10 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	12800	40 U	5 U	10 U	20 U
	1992 – 4th	10 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	13200	40 U	5 U	10 U	26.4
B39W05M	1992 – 4th	10 U	12	208	100 U	5 U	13.2	73.1	27.4	71400	40 U	5 U	10 U	169
B39W05S	1992 – 1st	60 U	10 U	200 U	637	5 U	10 U	25 U	3.4	15800	40 U	5 U	10 U	21.3
	1992 – 3rd	10 U	10 U	200 U	546	5 U	10 U	25 U	3 U	13900	40 U	5 U	10 U	53.4
	1992 – 4th	10 U	10 U	200 U	633	5 U	10 U	25 U	3 U	14000	40 U	5 U	10 U	37.5
B39W06S	1992 – 4th	10 U	10 U	400	1110	5 U	25.5	25 U	3.9	9280	83.7	5 U	10 U	34.2
B39W07S	1992 – 1st	60 U	10 U	200 U	253	5 U	10 U	25 U	3 U	14700	40 U	5 U	10 U	21.4
	1992 – 3rd	10 U	10 U	200 U	224	5 U	10 U	25 U	5.9	13000	40 U	5 U	10 U	25
	1992 – 4th	10 U	10 U	200 U	250	5 U	10 U	25 U	3 U	12900	40 U	5 U	10 U	66.9
B39W08M	1992 – 1st	60 U	24.4	229	100 U	5 U	21.9	112	27.7	99200	42.1	5 U	10 U	160
	1992 – 3rd	10 U	23.2	310	100 U	5 U	15.1	153	30.3	112000	30.3	5 U	10 U	173
B39W08S	1992 – 1st	60 U	10 U	200 U	202	5 U	10 U	25 U	3 U	10800	40 U	5 U	10 U	28.1
	1992 – 3rd	10 U	10 U	200 U	164	5 U	10 U	25 U	3 U	11100	40 U	5 U	10 U	20 U
B39W10M	1992 – 1st	60 U	11.1	200 U	101	5 U	10 U	25.7	3.7	18800	40 U	5 U	10 U	49.8
	1992 – 2nd	60 U	19.8	271	100 U	5 U	33.6	113	29.3	13600	68.1	5 U	10 U	265
	1992 – 3rd	10 U	14.8	200 U	100 U	5 U	10 U	72.7	14.4	56200	40 U	5 U	10 U	101
	1992 – 4th	10 U	13	200 U	131	5 U	10 U	32.1	4.5	17500	40 U	5 U	10 U	44.5
B39W10S	1992 – 1st	60 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	7220	40 U	5 U	10 U	33.9
	1992 – 3rd	10 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	7480	40 U	5 U	10 U	20 U
	1992 – 4th	10 U	10.9	200 U	100 U	5 U	10 U	25 U	3 U	7420	40 U	5 U	10 U	20 U
B39W14M	1992 – 2nd	60 U	29.1	840	100 U	5 U	69.8	231	47.9	189000	117	5 U	10 U	400
	1992 – 3rd	10 U	19	238	100 U	5 U	10 U	140	18.6	61200	40 U	5 U	10 U	119
B39W14S	1992 – 3rd	10 U	10 U	200 U	100 U	5 U	10 U	25 U	3 U	11500	40 U	5 U	10 U	20 U
B39W15S	1992 – 4th	10 U	10 U	200 U	218	5 U	10 U	25 U	3 U	17800	40 U	5 U	10 U	45.4
B39W19S	1992 – 1st	60 U	10 U	200 U	462	5 U	10 U	79.6	49.2	14400	40 U	5 U	10 U	1650
	1992 – 3rd	13.7	10 U	200 U	400	5 U	10 U	47.9	108	15800	40 U	5 U	10 U	1740
	1992 – 4th	10 U	10 U	200 U	413	5 U	10 U	29.5	72.2	15000	40 U	5 U	10 U	1500

U = Below detection limit.

Table A–5
Colonie Interim Storage Site
Chemical Results – Volatiles
1992

Page 1 of 5

(All units are μg/L)

WELL NO.	DATE – QTR	CLME	BRME	VC	CLEA	MTLNCL	ACE	CDS	DCE11	DCA11
2M	1992 – 2nd	10 U	10 U	10 U	10 U	5 B	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	5 U	12 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	5 U	29	5 U	5 U	5 U
2S	1992 – 2nd	10 U	10 U	10 U	10 U	5 B	3 JB	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	11 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
5M	1992 – 3rd	10 U	10 U	10 U	10 U	5	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	7 B	10	5 U	5 U	5 U
5S	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	2 J	10 U	6 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	3 JB	10 U	5 U	5 U	5 U
6S	1992 – 3rd	10 U	10 U	10 U	10 U	6 U	10 U	5 U	5 U	5
	1992 – 4th	10 U	10 U	10 U	10 U	4 JB	10 U	5 U	5 U	5 U
7S	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	6 B	10 U	5 U	5 U	5 U
8M	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	7 U	10 U	5 U	5 U	5 U
8S	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	7 U	10 U	5 U	5 U	5 U
10M	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 2nd	10 U	10 U	10 U	10 U	7	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	5 B	10 U	5 U	5 U	5 U
10S	1992 – 1st	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	7 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	10 U	10 U	3 JB	10 U	5 U	5 U	5 U
14M	1992 – 2nd	10 U	10 U	10 U	10 U	7	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	6 U	10 U	5 U	5 U	5 U
14S	1992 – 2nd	10 U	10 U	10 U	10 U	3 J	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	8 U	10 U	5 U	5 U	5 U
15S	1992 – 2nd	10 U	10 U	4 J	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	3 J	10 U	6 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	7 J	10 U	4 JB	13	5 U	5 U	5 U
19S	1992 – 1st	10 U	10 U	10 U	10 U	16 B	10 U	5 U	4 J	5 U
	1992 – 2nd	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	10 U	10 U	10 U	5 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	10 U	3 J	10 U	5 U	10 U	5 U	5 U	5 U

Table A–5
(continued)

Page 2 of 5

WELL NO.	DATE – QTR	DCE12 T	TCLME	DCA 11	BU2	TCA111	CTCl	VA	BDCME
2M	1992 – 2nd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
2S	1992 – 2nd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
5M	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
5S	1992 – 1st	37	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	120	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	50	5 U	5 U	10 U	5 U	5 U	10 U	5 U
6S	1992 – 3rd	10	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	3 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
7S	1992 – 1st	1 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	3 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	3 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
8M	1992 – 1st	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
8S	1992 – 1st	5 U	5 U	5 U	10 U	1 J	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	2 J	5 U	10 U	5 U
10M	1992 – 1st	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 2nd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
10S	1992 – 1st	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
14M	1992 – 2nd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
14S	1992 – 2nd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	5 U	5 U	5 U	10 U	5 U	5 U	10 U	5 U
15S	1992 – 2nd	160 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	120	1 J	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	170 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
19S	1992 – 1st	4 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 2nd	3 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 3rd	1 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U
	1992 – 4th	2 J	5 U	5 U	10 U	5 U	5 U	10 U	5 U

Table A–5
(continued)

Page 3 of 5

WELL NO.	DATE – QTR	DCPA12	DCP13C	TCE	DBCME	TCA112	B2	DCP13T
2M	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
2S	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
5M	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 U	5 U
5S	1992 – 1st	5 U	5 U	10	5 U	5 U	5 UJ	5 U
	1992 – 3rd	5 U	5 U	44	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	20	5 U	5 U	5 U	5 U
6S	1992 – 3rd	5 U	5 U	120	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	48	5 U	5 U	5 U	5 U
7S	1992 – 1st	5 U	5 U	6	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	9	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	12	5 U	5 U	5 U	5 U
8M	1992 – 1st	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
8S	1992 – 1st	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
10M	1992 – 1st	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 U	5 U
10S	1992 – 1st	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 U	5 U
14M	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
14S	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
15S	1992 – 2nd	5 U	5 U	1100	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	260	5 U	5 U	5 U	5 U
	1992 – 4th	5 U	5 U	1400	5 U	5 U	5 U	5 U
19S	1992 – 1st	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 2nd	5 U	5 U	5 U	5 U	5 U	5 U	5 U
	1992 – 3rd	5 U	5 U	5 U	5 U	5 U	5 UJ	5 U
	1992 – 4th	5 U	5 U	5 U	5 U	5 U	5 U	5 U

Table A–5
(continued)

Page 4 of 5

WELL NO.	DATE – QTR	CEVETH	TBME	ME4PEOH2	HX02	PCE	PCA	BZME
2M	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
2S	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
5M	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 U
5S	1992 – 1st	10 U	5 U	10 U	10 U	79	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	190	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	83	5 U	5 U
6S	1992 – 3rd	10 U	5 U	10 U	10 U	5700	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	1100	5 U	5 U
7S	1992 – 1st	10 U	5 U	10 U	10 U	64	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	98	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	110	5 U	5 U
8M	1992 – 1st	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
8S	1992 – 1st	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
10M	1992 – 1st	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 U
10S	1992 – 1st	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 U
14M	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
14S	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
15S	1992 – 2nd	10 U	5 U	10 U	10 U	6600	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	3200	5 U	5 U
	1992 – 4th	10 U	5 U	10 U	10 U	10000	5 U	5 U
19S	1992 – 1st	10 U	5 U	10 U	10 U	2 J	5 U	5 U
	1992 – 2nd	10 U	5 U	10 U	10 U	5 U	5 U	5 U
	1992 – 3rd	10 U	5 U	10 U	10 U	5 U	5 U	5 UJ
	1992 – 4th	10 U	5 U	10 U	10 U	5 U	5 U	5 U

Table A-5
(continued)

Page 5 of 5

WELL NO.	DATE – QTR	CLBZ	EBZ	STY	XYLENE T	ACRL	ACRN
2M	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 4th	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
2S	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 4th	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
5M	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
5S	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
6S	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
7S	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
8M	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
8S	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
10M	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
10S	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
14M	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
14S	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
15S	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U
19S	1992 – 1st	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 2nd	5 U	5 U	5 U	5 U	10 U	10 U
	1992 – 3rd	5 UJ	5 UJ	5 UJ	5 UJ	10 U	10 U
	1992 – 4th	5 U	5 U	5 U	5 U	10 U	10 U

U = Below detection limit.
J = Estimated value.
B = Analyte is found in the associated blank as well as in the sample.

Table A-6
Colonie Interim Storage Site
Field Parameters
1992

Well No.	Date - Qtr.	pH Units	Conductivity umhos/cm	Temperature Degrees C
B39W02M	04/13/92 - 2nd	9.4	220.0	14.0
	07/21/92 - 3rd	9.3	235.0	15.0
	10/07/92 - 4th	10.23	301	14.0
B39W02S	04/13/92 - 2nd	7.72	880	15.0
	07/21/92 3rd	7.6	763.0	15.0
	10/06/92 - 4th	7.89	640	13.0
B39W05M	07/22/92 - 3rd	8.8	269.0	14.0
	10/08/92 - 4th	8.63	260	15.0
B39W05S	01/08/92 - 1st	7.05	788	10.3
	07/22/92 - 3rd	7.2	625.0	15.0
	10/08/92 - 4th	7.13	643	16.0
B39W06S	04/13/92 - 2nd	6.71	489	12.0
	07/22/92 - 3rd	7.1	366.0	18.0
	10/08/92 - 4th	6.83	437	18.0
B39W07S	01/08/92 - 1st	7.1	773.0	12.1
	07/22/92 - 3rd	7.4	635.0	15.0
	10/08/92 - 4th	7.04	602	17.0
B39W08M	01/07/92 - 1st	9.1	203.0	10.6
	04/13/92 - 2nd	9.1	200.0	14.0
	07/21/92 - 3rd	8.5	177.0	14.0
B39W08S	01/08/92 - 1st	6.8	560.0	8.7
	07/21/92 - 3rd	7.2	552.0	16.0
B39W10M	01/08/92 - 1st	8.8	293.0	10.6
	04/14/92 - 2nd	9.0	279.0	12.0
	07/22/92 - 3rd	8.8	241.0	16.0
	10/09/92 - 4th	8.96	244	13.0
B39W10S	01/08/92 - 1st	7.2	342.0	11.9
	07/22/92 - 3rd	8.0	242.0	15.0
	10/09/92 - 4th	7.98	250	15.0
B39W14M	04/14/92 - 2nd	7.8	162.0	12.0
	07/21/92 - 3rd	8.4	191.0	14.0
B39W14S	04/14/92 - 2nd	7.3	844.0	7.0
	07/21/92 - 3rd	7.4	681.0	15.0
B39W19S	01/09/92 - 1st	7.1	942.0	12.4
	07/22/92 - 3rd	7.4	848.0	15.0
	10/09/92 - 4th	7.32	870	16.0

APPENDIX B Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
A09	1	08-26-92	1,2-DCE (T)	NC	ND	2 (a)	
			TCE	NC	ND	2 (a)	
			PCE	NC	ND	2 (a)	
A11		08-20-92	1,2-DCE (T)	NC	ND	49	
			TCE	NC	ND	49	
			PCE	NC	ND	49	
A13	2	08-20-92	1,2-DCE (T)	NC	ND	47	
			TCE	NC	ND	47	
			PCE	NC	ND	47	
A15	4	08-20-92	1,2-DCE (T)	NC	ND	48	
			TCE	NC	ND	48	
			PCE	NC	ND	48	
A16	4	08-21-92	1,2-DCE (T)	NC	ND	58	
			TCE	NC	ND	58	
			PCE	NC	ND	58	
A18	4	08-21-92	1,2-DCE (T)	NC	ND	57	
			TCE	NC	ND	57	
			PCE	NC	ND	57	
A19	3	08-20-92	1,2-DCE (T)	NC	ND	36	
			TCE	NC	ND	36	
			PCE	NC	ND	36	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
A20	4	08-21-92	1,2-DCE (T)	NC	ND	56	
			TCE	NC	ND	56	
			PCE	NC	ND	56	
B07	4	08-20-92	1,2-DCE (T)	NC	ND	50	
			TCE	NC	ND	50	
			PCE	NC	ND	50	
B07 (Dup)	4	08-20-92	1,2-DCE (T)	NC	ND	51	
			TCE	NC	ND	51	
			PCE	NC	ND	51	
B07	4	08-26-92	1,2-DCE (T)	NC	ND	3 (a)	
			TCE	NC	ND	3 (a)	
			PCE	NC	ND	3 (a)	
C15	4	08-21-92	1,2-DCE (T)	NC	ND	59	
			TCE	NC	ND	59	
			PCE	NC	ND	59	
C15 (Dup)	4	08-21-92	1,2-DCE (T)	NC	ND	60	
			TCE	NC	ND	60	
			PCE	NC	ND	60	
C16	4	08-21-92	1,2-DCE (T)	NC	ND	61	
			TCE	NC	ND	61	
			PCE	NC	ND	61	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
C17	4	08-21-92	1,2-DCE (T)	NC	ND	62	
			TCE	NC	ND	62	
			PCE	NC	ND	62	
C17 (Dup)	4	08-21-92	1,2-DCE (T)	NC	ND	63	
			TCE	NC	ND	63	
			PCE	NC	ND	63	
C18 (d)	4	08-21-92	1,2-DCE (T)	NC	ND	64	
			TCE	NC	ND	64	
			PCE	NC	ND	64	
C18 (Rep) (d)	4	08-21-92	1,2-DCE (T)	NC	ND	65	
			TCE	NC	ND	65	
			PCE	NC	ND	65	
C18 Resample	4	08-21-92	1,2-DCE (T)	NC	ND (e)	67	
			TCE	NC	ND	67	
			PCE	NC	ND	67	
C19	2.5	08-20-92	1,2-DCE (T)	NC	ND	37	
			TCE	NC	ND	37	
			PCE	NC	ND	37	
D05	1.5	08-18-92	1,2-DCE (T)	NC	ND	47 (c)	
			TCE	NC	ND	47 (c)	
			PCE	NC	ND	47 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
D07	1	08-20-92	1,2-DCE (T)	NC	ND	45	
			TCE	NC	ND	45	
			PCE	NC	ND	45	
D07 (Rep)	1	08-20-92	1,2-DCE (T)	NC	ND	46	
			TCE	NC	ND	46	
			PCE	NC	ND	46	
D11	1	08-25-92	1,2-DCE (T)	NC	ND	119	
			TCE	NC	ND	119	
			PCE	NC	ND	119	
D13	0.9	08-24-92	1,2-DCE (T)	NC	ND	88	
			TCE	NC	ND	88	
			PCE	NC	ND	88	
D13 (Rep)	0.9	08-24-92	1,2-DCE (T)	NC	ND	89	
			TCE	NC	ND	89	
			PCE	NC	0.36	89	931
D15	1.5	08-24-92	1,2-DCE (T)	NC	ND	90	
			TCE	NC	ND	90	
			PCE	NC	0.5	90	925
D16	3.5	08-21-92	1,2-DCE (T)	NC	ND	71	
			TCE	NC	ND	71	
			PCE	NC	ND	71	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
D17	4	08-21-92	1,2-DCE (T)	NC	ND	68	
			TCE	NC	ND	68	
			PCE	NC	ND	68	
D18	3	08-21-92	1,2-DCE (T)	< 2	ND	70	
			TCE	< 2	ND	70	
			PCE	< 1	ND	70	
			Vinyl chloride	< 2	NA (q)		
D18 (Rep)	3	08-21-92	1,2-DCE (T)	NC	ND	72	
			TCE	NC	ND	72	
			PCE	NC	ND	72	
E12	1.5	08-26-92	1,2-DCE (T)	NC	ND	7 (a)	
			TCE	NC	ND	7 (a)	
			PCE	NC	ND	7 (a)	
E13	1.5	08-26-92	1,2-DCE (T)	NC	ND	8 (a)	
			TCE	NC	ND	8 (a)	
			PCE	NC	ND	8 (a)	
E13 (Dup)	1.5	08-26-92	1,2-DCE (T)	NC	ND	9 (a)	
			TCE	NC	ND	9 (a)	
			PCE	NC	ND	9 (a)	
E14	2	08-26-92	1,2-DCE (T)	NC	ND	10 (a)	
			TCE	NC	ND	10 (a)	
			PCE	NC	ND	10 (a)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
E15	3	08–19–92	1,2–DCE (T)	NC	ND (e)	17	
			TCE	NC	ND	17	
			PCE	NC	ND	17	
E16	1	08–24–92	1,2–DCE (T)	NC	ND	93	
			TCE	NC	ND	93	
			PCE	NC	ND	93	
E16 (Rep)	1	08–24–92	1,2–DCE (T)	NC	ND	96	
			TCE	NC	ND	96	
			PCE	NC	ND	96	
E17	1.5	08–24–92	1,2–DCE (T)	NC	ND	101	
			TCE	NC	ND	101	
			PCE	NC	ND (f)	101	
E18	1	08–24–92	1,2–DCE (T)	NC	ND	94	
			TCE	NC	ND	94	
			PCE	NC	ND (f)	94	
E18 (Dup)	1	08–24–92	1,2–DCE (T)	NC	ND	95	
			TCE	NC	ND	95	
			PCE	NC	ND	95	
F05	2	08–17–92	1,2–DCE (T)	NC	ND	11 (c)	
			TCE	NC	ND	11 (c)	
			PCE	NC	ND	11 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
F05 (Dup)	2	08-17-92	1,2-DCE (T)	NC	ND	13 (c)	
			TCE	NC	ND	13 (c)	
			PCE	NC	ND	13 (c)	
F07	1.5	08-19-92	1,2-DCE (T)	< 2	ND	5	
			TCE	< 2	ND	5	
			PCE	< 1	ND	5	
			Vinyl chloride	< 2	NA (q)		
F09	1.5	08-19-92	1,2-DCE (T)	NC	ND	6	
			TCE	NC	ND	6	
			PCE	NC	ND	6	
F11	1.5	08-19-92	1,2-DCE (T)	NC	ND (f)	7	
			TCE	NC	ND	7	
			PCE	NC	ND	7	
F13	1.5	08-19-92	1,2-DCE (T)	NC	ND	8	
			TCE	NC	2.63 (h)	8	229
			PCE	NC	134.52 (h)	8	958
			Unknown			10 (g)	3400
F13	1.5	08-19-92	1,2-DCE (T)	NC	ND	22	
			TCE	NC	0.74 (h,i)	22	95
			PCE	NC	14.85 (h)	22	285
F13(Dup)	1.5	08-19-92	1,2-DCE (T)	NC	ND	26	
			TCE	NC	ND	26	
			PCE	NC	7.93	26	284

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
F13(Rep)	1.5	08-19-92	1,2-DCE (T)	NC	ND	27	
			TCE	NC	0.28 (h,i)	27	97
			PCE	NC	8.12 (h)	27	292
F13	1	08-20-92	1,2-DCE(T)	< 2			
			TCE	2.32			
			PCE	16.54			
			Vinyl chloride	< 2			
F13 (1 1/2)	1.5	08-27-92	1,2-DCE(T)	ND			
			TCE	ND			
			PCE	295 (p)			
			Vinyl chloride	ND			
F13	2	09-02-92	1,2-DCE (T)	NC	ND	23	
			TCE	NC	0.07	23	300
			PCE	NC	87.7 (i)	23	815
			Unknown			24 (g)	2900
F13	2	09-03-92	1,2-DCE (T)	NC	0.0064	33 (a)	41
			TCE	NC	115.96	33 (a)	271
			PCE	NC	0.0009	33 (a)	860
F13	2	09-03-92	1,2-DCE (T)	NC	ND (m)	34 (a)	
			TCE	NC	ND (m)	34 (a)	
			PCE	NC	ND (m)	34 (a)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
G14	1.5	08-26-92	1,2-DCE (T)	NC	ND	12 (a)	
			TCE	NC	ND	12 (a)	
			PCE	NC	3.2 (k)	12 (a)	878
G14	2	09-02-92	1,2-DCE (T)	NC	ND	27 (a)	
			TCE	NC	ND	27 (a)	
			PCE	NC	ND (f)	27 (a)	
G15	1.3	08-19-92	1,2-DCE (T)	NC	ND	15	
			TCE	NC	ND	15	
			PCE	NC	ND (f)	15	
G16	1.5	08-24-92	1,2-DCE (T)	NC	ND	92	
			TCE	NC	ND	92	
			PCE	NC	ND (f)	92	
G17	1.5	08-24-92	1,2-DCE (T)	NC	ND	102	
			TCE	NC	ND	102	
			PCE	NC	ND (f)	102	
F16a (F/G 16.5)	2	08-27-92	1,2-DCE (T)	NC	ND	19 (a)	
			TCE	NC	ND	19 (a)	
			PCE	NC	ND	19 (a)	
H03	2	08-17-92	1,2-DCE (T)	NC	ND	12 (c)	
			TCE	NC	ND	12 (c)	
			PCE	NC	ND	12 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
H05	2.3	08-17-92	1,2-DCE (T)	NC	ND (d)	14 (c)	
			TCE	NC	ND (d)	14 (c)	
			PCE	NC	ND (d)	14 (c)	
H05 (Dup)	2.3	08-17-92	1,2-DCE (T)	NC	ND (d)	15 (c)	
			TCE	NC	ND (d)	15 (c)	
			PCE	NC	ND (d)	15 (c)	
H07	1.5	08-19-92	1,2-DCE (T)	NC	ND	13	
			TCE	NC	ND	13	
			PCE	NC	ND	13	
H09	1.5	08-19-92	1,2-DCE (T)	NC	ND	10	
			TCE	NC	ND	10	
			PCE	NC	ND	10	
H09 (Rep)	1.5	08-19-92	1,2-DCE (T)	NC	ND (o)	11	
			TCE	NC	ND (o)	11	
			PCE	NC	ND (o)	11	
H09 (Rep)	1.5	08-19-92	1,2-DCE (T)	NC	ND	12	
			TCE	NC	ND	12	
			PCE	NC	ND (f)	12	
H11	1.5	08-19-92	1,2-DCE (T)	NC	ND (e)	9	
			TCE	NC	ND	9	
			PCE	NC	ND	9	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
F13	2	09-03-92	1,2-DCE (T)	NC	ND (m)	35 (a)	
			TCE	NC	ND (m)	35 (a)	
			PCE	NC	ND (m)	35 (a)	
F14	1.5	08-26-92	1,2-DCE (T)	NC	ND	11 (a)	
			TCE	NC	0.01	11 (a)	220
			PCE	NC	100 (h,i)	11 (a)	904
F14	2	09-02-92	1,2-DCE (T)	NC	ND	24 (a)	
			TCE	NC	ND	24 (a)	
			PCE	NC	ND	24 (a)	
F14(Rep)	2	09-02-92	1,2-DCE (T)	NC	ND (j)	25 (a)	
			TCE	NC	ND (j)	25 (a)	
			PCE	NC	ND (j)	25 (a)	
F15	1.5	08-19-92	1,2-DCE (T)	NC	ND (e)	16	
			TCE	NC	ND	16	
			PCE	NC	1.13 (i)	16	902
F15(Rep)	1.5	08-19-92	1,2-DCE (T)	NC	ND	24	
			TCE	NC	0.92 (i)	24	102
			PCE	NC	0.45	24	285
F15	1.5	08-19-92	1,2-DCE (T)	NC	ND	25	
			TCE	NC	ND	25	
			PCE	NC	270 (h,n)	25	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
F15	1.5	09-02-92	1,2-DCE (T)	NC	ND	26 (a)	
			TCE	NC	ND	26 (a)	
			PCE	NC	ND	26 (a)	
F16	1.5	08-24-92	1,2-DCE (T)	NC	ND	100	
			TCE	NC	ND	100	
			PCE	NC	ND (f)	100	
F17	1.5	08-24-92	1,2-DCE (T)	< 2	ND	98	
			TCE	< 2	ND	98	
			PCE	2.75	0.12 (i)	98	913
			Vinyl chloride	< 2	NA (q)		
F17 (Rep)	1.5	08-24-92	1,2-DCE (T)	NC	ND	99	
			TCE	NC	ND	99	
			PCE	NC	0.53 (i)	99	907
F17a (E/F 17.5)	2	08-27-92	1,2-DCE (T)	NC	ND	18 (a)	
			TCE	NC	ND	18 (a)	
			PCE	NC	ND	18 (a)	
G13	1.5	08-26-92	1,2-DCE (T)	< 2	ND	4 (a)	
			TCE	< 2	ND	4 (a)	
			PCE	9 (l)	ND	4 (a)	
			Vinyl chloride	8 (l)	NA (q)		
G13 (Rep)	1.5	08-26-92	1,2-DCE (T)	NC	ND	5 (a)	
			TCE	NC	ND	5 (a)	
			PCE	NC	ND	5 (a)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
H13	1	08-19-92	1,2-DCE (T)	NC	ND	14	
			TCE	NC	ND	14	
			PCE	NC	ND	14	
H16	2	08-22-92	1,2-DCE (T)	NC	ND	82	
			TCE	NC	ND	82	
			PCE	NC	ND	82	
H16 (Rep)	2	08-22-92	1,2-DCE (T)	NC	ND	83	
			TCE	NC	ND	83	
			PCE	NC	ND (f)	83	
J03	2	08-14-92	1,2-DCE (T)	NC	ND (d)	8 (b)	
			TCE	NC	ND (d)	8 (b)	
			PCE	NC	ND (d)	8 (b)	
J03 (Rep)	2	08-14-92	1,2-DCE (T)	NC	ND (d)	9 (b)	
			TCE	NC	ND (d)	9 (b)	
			PCE	NC	ND (d)	9 (b)	
J03 (Rep)	2	08-14-92	1,2-DCE (T)	NC	ND (d)	10 (b)	
			TCE	NC	ND (d)	10 (b)	
			PCE	NC	ND (d)	10 (b)	
J03	2	08-17-92	1,2-DCE (T)	NC	ND (d)	9 (c)	
			TCE	NC	ND (d)	9 (c)	
			PCE	NC	ND (d)	9 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
J05	2	08-14-92	1,2-DCE (T)	NC	ND	11 (b)	
			TCE	NC	ND	11 (b)	
			PCE	NC	ND	11 (b)	
J05	2	08-17-92	1,2-DCE (T)	NC	ND (d)	10 (c)	
			TCE	NC	ND (d)	10 (c)	
			PCE	NC	ND (d)	10 (c)	
K14	2	08-22-92	1,2-DCE (T)	< 2	ND	81	
			TCE	< 2	ND	81	
			PCE	< 1	ND	81	
			Vinyl chloride	< 2	NA (q)		
L03	2	08-14-92	1,2-DCE (T)	NC	ND (d)	6 (b)	
			TCE	NC	ND (d)	6 (b)	
			PCE	NC	ND (d)	6 (b)	
L03 (Rep)	2	08-14-92	1,2-DCE (T)	NC	ND (d)	7 (b)	
			TCE	NC	ND (d)	7 (b)	
			PCE	NC	ND (d)	7 (b)	
L03	2.3	08-17-92	1,2-DCE (T)	NC	ND	8 (c)	
			TCE	NC	ND	8 (c)	
			PCE	NC	ND	8 (c)	
L05	2	08-17-92	1,2-DCE (T)	NC	ND	24 (c)	
			TCE	NC	ND	24 (c)	
			PCE	NC	ND	24 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
L05 (Rep)	2	08–17–92	1,2–DCE (T)	NC	ND	25 (c)	
			TCE	NC	ND	25 (c)	
			PCE	NC	ND	25 (c)	
L13	3.5	08–22–92	1,2–DCE (T)	NC	ND	79	
			TCE	NC	ND	79	
			PCE	NC	ND	79	
L13 Resample	3.5	08–22–92	1,2–DCE (T)	NC	ND	80	
			TCE	NC	ND	80	
			PCE	NC	ND	80	
N05	1.5	08–18–92	1,2–DCE (T)	< 2	ND	33 (c)	
			TCE	< 2	ND	33 (c)	
			PCE	< 1	ND	33 (c)	
			Vinyl chloride	< 2	NA (q)		
N07	2.5	08–18–92	1,2–DCE (T)	NC	ND	44 (c)	
			TCE	NC	ND	44 (c)	
			PCE	NC	ND	44 (c)	
N11	3.5	08–22–92	1,2–DCE (T)	NC	ND	77	
			TCE	NC	ND	77	
			PCE	NC	ND	77	
N11 (Dup)	3.5	08–22–92	1,2–DCE (T)	NC	ND	78	
			TCE	NC	ND	78	
			PCE	NC	ND	78	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
O10	2	08-25-92	1,2-DCE (T)	NC	ND	116	
			TCE	NC	0.17	116	232
			PCE	NC	8.75	116	920
			Unknown	NC		118	2000
O10 (Rep)	2	08-25-92	1,2-DCE (T)	NC	ND	117	
			TCE	NC	0.02 (n)	117	223
			PCE	NC	0.19 (n)	117	912
O10	3	09-02-92	1,2-DCE (T)	NC	ND	28 (a)	
			TCE	NC	0.08 (n)	28 (a)	282
			PCE	NC	0.13 (n)	28 (a)	850
P05	1.5	08-18-92	1,2-DCE (T)	NC	ND	35 (c)	
			TCE	NC	ND	35 (c)	
			PCE	NC	ND	35 (c)	
P07	2	08-20-92	1,2-DCE (T)	NC	ND	34	
			TCE	NC	ND	34	
			PCE	NC	ND	34	
P09	1.5	08-25-92	1,2-DCE (T)	NC	ND	107	
			TCE	NC	0.02	107	240
			PCE	NC	ND	107	
P09 (Dup)	1.5	08-25-92	1,2-DCE (T)	NC	ND	108	
			TCE	NC	0.02	108	230
			PCE	NC	ND	108	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
P09 (Rep)	1.5	08–25–92	1,2–DCE (T)	NC	ND	109	
			TCE	NC	ND	109	
			PCE	NC	ND	109	
Q07	1	08–20–92	1,2–DCE (T)	NC	ND	35	
			TCE	NC	ND	35	
			PCE	NC	ND	35	
Q07	1.5	08–25–92	1,2–DCE (T)	NC	ND	111	
			TCE	NC	ND	111	
			PCE	NC	ND	111	
Q08	1.5	08–25–92	1,2–DCE (T)	NC	ND	112	
			TCE	NC	ND	112	
			PCE	NC	ND	112	
Q09	2	08–25–92	1,2–DCE (T)	< 2	ND	113	
			TCE	< 2	ND	113	
			PCE	< 1	ND	113	
			Vinyl chloride	< 2	NA (q)		
R05	1.5	08–18–92	1,2–DCE (T)	NC	ND	38 (c)	
			TCE	NC	ND	38 (c)	
			PCE	NC	ND	38 (c)	
R07	1.5	08–18–92	1,2–DCE (T)	NC	ND	42 (c)	
			TCE	NC	ND	42 (c)	
			PCE	NC	ND	42 (c)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
R07 (Dup)	1.5	08-18-92	1,2-DCE (T)	NC	ND	43 (c)	
			TCE	NC	ND	43 (c)	
			PCE	NC	ND	43 (c)	
R08	2	08-25-92	1,2-DCE (T)	NC	ND	114	
			TCE	NC	0.02	114	244
			PCE	NC	0.01	114	924
R08 (Rep)	2	08-25-92	1,2-DCE (T)	NC	ND	115	
			TCE	NC	0.01	115	229
			PCE	NC	0.03	115	911
T05	1.5	08-18-92	1,2-DCE (T)	NC	ND	39 (c)	
			TCE	NC	ND	39 (c)	
			PCE	NC	ND	39 (c)	
T07	1.5	08-18-92	1,2-DCE (T)	NC	ND	40 (c)	
			TCE	NC	ND	40 (c)	
			PCE	NC	ND	40 (c)	
T07 (Rep)	1.5	08-18-92	1,2-DCE (T)	NC	ND	41 (c)	
			TCE	NC	ND	41 (c)	
			PCE	NC	ND	41 (c)	
PB	NA	08-17-92	1,2-DCE (T)	NC	ND	17 (b)	
			TCE	NC	ND	17 (b)	
			PCE	NC	ND	17 (b)	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
PB	NA	08–19–92	1,2–DCE (T)	NC	ND	4	
			TCE	NC	ND	4	
			PCE	NC	ND	4	
PB	NA	08–20–92	1,2–DCE (T)	NC	ND	31	
			TCE	NC	ND	31	
			PCE	NC	ND	31	
PB	NA	08–21–92	1,2–DCE (T)	NC	ND	53	
			TCE	NC	ND	53	
			PCE	NC	ND	53	
PB	NA	08–22–92	1,2–DCE (T)	NC	ND	76	
			TCE	NC	ND	76	
			PCE	NC	ND	76	
PB	NA	08–24–92	1,2–DCE (T)	NC	ND	91	
			TCE	NC	ND	91	
			PCE	NC	ND	91	
PB	NA	08–25–92	1,2–DCE (T)	NC	ND	106	
			TCE	NC	ND	106	
			PCE	NC	ND	106	
PB	NA	08–26–92	1,2–DCE (T)	NC	ND (d)	122	
			TCE	NC	ND (d)	122	
			PCE	NC	ND (d)	122	

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Date	Analyte Name	Offsite analysis	Onsite analysis		
				Analyte conc. (ppm)	Analyte conc. (ppm)	Trace Number (third set unless otherwise noted)	Analyte RT (sec)
PB	NA	08-27-92	1,2-DCE (T)	NC	ND	20 (a)	
			TCE	NC	ND	20 (a)	
			PCE	NC	ND	20 (a)	
PB	NA	09-02-92	1,2-DCE (T)	NC	ND	29 (a)	
			TCE	NC	ND	29 (a)	
			PCE	NC	ND	29 (a)	

(a) Fourth set of data, first set used Sentex version 2.152, and ended with trace 52. Second and third sets used Sentex version 2.160, second set ended with trace 123 and third set ended with trace 36.
(b) First set of data.
(c) Second set of data.
(d) Significant isopropanol peak; also have other contamination from isopropanol decon solution.
(e) Have significant DCE reading from summary table; the graph shows the peak to be wandering water vapor peak.
(f) Table identification & correlation peak believed to be noise.
(g) Elution of this peak was on following run(s).
(h) Peaks have overloaded sensor.
(i) Peaks not identified correctly by computer, hand calculated.
(j) Peak on this run is a carry over from a previous run.
(k) PCE peak may not be from this run (G14); it is a possible carry over from the previous run (F14).
If it is a carry over, then the compound is not PCE.
(l) PCE: Backup section contained more than 25% of analyte found in the main section; the sample appears to have been oversampled, and the reported air concentration may be less than the actual value. Vinyl chloride: Confirmed by secondary column.
(m) GC problems, bad data.
(n) Data highly suspect.
(o) Bad run.
(p) Estimated value.
(q) Onsite GC was not calibrated for vinyl chloride.

Soil Gas Results for Volatile Organic Compounds at CISS, 1992

1,2–DCE(T): 1,2–Dichloroethene (Total); TCE: Trichloroethene; PCE: Tetrachloroethene.
NA: Not applicable.
NC: Not collected for offsite analysis.
ND: Not detected; RT: Retention time.
PB: Probe blank.
Offsite samples: Used a low flow pump at flow rate of 100 cc/min. for 15 minutes;
GC was calibrated for 1,2–DCE(T), TCE, and PCE.

Groundwater Sample Results for Volatile Organic Compounds at CISS, 1992

Sample Number	Sampling Depth (ft)	Concentration (ppb) 1,2–Dichloroethene (Total)	Trichloroethene	Tetrachloroethene	pH	Temp °C	Specific Conductivity (μmhos/cm)
D18a (D/E 18.5)	8	5 U	5 U	5 U	7	26	2004
E11	4	5 U	5 U	5 U	NA	NA	NA
E13	3.5	5 U	5 U	5 U	6.97	24	2549
E16	8	6	14	140	6.91	22	2442
F17b (F 17.5)	8	5 U	5 U	5 U	7.5	21	2380
G16a (G/H 16)	8	32	230	540	6.97	22	2680
N13	8	120	32	81	7.8	25	2333

U – detection limit.
NA – Not available.

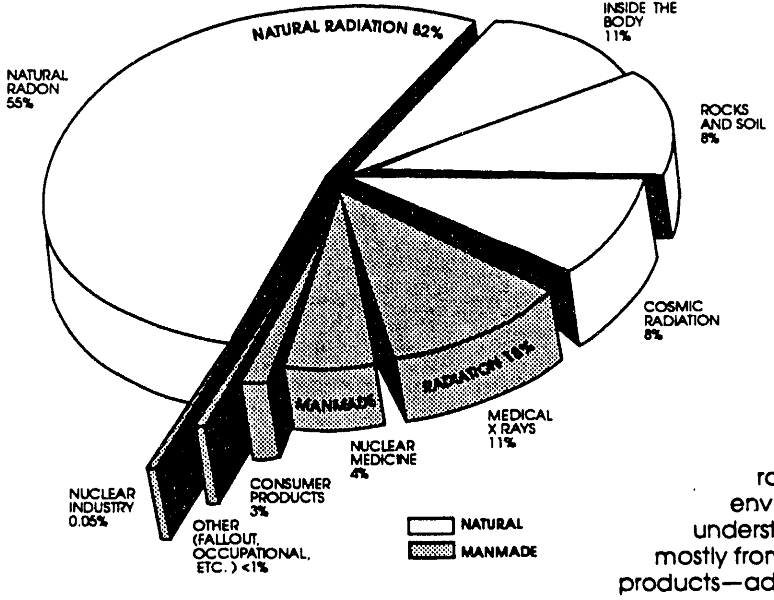
APPENDIX C Radiation in the Environment

Radiation in the Environment

Radiation is a natural part of our environment. When our planet was formed, radiation was present—and radiation surrounds it still. Natural radiation showers down from the distant reaches of the cosmos and continuously radiates from the rocks, soil, and water on the Earth itself.

During the last century, mankind has discovered radiation, how to use it, and how to control it. As a result, some manmade radiation has been added to the natural amounts present in our environment.

Sources of Radiation



Many materials—both natural and manmade—that we come into contact with in our everyday lives are radioactive. These materials are composed of atoms that release energetic particles or waves as they change into more stable forms. These particles and waves are referred to as *radiation*, and their emission as *radioactivity*.

As the chart on the left shows, most environmental radiation (82%) is from natural sources. By far the largest source is radon, an odorless, colorless gas given off by natural radium in the Earth's crust. While radon has always been present in the environment, its significance is better understood today. Manmade radiation—mostly from medical uses and consumer products—adds about eighteen percent to our total exposure.

TYPES OF IONIZING RADIATION

Radiation that has enough energy to disturb the electrical balance in the atoms of substances it passes through is called *ionizing radiation*. There are three basic forms of ionizing radiation.

Alpha

Alpha particles are the largest and slowest moving type of radiation. They are easily stopped by a sheet of paper or the skin. Alpha particles can move through the air only a few inches before being stopped by air molecules. However, alpha radiation is dangerous to sensitive tissue inside the body.

Beta

Beta particles are much smaller and faster moving than alpha particles. Beta particles pass through paper and can travel in the air for about 10 feet. However, they can be stopped by thin shielding such as a sheet of aluminum foil.

Gamma

Gamma radiation is a type of electromagnetic wave that travels at the speed of light. It takes a thick shield of steel, lead, or concrete to stop gamma rays. X rays and cosmic rays are similar to gamma radiation. X rays are produced by manmade devices; cosmic rays reach Earth from outer space.

SAIC189

Units of Measure

Radiation can be measured in a variety of ways. Typically, units of measure show either 1) the total amount of radioactivity present in a substance, or 2) the level of radiation being given off.

The radioactivity of a substance is measured in terms of the number of transformations (changes into more stable forms) per unit of time. The *curie* is the standard unit for this measurement and is based on the amount of radioactivity contained in 1 gram of radium. Numerically, 1 curie is equal to 37 billion transformations per second. The amounts of radioactivity that people normally work with are in the millicurie (one-thousandth of a curie) or microcurie (one-millionth of a curie) range. Levels of radioactivity in the environment are in the picocurie, or pCi (one-trillionth of a curie) range.

Levels of radiation are measured in various The level of gamma radiation in the air is measure the *roentgen*. This is a relatively large unit, so measurements are often calculated in millroentg Radiation absorbed by humans is measured in e *rad* or *rem*. The rem is the most descriptive beca it measures the ability of the specific type of radiation to do damage to biological tissue. A typical measurements will often be in the mill (mrem), or one-thousandth of a rem, range. In the international scientific community, abso dose and biological exposure are expressed in *g* and *seiverts*. 1 gray (Gy) equals 100 rad. 1 seivert equals 100 rem. On the average, Americans receive about 360 mrem of radiation a year. of this (97%) is from natural radiation and medica exposure. Specific examples of common source radiation are shown in the chart below.

RADIATION IN THE ENVIRONMENT

Because the radioactivity of individual samples varies, the numbers given here are approximate or represent an average. They are shown to provide a perspective for concentrations and levels of radioactivity rather than dose.

mrem = millirem
pCi = picocurie

Cosmic Radiation

Cosmic radiation is high-energy gamma radiation that originates in outer space and filters through our atmosphere.

Sea Level (increases about 1/2 mrem for each additional 100 feet in elevation)	26 mrem/year
Atlanta, Georgia (1,050 feet)	31 mrem/year
Denver, Colorado (5,300 feet)	50 mrem/year
Minneapolis, Minnesota (815 feet)	30 mrem/year
Salt Lake City, Utah (4,400 feet)	46 mrem/year

Terrestrial Radiation

Terrestrial sources are naturally radioactive elements in the soil and water such as uranium, radium, and thorium. Average levels of these elements are 1 pCi/gram of soil.

United States (average)	26 mrem/year
Denver, Colorado	63 mrem/year
Nile Delta, Egypt	350 mrem/year
Paris, France	350 mrem/year
Coast of Kerala, India	400 mrem/year
McAlpe, Brazil	2,558 mrem/year
Pocos De Caldas, Brazil	7,000 mrem/year

Buildings

Many building materials, especially granite, contain naturally radioactive elements.

U.S. Capitol Building	85 mrem/year
Base of Statue of Liberty	325 mrem/year
Grand Central Station	525 mrem/year
The Vatican	800 mrem/year

Radon

Radon levels in buildings vary, depending on geographic location, from 0.1 to 200 pCi/liter.

Average Indoor Radon Level	1.5 pCi/liter
Occupational Working Limit	100.0 pCi/liter

Food

Food contributes an average of 20 mrem/year, mostly from potassium-40, carbon-14, hydrogen-3, radium-226, and thorium-232.

Beer	390 pCi/liter
Tap Water	20 pCi/liter
Milk	1,400 pCi/liter
Salad Oil	4,900 pCi/liter
Whiskey	1,200 pCi/liter
Brazil Nuts	14 pCi/g
Bananas	3 pCi/g
Flour	0.14 pCi/g
Peanuts & Peanut Butter	0.12 pCi/g
Tea	0.40 pCi/g

Medical Treatment

The exposures from medical diagnosis vary widely according to the required procedure, the equipment and film used for x rays, and the skill of the operator.

Chest X Ray	10 mrem
Dental X Ray,Each	100 mrem

Consumer Goods

Cigarettes–two packs/day (polonium-210)	8,000 mrem/y
Color Television	<1 mrem/y
Gas Lantern Mantle (thorium-232)	2 mrem/y
Highway Construction	4 mrem/y
Airplane Travel at 39,000 feet (cosmic)	0.5 mrem/
Natural Gas Heating and Cooking (radon-222)	2 mrem/y
Phosphate Fertilizers	4 mrem/y

Natural Radioactivity in Florida Phosphat Fertilizers (in pCi/gram)

	Normal Superphosphate	Concentrated Superphosphate	Gypsu
Ra-226	21.3	21.0	33.
U-238	20.1	58.0	6.
Th-230	18.9	48.0	13.
Th-232	0.6	1.3	0.

Porcelain Dentures (uranium)	1,500 mrem/ye
Radioluminescent Clock (promethium-147)	<1 mrem/ye
Smoke Detector (americium-241)	0.01 mrem/ye

International Nuclear Weapons Te Fallout from pre–1980 atmospheric tests

(average for a U.S. citizen)	1 mrem/ye

References

Effect of Ionizing Radiation on Human Health, The. Arthur C. Upton. New York University Medical Center. Atomic Industrial Forum, 1984.
Effects on Populations of Exposure to Low Levels of Ionizing Radiation: 1980. Committee on the Biological Effects of Ionizing Radiation. National Academy Press, 1984.
Ionizing Radiation Exposure of the Population of the United States: Report Number 93. National Council on Radiation Protection and Measurements, 1987.
Radiation Exposure of the U.S. Population from Consumer Products and Miscellaneous Sources: Report Number 95. National Council on Radiaton Protection and Measurments , 19
Radiation in Medicine and Industry. A.P. Jacobson and G.P. Sakolosky, 1980.
Radioactivity in Consumer Products. U.S. Nuclear Regulatory Commision, 1978.

PERSPECTIVE: How Big is a Picocurie?

The *curie* is a standard measure for the intensity of radioactivity contained in a sample of radioactive material. It was named after French scientists Marie and Pierre Curie for their landmark research into the nature of radioactivity.

The basis for the curie is the radioactivity of one gram of radium. Radium decays at a rate of about 2.2 trillion disintegrations ($2.2X10^{12}$) per minute. A *picocurie* is one trillionth of a curie. Thus, a picocurie represents 2.2 disintegrations per minute.

To put the relative size of one *trillionth* into perspective, consider that if the Earth were reduced to one trillionth of its diameter, the "pico earth" would be smaller in diameter than a speck of dust. In fact, it would be six times smaller than the thickness of a human hair.

The difference between the curie and the picocurie is so vast that other metric units are used between them. These are as follows:

Millicurie = $\frac{1}{1{,}000}$ **(one thousandth) of a curie**

Microcurie = $\frac{1}{1{,}000{,}000}$ **(one millionth) of a curie**

Nanocurie = $\frac{1}{1{,}000{,}000{,}000}$ **(one billionth) of a curie**

Picocurie = $\frac{1}{1{,}000{,}000{,}000{,}000}$ **(one trillionth) of a curie**

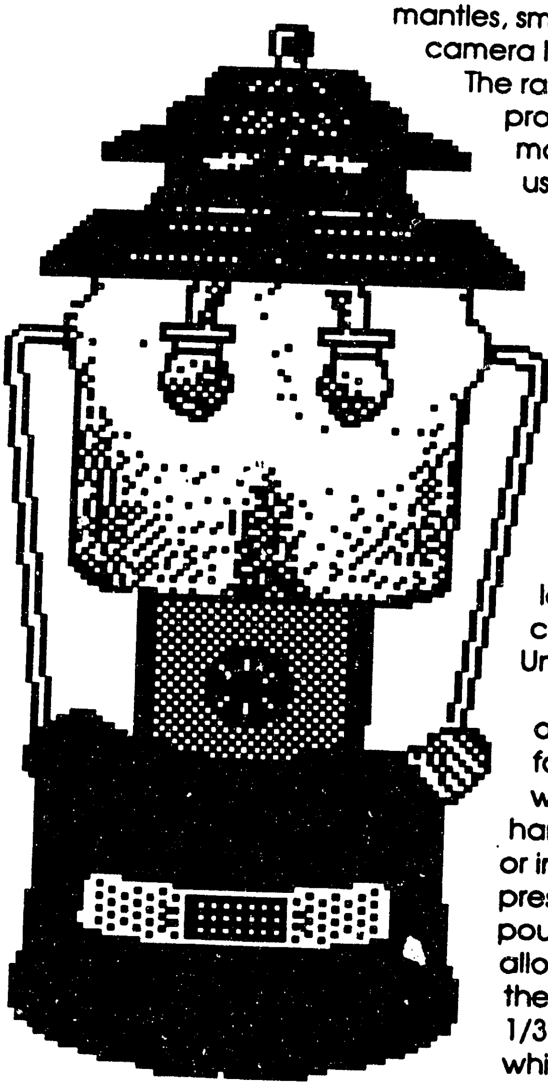
The following chart shows the relative differences between the units and gives analogies in dollars. It also gives examples of where these various amounts of radioactivity could typically be found. The number of disintegrations per minute has been rounded off for the chart.

UNIT OF RADIOACTIVITY	SYMBOL	DISINTEGRATIONS PER MINUTE	DOLLAR ANALOGY	EXAMPLES OF RADIOACTIVE MATERIALS
1 Curie	Ci	$2x10^{12}$ or 2 Trillion	2 Times the Annual Federal Budget	Nuclear Medicine Generator
1 Millicurie	mCi	$2x10^{9}$ or 2 Billion	Cost of a New Interstate Highway from Atlanta to San Francisco	Amount Used for a Brain or Liver Scan
1 Microcurie	µCi	$2x10^{6}$ or 2 Million	All-Star Baseball Player's Salary	Amount Used in Thyroid Tests
1 Nanocurie	nCi	$2x10^{3}$ or 2 Thousand	Annual Home Energy Costs	Consumer Products
1 Picocurie	pCi	2	Cost of a Hamburger and Coke	Background Environmental Levels

Chart provided by W.L. Beck, Bechtel National, Inc.

PERSPECTIVE: Radioactivity in Gas Lantern Mantles

Around the House



Many household products contain a small amount of radioactivity. Examples include gas lantern mantles, smoke detectors, dentures, camera lenses, and anti-static brushes. The radioactivity is added to the products either specifically to make them work, or as a result of using compounds of elements like thorium and uranium in producing them. The amount of radiation the products gives off is not considered significant. But with today's sensitive equipment, it can be detected.

Lanterns: In a New Light

About 20 million gas lantern mantles are used by campers each year in the United States.

Under today's standards, the amount of natural radioactivity found in a lantern mantle would require precautions in handling it at many Government or industry sites. The radioactivity present would contaminate 15 pounds of dirt to above allowable levels. This is because the average mantle contains 1/3 of a gram of thorium oxide, which has a specific activity (a measure of radioactivity) of approximately 100,000 picocuries per gram. The approximately 35,000 picocuries of radioactivity in the mantle would, if thrown onto the ground, be considered low-level radioactive contamination.

From information provided by W.L. Beck, Bechtel National, Inc.

SAIC169

APPENDIX D Parameters for Analysis

Table D-1

Parameters for Analysis at CISS, 1992

Medium	Parameter	Technique
Groundwater	Total uranium	Kinetic phosphorescence analyzer
	Thorium-232	Alpha spectrometry
	Total organic carbon	Wet ultraviolet-aided persulfate oxidation
	Total organic halides	Microcoulimetry
	Specific conductivity	Electrometric
	pH	Electrometric
	Volatile organics	Gas chromatography/mass spectrometry
	Metals: boron, barium, cadmium, chromium, copper, magnesium, nickel, zinc	Inductively coupled plasma atomic emission spectrophotometry (ICPAES)
	antimony, arsenic, lead, selenium, thallium	Atomic absorption (AA) spectrophometry
Surface Water	Total uranium	Kinetic phosphorescence analysis
	Thorium-232	Alpha spectrometry
Sediment	Total uranium	Kinetic phosphorescence analyzer
	Thorium-232	Gamma spectrometry
Air	External gamma radiation	Thermoluminescence

[a] Air samples are cumulative; all others are grab samples.

Table D-2

Detection Limits for Organic Chemical Analyses of Groundwater at CISS

Compound	Laboratory Detection Limit[a] (μg/L)
Volatile Organic	
Chloromethane	10
Bromomethane	10
Vinyl chloride	10
Chloroethane	10
Methylene chloride	5
Acetone	10
Carbon disulfide	5
1,1-Dichloroethene	5
1,1-Dichloroethane	5
1,2-Dichloroethene (total)	5
Chloroform	5
1,2-Dichloroethane	5
2-Butanone	10
1,1,1-Trichloroethane	5
Carbon tetrachloride	5
Vinyl acetate	10
Bromodichloromethane	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
Trichloroethylene	5
Dibromochloromethane	5
1,1,2-Trichloroethane	5
Benzene	5
trans-1,3-Dichloropropene	5
2-chloroethylvinylether	10
Bromoform	5
4-Methyl-1,2-pentanone	10
2-Hexanone	10
Tetrachloroethylene	5
1,1,2,2-Tetrachloroethane	5
Toluene	5
Chlorobenzene	5
Ethylbenzene	5
Styrene	5
Xylene (total)	5
Acrolein	10
Acrylonitrile	10

---

[a] Detection limits can vary because of dilution ratios.

Table D-3
Detection Limits for Metals Analyses of Groundwater at CISS

Analyte	Detection Limit (μg/L)
Antimony	10.0
Arsenic	10.0
Barium	200
Boron	100
Cadmium	5.0
Chromium	10.0
Copper	25.0
Lead	3
Magnesium	5,000
Nickel	40.0
Selenium	5.0
Thallium	10.0
Zinc	20.0

APPENDIX E Methodology for Statistical Analysis of Data

METHODOLOGY FOR STATISTICAL ANALYSIS OF DATA

Treatment of "Less than Zero" Values

Occasionally a radiological analytical value may be reported as a negative number. This is not a mistake, and the value does not represent "negative radioactivity." Rather, it is an artifact of the radiological measurement process resulting from the subtraction of the background radiation measured by the instrument from the radiation measured in the sample. These results are essentially indistinguishable from zero.

Radioactive decay is a random phenomenon that can be described by a normal distribution (i.e., mean and standard deviation). When a sample contains radioactive elements at activities that are near instrument background, a single measurement of the sample can result in a negative value (when the instrument background is subtracted). If many measurements of the sample were taken and used to calculate the mean, this mean would be positive and would approximate the true radioactivity, however small, of the sample. In practice at FUSRAP sites, multiple measurements to calculate the mean activity of a sample near the instrument background are not necessary because the instrument background is typically several orders of magnitude less than any DCGs.

Beginning with the third quarter 1992 environmental monitoring, less-than-zero radiological values have been reported when they occur. This practice will be continued for all future environmental monitoring, which will result in more accurate statistical analysis. For 1992 this results in both negative values and values reported as less than a detection limit being used in the site environmental report. The negative values are used as reported in the statistical calculations. For values that are reported as less than the detection limit, the detection limit is used in the statistical calculations.

Treatment of Rounding and Significant Figures

When performing calculations, the answer can be no more accurate than the least accurate number in the data (i.e., the number with the least number of significant digits). Regardless of whether a number contains a decimal, the number of significant digits is the total number of digits starting with the left-most, non-zero digit and ending with the right-most digit (even if it is a zero). For example, 231, 230, and 23.0 each have three significant digits, while 0.05 and 5 each have one significant digit. Rounding is performed on final calculation results only, not on interim results.

Treatment of Annual Average Concentrations

Annual average concentrations are calculated by adding the results for the year and dividing by the number of quarters for which data have been taken and reported (usually four). An example follows.

Thorium-230 Results (pCi/L)

Sampling Location	Quarter			
	1	2	3	4
1	13	7	12	5

First, results reported for the year are added.

13 + 7 + 12 + 5 = 37

Next, the sum of all results is divided by the number of quarters for which data were taken and reported. In this example there were data for all four quarters.

37 ÷ 4 = 9.25

Because there are two single-digit numbers (5 and 7) (the number of significant figures is 1), the result is rounded to 9. This value is entered into the average value column.

Thorium-230 Results (pCi/L)

Sampling Location	Quarter				Average Value
	1	2	3	4	
1	13	7	12	5	9

Expected concentration ranges are calculated to provide a basis for trend analysis of the data. These expected ranges are calculated by taking the average of the annual average concentrations for the past five years (when possible) and calculating a standard deviation for these data. The lower expected range is calculated by subtracting two standard deviations from the average value, and the upper range is calculated by adding two standard deviations to the average values. If site conditions do not change, 95 percent of the data points would be expected to fall within this range. An example of these calculations is shown below.

Thorium-230 Results (pCi/L)

Sampling Location	Year					Average Value	Standard Deviation
	1986	1987	1988	1989	1990		
1	10	5	14	8	5	8	4

The formula for calculation of the standard deviation of a sample xi, ..., xn is:

$$S = \sqrt{S^2} = \sqrt{\frac{\sum (x_i - \overline{x})^2}{n - 1}}$$

where: S = Standard deviation

x_i = Individual values

x = Average of values

n = Number of values

n	x_i	$\bar{x}$	$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
1	10	8	2	4
2	5	8	-3	9
3	14	8	6	36
4	8	8	0	0
5	5	8	-3	9

$$\sum (x_i - \bar{x})^2 = 58$$

$$S = \sqrt{\frac{58}{5 - 1}} = \sqrt{\frac{58}{4}} = \sqrt{14.5} = 3.807,$$

which rounds to 4 because there is only one significant figure.

The calculation for the expected ranges for this example is shown below.

Lower expected range: 8 - 2(4) = 0
Upper expected range: 8 + 2(4) = 20 (rounded to one significant figure)

Annual average values for the site for the current year are compared with these ranges to indicate a possible anomaly or trend. If a discernible trend is found from this comparison, the data are presented in the appropriate section of the report.

APPENDIX F Population Exposure Methodology

POPULATION EXPOSURE METHODOLOGY

DOSE CALCULATION METHODOLOGY

DOE Order 5400.5 requires that the impacts of the site on both the hypothetical maximally exposed individual and the population within 80 km (50 mi) of the site be evaluated. For radioactive materials, this evaluation is usually conducted by calculating the dose received by the hypothetical individual and the general population and comparing this dose with DOE guidelines. This appendix describes the methodology used to calculate the doses discussed in Section 4.0.

PATHWAYS

The purpose of the dose calculation is to identify the potential routes or pathways that are available to transmit either radioactive material or ionizing radiation to the receptor. In general, the pathways are (1) direct exposure to gamma radiation, (2) atmospheric transport of radioactive material, (3) transport of radioactive material via surface water or groundwater, (4) bioaccumulation of radioactive materials in animals used as a food source, and (5) uptake of radioactive materials into plants used as a food source. For FUSRAP sites, the primary pathways may be direct gamma radiation and transport of radioactive materials by the atmosphere, groundwater, and surface water. The others are not considered primary pathways because FUSRAP sites are not located in areas where significant numbers of livestock are raised or foodstuffs are grown.

Gamma rays can travel until they expend all their energy in molecular or atomic interactions. In general, these distances are not very great, and the exposure pathway would affect only the hypothetical maximally exposed individual.

Contamination transported by the atmospheric pathway may take the form of contaminated particulates or dust and can provide a potential dose only when it is inhaled. Doses from radon are excluded in accordance with DOE Order 5400.5 II, 1.a(3) Application

(02/08/90). Radon exposure is controlled through compliance with boundary concentration requirements.

Contamination may be transported in surface water when runoff from a rainfall event or some other source of overland flow carries contamination from the site to the surface water system. This contamination only poses an exposure potential when the surface water is used to provide municipal drinking water, to water livestock, and/or to irrigate crops. Contamination may be transported via groundwater if contaminants migrate into the groundwater system.

Primary Radionuclides of Concern

The primary radionuclides of concern for these calculations at most FUSRAP sites are uranium-238, uranium-235, uranium-234, thorium-232, radium-226, and the daughter products (excluding radon). For several of the dose conversion factors used in these calculations, the contributions of the daughters with half-lives less than one year are included with the parent radionuclide. Table F-1 lists the pertinent radionuclides common among FUSRAP sites, their half-lives, and dose conversion factors for ingestion.

DOSE CALCULATION METHOD

Direct Gamma Radiation Exposure

As previously indicated, direct gamma radiation exposure is important in calculating the dose to the hypothetical maximally exposed individual. The dose from direct gamma radiation exposure is determined by using data collected through the tissue-equivalent thermoluminescent dosimeter (TETLD) program. These data provide a measure of the amount and energy (in units of mR/yr) of the ionizing radiation at 1 m (3 ft) above the ground. For the purposes of this report, the hypothetical maximally exposed individual is assumed to live 69 m (227 ft) south of the southwestern boundary of the site and to spend 100 percent of his or her time at this location.

The dose to the hypothetical maximally exposed individual for 1992 can be determined by assuming that the individual is exposed to a line source located along the fenceline. Because the average exposure rate is known from the TETLD program for a distance of 1 m (3 ft) from the fenceline, the exposure at 69 m (230 ft) from the fenceline can be calculated by using the following equation (Cember 1983).

$$Exposure\ at\ 69\ m = (Exposure\ at\ 1\ m)\ x\ \frac{h_1}{h_2}\ x\ \frac{\tan^{-1}\ (L/h_2)}{\tan^{-1}\ (L/h_1)}$$

where: h_1 = TETLD distance from the fenceline [1 m (3 ft)]

h_2 = Distance to hypothetical maximally exposed individual [69 m (230 ft)]

L = Half of the length of the southwestern side of the site [170 m (560 ft)]

The exposure at 1 m (3 ft) can be calculated by taking the average of the results from the four dosimeters along this portion of the fenceline (stations 3, 4, 5, and 6). The average exposure for these dosimeters was 30.5 mR/yr. Using the formula above, the exposure at 69 m (230 ft) is approximately 0.34 mR/yr. Because 1 mR is approximately equal to 1 mrem, the resulting dose would be 0.34 mrem/yr (3.4×10^{-3} mSv/yr), assuming 24-h continuous residence.

Surface Water Pathway

Exposures from contaminants in surface water can be important in calculating the dose to both the hypothetical maximally exposed individual and the nearby population. The data used to support the surface water dose calculation consist of measurements of concentrations of contaminants in surface water at the site and of the amount of dilution provided by tributaries or rivers between the site and the intake. Thus, the dose to the hypothetical individual can be calculated as follows:

$$D_s = \sum_{i=1}^{N} C_i (F_s + F_i)\ U_a\ x\ DCF_i$$

where: D_s = Committed effective dose from surface water

C_i = Concentration of the i^{th} radionuclide in surface water at the site

F_s = Average annual flow of surface water at the site

F_i = Average flow of surface water at the intake

U_a = Annual consumption of liquid (approximately 730 L/yr)

DCF_i = Dose conversion factor for the i^{th} radionuclide

To determine the dose for the population, the same equation would be used, and the dose would be multiplied by the population group served by the drinking water supply. It is important to note that for the population dose, the intake point is probably not the same as that for the hypothetical maximally exposed individual.

The approach outlined above should provide a very conservative dose calculation for the surface water pathway because it does not account for radionuclides settling out or for any municipal water treatment.

Groundwater Pathway

Exposures from contaminants in groundwater are important in calculating the dose to both the hypothetical maximally exposed individual and the nearby population. The data used to support the groundwater dose calculations consist of measurements of the concentrations of the contaminants in groundwater and an estimate of the dilution that has occurred between the measurement location and the intake point; however, groundwater near the site is not used as a drinking water source.

Air Pathway (Inhalation)

The doses to the hypothetical maximally exposed individual and general public from particulate radionuclides transported via the air pathway are calculated using EPA's computer model CAP88-PC. Two sources of radionuclide emission were used in calculating the inhalation exposure: (1) contaminated surface soils, and (2) the HEPA system exhaust from the building. The total alpha activity for each sample set limited from the HEPA system is provided in Table F-2.

The release of particulates was calculated using a model for wind erosion because there are no other mechanisms for releasing surface soil particulates from the site. The wind erosion model used was taken from the *Rapid Assessment of Exposure to Particulate Emissions from Surface Contamination Sites*. The EPA wind erosion model uses the average particle size for the soil at CISS (0.15 mm), the area of contaminated soils outside the building, 99 percent vegetation cover of the surface soils, and local meteorological data (see Section 1.0).

TABLES FOR APPENDIX F

Table F-1

Radionuclides of Interest

Radionuclide	Half-life[a]	Dose Conversion Factor[b] for Ingestion (mrem/pCi)
Uranium-238	4.51×10^9 years	2.5×10^{-4}
Thorium-234	24.1 days	--[c]
Protactinium-234 m	1.17 minutes	--[c]
Protactinium-234	6.75 hours	--[c]
Uranium-234	2.47×10^5 years	2.6×10^{-4}
Thorium-230	8×10^4 years	5.3×10^{-4}
Radium-226	1602 years	1.1×10^{-3}
Uranium-235	7.1×10^8 years	2.5×10^{-4}
Thorium-231	25.5 hours	--[d]
Thorium-232	1.4×10^{10} years	2.8×10^{-3}
Protactinium-231	3.25×10^4 years	1.1×10^{-2}
Actinium-227	21.6 years	1.5×10^{-2}
Thorium-227	18.2 days	--[e]
Radium-223	11.43 days	--[e]

[a] Source: HEW 1970.

[b] Source: *Federal Guidance Report No. 11, Limiting Values of Radionuclide Intake and Air Concentrations and Dose Conversion Factors for Inhalation Submersion* (EPA-520/1-88-020) and *International Dose Conversion Factors for Calculation of Dose to the Public* (DOE/EH-0071).

[c] Included in the uranium-238 dose conversion factor.

[d] Included in the uranium-235 dose conversion factor.

[e] Included in the actinium-227 dose conversion factor.

TABLE F-2

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
209	06-03-92	06-08-92	Outside HVAC exhaust	511	26.5	1.4E+07	0.94	1.40	0.318	4.8E-14	1.528E-02
213	06-04-92	06-09-92	Outside HVAC exhaust	224	25.0	5.6E+06	0.94	1.72	0.321	2.0E-13	2.791E-02
214	06-08-92	06-15-92	Outside HVAC exhaust	570	27.5	1.6E+07	0.64	0.40	0.341	< 2.2E-14	< 7.812E-03
220	06-09-92	06-15-92	Outside HVAC exhaust	583	26.0	1.5E+07	0.64	0.68	0.341	< 2.7E-14	< 9.806E-03
221	06-10-92	06-15-92	Outside HVAC exhaust	575	26.0	1.5E+07	0.46	1.34	0.317	8.4E-14	3.009E-02
225	06-11-92	06-16-92	Outside HVAC exhaust	588	27.0	1.6E+07	0.46	0.48	0.343	< 2.0E-14	< 7.326E-03
228	06-15-92	06-22-92	Outside HVAC exhaust	579	26.5	1.5E+07	0.40	0.34	0.344	< 1.8E-14	< 6.493E-03
233	06-16-92	06-22-92	Outside HVAC exhaust	574	28.0	1.6E+07	0.40	0.66	0.344	2.1E-14	7.509E-03
235	06-17-92	06-22-92	Outside HVAC exhaust	580	31.0	1.8E+07	0.40	0.54	0.344	< 2.7E-14	< 9.756E-03
239	06-18-92	06-23-92	Outside HVAC exhaust	585	27.0	1.6E+07	0.54	0.82	0.314	2.5E-14	9.111E-03
241	06-22-92	06-29-92	Outside HVAC exhaust	588	27.0	1.6E+07	0.62	0.92	0.319	2.7E-14	9.890E-03
246	06-23-92	06-29-92	Outside HVAC exhaust	595	27.0	1.6E+07	0.62	1.98	0.319	1.2E-13	4.448E-02
244	06-24-92	06-29-92	Outside HVAC exhaust	595	27.0	1.6E+07	0.62	0.90	0.319	2.5E-14	9.267E-03
251	06-25-92	06-30-92	Outside HVAC exhaust	605	27.0	1.6E+07	0.60	0.96	0.319	3.1E-14	1.168E-02
254	06-29-92	07-06-92	Outside HVAC exhaust	592	26.0	1.5E+07	0.56	0.90	0.403	2.5E-14	9.220E-03
257	06-30-92	07-06-92	Outside HVAC exhaust	582	26.0	1.5E+07	0.56	1.66	0.407	8.0E-14	2.900E-02

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
264	07-02-92	07-07-92	Outside HVAC exhaust	605	27.0	1.6E+07	0.88	1.04	0.384	< 3.5E-14	< 1.319E-02
266	07-06-92	07-13-92	Outside HVAC exhaust	570	26.0	1.5E+07	0.70	1.78	0.378	8.7E-14	3.089E-02
270	07-07-92	07-13-92	Outside HVAC exhaust	373	25.0	9.3E+06	0.70	1.96	0.378	1.6E-13	3.718E-02
273	07-08-92	07-08-92	Outside HVAC exhaust	566	34.0	1.9E+07	0.70	0.94	0.398	< 3.2E-14	< 1.128E-02
278	07-09-92	07-17-92	Outside HVAC exhaust	611	25.0	1.5E+07	0.74	0.88	0.399	< 3.2E-14	< 1.128E-02
283	07-13-92	07-20-92	Outside HVAC exhaust	578	25.0	1.4E+07	0.72	2.16	0.381	1.2E-13	4.321E-02
287	07-14-92	07-20-92	Outside HVAC exhaust	550	24.0	1.3E+07	0.80	2.22	0.414	1.2E-13	4.111E-02
290	07-15-92	07-21-92	Outside HVAC exhaust	566	26.0	1.5E+07	1.06	1.68	0.400	4.7E-14	1.657E-02
297	07-16-92	07-21-92	Outside HVAC exhaust	579	24.0	1.4E+07	1.06	2.18	0.400	9.1E-14	3.282E-02
299	07-17-92	07-22-92	Outside HVAC exhaust	585	27.0	1.6E+07	0.96	1.14	0.379	3.9E-14	1.421E-02
302	07-18-92	07-23-92	Outside HVAC exhaust	320	28.0	9.0E+06	0.92	1.34	0.379	5.6E-14	1.116E-02
307	07-20-92	07-27-92	Outside HVAC exhaust	597	29.0	1.7E+07	0.16	0.20	0.382	1.2E-14	4.463E-03
310	07-21-92	07-27-92	Outside HVAC exhaust	524	25.0	1.3E+07	0.34	0.56	0.387	2.0E-14	6.529E-03
317	07-22-92	07-28-92	Outside HVAC exhaust	580	30.0	1.7E+07	0.32	0.32	0.379	< 1.3E-14	< 4.697E-03
318	07-23-92	07-28-92	Outside HVAC exhaust	605	25.0	1.5E+07	0.36	0.64	0.408	2.0E-14	7.538E-03
325	07-27-92	08-03-92	Outside HVAC exhaust	620	27.0	1.7E+07	0.42	0.46	0.405	1.7E-14	6.566E-03
334	07-28-92	08-03-92	Outside HVAC exhaust	605	24.0	1.5E+07	0.40	0.30	0.393	1.6E-14	6.030E-03

TABLE F-2

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
335	07-29-92	08-03-92	Outside HVAC exhaust	592	24.0	1.4E+07	0.40	0.34	0.393	< 1.7E-14	< 6.270E-03
343	07-30-92	08-04-92	Outside HVAC exhaust	610	24.0	1.5E+07	0.32	0.14	0.382	1.5E-14	5.700E-03
352	08-03-92	08-10-92	Outside HVAC exhaust	603	24.0	1.4E+07	0.16	0.26	0.388	2.0E-14	7.513E-03
357	08-04-92	08-10-92	Outside HVAC exhaust	597	24.0	1.4E+07	048	0.50	0.404	2.0E-14	7.438E-03
360	08-05-92	08-10-92	Outside HVAC exhaust	613	25.0	1.5E+07	0.16	0.22	0.388	< 1.5E-14	< 5.728E-03
366	08-06-92	08-11-92	Outside HVAC exhaust	600	25.0	1.5E+07	0.16	0.28	0.392	< 2.1E-14	< 7.849E-03
379	08-10-92	08-17-92	Outside HVAC exhaust	605	25.0	1.5E+07	0.16	0.34	0.388	1.4E-14	5.277E-03
382	08-11-92	08-17-92	Outside HVAC exhaust	612	25.0	1.5E+07	0.46	0.58	0.381	< 2.8E-14	< 1.068E-02
385	08-12-92	08-17-92	Outside HVAC exhaust	608	25.0	1.5E+07	0.16	0.16	0.388	< 1.0E-14	< 3.788E-03
393	08-13-92	08-18-92	Outside HVAC exhaust	615	25.0	1.5E+07	0.18	0.30	0.380	< 2.2E-14	< 8.429E-03
400	08-17-92	08-24-92	Outside HVAC exhaust	600	24.5	1.5E+07	0.40	0.58	0.395	< 3.2E-14	< 1.196E-02
408	08-18-92	08-24-92	Outside HVAC exhaust	613	25.0	1.5E+07	0.26	0.26	0.392	< 1.3E-14	< 4.964E-03
409	08-19-92	08-24-92	Outside HVAC exhaust	608	25.0	1.5E+07	0.26	0.28	0.392	< 1.4E-14	< 5.303E-03
417	08-20-92	08-25-92	Outside HVAC exhaust	605	25.0	1.5E+07	0.18	0.42	0.377	1.9E-14	7.161E-03
433	08-24-92	08-31-92	Outside HVAC exhaust	610	25.0	1.5E+07	0.50	0.26	0.389	< 1.8E-14	< 6.840E-03
435	08-25-92	08-31-92	Outside HVAC exhaust	589	25.0	1.5E+07	0.36	0.32	0.385	< 1.6E-14	< 5.871E-03
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.50	0.32	0.389	[illegible]	< 6.784E-03

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992

(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
448	08-27-92	09-01-92	Outside HVAC exhaust	545	25.0	1.4E+07	0.26	0.36	0.376	< 2.5E-14	< 8.488E-03
466	08-31-92	09-08-92	Outside HVAC exhaust	605	25.0	1.5E+07	0.30	0.28	0.371	< 1.5E-14	< 5.653E-03
473	09-01-92	09-08-92	Outside HVAC exhaust	613	24.0	1.5E+07	0.44	0.26	0.399	< 1.7E-14	< 6.492E-03
476	09-02-92	09-08-92	Outside HVAC exhaust	624	24.5	1.5E+07	0.30	0.34	0.371	< 1.8E-14	< 6.997E-03
483	09-03-92	09-08-92	Outside HVAC exhaust	658	25.5	1.7E+07	0.44	0.62	0.399	< 2.8E-14	< 1.148E-02
484	09-04-92	09-09-92	Outside HVAC exhaust	392	25.0	9.8E+06	0.26	0.32	0.379	< 2.9E-14	< 7.082E-03
489	09-08-92	09-14-92	Outside HVAC exhaust	603	24.0	1.4E+07	0.34	0.30	0.366	< 1.6E-14	< 6.010E-03
493	09-09-92	09-14-92	Outside HVAC exhaust	603	21.0	1.3E+07	0.42	0.58	0.395	< 3.5E-14	< 1.315E-02
498	09-10-92	09-15-92	Outside HVAC exhaust	605	25.0	1.5E+07	0.52	0.68	0.410	< 3.0E-14	< 1.131E-02
506	09-14-92	09-21-92	HVAC exhaust routine	594	25.0	1.5E+07	0.30	0.40	0.368	< 2.4E-14	< 8.881E-03
510	09-15-92	09-21-92	HVAC exhaust routine	603	25.0	1.5E+07	0.38	0.54	0.396	< 2.9E-14	< 1.089E-02
511	09-16-92	09-21-92	HVAC exhaust routine	583	25.0	1.5E+07	0.30	0.58	0.368	< 2.4E-14	< 8.717E-03
518	09-17-92	09-22-92	HVAC exhaust routine	590	25.0	1.5E+07	0.46	0.60	0.375	< 3.1E-14	< 1.139E-02
523	09-21-92	09-28-92	HVAC exhaust routine	603	25.5	1.5E+07	0.40	0.44	0.383	< 1.9E-14	< 7.137E-03
527	09-22-92	09-28-92	HVAC exhaust routine	610	24.5	1.5E+07	0.52	0.40	0.395	< 1.8E-14	< 6.840E-03
531	09-23-92	09-28-92	HVAC exhaust routine	600	25.0	1.5E+07	0.40	0.38	0.383	< 1.6E-14	< 5.981E-03
540	09-24-92	09-29-92	HVAC exhaust routine	600	25.0	1.5E+07	0.32	0.32	0.376	< 1.5E-14	< 5.607E-03

TABLE F-2

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
552	09-28-92	10-05-92	HVAC exhaust routine	605	25.0	1.5E+07	0.36	0.32	0.378	< 1.6E-14	< 6.030E-03
554	09-29-92	10-05-92	HVAC exhaust routine	590	25.0	1.5E+07	0.36	0.32	0.378	< 1.6E-14	< 5.881E-03
555	09-30-92	10-05-92	HVAC exhaust routine	403	23.0	9.3E+06	0.36	0.36	0.378	< 2.5E-14	< 6.276E-03
563	10-01-92	10-06-92	HVAC exhaust routine	598	24.0	1.4E+07	0.44	0.56	0.402	< 2.8E-14	< 1.043E-02
572	10-05-92	10-12-92	HVAC exhaust routine	621	24.5	1.5E+07	0.30	0.54	0.401	1.8E-14	6.964E-03
574	10-06-92	10-12-92	HVAC exhaust routine	600	28.5	1.7E+07	0.30	0.22	0.401	< 1.2E-14	< 4.485E-03
575	10-07-92	10-12-92	HVAC exhaust routine	650	27.0	1.8E+07	0.30	0.18	0.401	< 1.2E-14	< 4.859E-03
582	10-08-92	10-13-92	HVAC exhaust routine	616	29.0	1.79E+07	0.54	0.50	0.406	< 1.5E-14	< 5.756E-03
589	10-12-92	10-19-92	HEPA blower exhaust	608	3.0	1.82E+06	0.28	0.52	0.400	1.5E-13	5.681E-02
594	10-13-92	10-19-92	HEPA blower exhaust	611	27.0	1.65E+07	0.28	0.38	0.400	< 2.0E-14	< 7.613E-03
596	10-14-92	10-19-92	HEPA blower exhaust	609	3.0	1.83E+06	0.28	0.38	0.400	< 1.8E-13	< 6.829E-02
601	10-15-92	10-20-92	HEPA blower exhaust	607	25.0	1.52E+07	0.46	0.38	0.390	< 1.7E-14	< 6.428E-03
607	10-19-92	10-24-92	HEPA blower exhaust	641	26.0	1.63E+07	0.26	0.60	0.366	2.6E-14	1.038E-02
615	10-20-92	10-26-92	HEPA blower exhaust	610	30.0	1.83E+07	0.26	0.34	0.397	1.6E-14	6.080E-03
618	10-21-92	10-27-92	HEPA blower exhaust	615	29.0	1.78E+07	0.40	0.30	0.395	1.3E-14	4.981E-03
624	10-22-92 10-23-92	10-28-92	HEPA blower exhaust	1329	32.0	4.25E+07	0.52	0.58	0.389	< 8.3E-15	< 6.872E-03

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
630	10-26-92	11-02-92	HEPA blower exhaust	600	27.0	1.62E+07	0.46	0.68	0.394	< 3.3E-14	< 1.233E-02
634	10-27-92	11-02-92	HEPA blower exhaust	612	25.0	1.53E+07	0.46	0.40	0.394	< 1.7E-14	< 6.481E-03
642	10-28-92	11-03-92	HEPA blower exhaust	621	28.0	1.74E+07	0.58	0.72	0.400	< 2.6E-14	< 1.006E-02
649	10-29-92	11-04-92	HEPA blower exhaust	612	28.0	1.71E+07	0.52	0.52	0.411	< 1.5E-14	< 5.719E-03
651	11-02-92	11-09-92	HEPA blower exhaust	610	25.0	1.53E+07	0.60	0.34	0.860	< 8.8E-15	< 3.344E-03
657	11-03-92	11-09-92	HEPA blower exhaust	626	20.0	1.25E+07	0.60	0.56	0.386	< 2.4E-14	< 9.359E-03
659	11-04-92	11-10-92	HEPA blower exhaust	612	26.0	1.59E+07	0.46	0.60	0.409	< 2.6E-14	< 9.913E-03
670	11-05-92	11-11-92	HEPA blower exhaust	601	31.0	1.86E+07	0.40	0.76	0.368	2.4E-14	8.986E-03
672	11-09-92	11-16-92	HEPA blower exhaust	597	33.0	1.97E+07	0.60	0.66	0.386	< 1.9E-14	< 7.066E-03
674	11-10-92	11-16-92	HEPA blower exhaust	605	32.0	1.94E+07	0.60	0.38	0.386	< 1.5E-14	< 5.653E-03
682	11-11-92	11-17-92	HEPA blower exhaust	609	35.0	2.13E+07	0.60	0.76	0.386	< 2.4E-14	< 9.105E-03
687	11-12-92	11-18-92	HEPA blower exhaust	561	35.0	1.94E+07	0.60	0.56	0.405	< 1.5E-14	< 5.242E-03
694	11-16-92	11-23-92	HEPA blower exhaust	590	35.0	2.07E+07	0.62	0.72	0.403	< 2.0E-14	< 7.351E-03
697	11-17-92	11-23-92	HEPA blower exhaust	588	35.0	2.06E+07	0.62	0.48	0.403	< 1.4E-14	< 5.128E-03
705	11-18-92	11-24-92	HEPA blower exhaust	580	33.0	1.89E+07	0.60	0.54	0.387	< 1.6E-14	< 5.781E-03

TABLE F-2

AIR PARTICULATE SAMPLES REPORT FOR CISS, 1992
(AREA SAMPLES, ALPHA)

Sample Set area #	Collection Date	Count Date	Sample Location Work Activity	Run Time min	Flow Rate L/min	Sample Vol ml	Bkg. cpm	Sample cpm	Detect. Eff/100	Sample Activity uCi/ml	Total Activity Released uCi
711	11-19-92	11-25-92	HEPA blower exhaust	600	37	2.19E+07	0.90	1.04	0.407	< 2.4E-14	< 8.970E-03
720	11-23-92	12-01-92	HEPA blower exhaust	610	34	2.07E+07	0.36	0.42	0.372	< 1.6E-14	< 6.080E-03
731	12-01-92	12-07-92	HEPA blower exhaust	585	37	2.16E+07	0.18	0.26	0.378	<1.3E-14	< 4.738E-03
737	12-02-92	12-08-92	HEPA blower exhaust	580	39	2.23E+07	0.32	0.34	0.377	<1.1E-14	< 3.975E-03
746	12-03-92	12-09-92	HEPA blower exhaust	580	36	2.09E+07	1.20	1.36	0.407	<2.8E-14	< 1.011E-02
751	12-07-92	12-14-92	HEPA blower exhaust	560	36	2.02E+07	0.46	0.32	0.384	<1.3E-14	< 4.535E-03
753	12-08-92	12-15-92	HEPA blower exhaust	590	33	1.92E+07	0.42	0.48	0.379	<1.7E-14	< 6.248E-03
760	12-09-92	12-15-92	HEPA blower exhaust	580	37	2.15E+07	0.42	0.42	0.379	<1.2E-14	< 4.336E-03
763	12-10-92	12-16-92	HEPA blower exhaust	525	38	1.97E+07	0.36	0.30	0.393	<1.2E-14	< 3.925E-03
770	12-14-92	12-21-92	HEPA blower exhaust	570	36	2.05E+07	0.50	0.54	0.386	<1.6E-14	< 5.681E-03
773	12-15-92	12-21-92	HEPA blower exhaust	600	34	2.04E+07	0.50	0.46	0.386	<1.3E-14	< 4.859E-03
775	12-16-92	12-22-92	HEPA blower exhaust	600	37	2.22E+07	0.34	0.40	0.371	<1.4E-14	< 5.233E-03
782	12-17-92	12-24-92	HEPA blower exhaust	600	35	2.10E+07	0.32	0.38	0.369	<1.5E-14	< 5.607E-03
785	12-21-92	12-28-92	HEPA blower exhaust	590	39	2.27E+07	0.44	0.40	0.379	<1.1E-14	< 4.043E-03
805	12-30-92	01-05-93	HEPA blower exhaust	460	34	1.54E+07	0.60	0.40	0.380	<2.0E-14	< 5.731E-03

Nov 24, 25, 30: Replaced HEPA filters. Dec 22-24, 28, 29, 31: The system was shut down.

APPENDIX G Environmental Standards

ENVIRONMENTAL STANDARDS

The DOE long-term radiation protection standard of 100 mrem/yr (1 mSv/yr) in excess of background level includes exposure from all pathways except medical treatments and exposures from radon (DOE 1990). Evaluation of exposure pathways and resulting dose calculations are based on assumptions such as the use of occupancy factors in determining dose caused by external gamma radiation; subtraction of background concentrations of radionuclides in air, water, and soil before calculating dose; closer review of water use, using the data that most closely represent actual exposure conditions rather than maximum values as applicable; and use of average consumption rates of food and water per individual rather than maximums. Use of such assumptions results in calculated doses that more accurately reflect the exposure potential from site activities.

DERIVED CONCENTRATION GUIDES

DOE orders provide the standards for radionuclide emissions from DOE facilities. DOE Order 5400.5, "Radiation Protection of the Public and the Environment," provides the procedures and requirements for radionuclide releases.

Applicable standards are found in Chapter III of DOE Order 5400.5 and are set as derived concentration guides (DCGs). A DCG is defined as the concentration of a radionuclide in air or water that, under conditions of continuous exposure to a single isotope for one year by one exposure mode (e.g., ingestion of water, inhalation), would result in an effective dose equivalent of 100 mrem. The following table provides reference values for conducting radiological environmental protection programs at operational DOE facilities and sites.

Radionuclide	F1 Value[a]	Ingested Water DCG (μCi/ml)[b]	Inhaled Air DCGs[c]		
			D	W	Y
Radium-226	2E-1	1E-7	--	1E-12	--
Thorium-230	2E-4	3E-7	--	4E-14	5E-14
Thorium 232	2E-4	5E-8	--	7E-15	1E-14
Uranium-234	2E-3	5E-6	--	--	9E-14
Uranium-235	2E-3	5E-6	--	--	1E-13
Uranium-238	2E-3	6E-6	--	--	1E-13
Radon-222[d]	3E-9	3E-9	--	--	3E-9
Radon-220[d]	3E-9	3E-9	--	--	3E-9

[a] F1 is defined as the gastrointestinal tract absorption factor, which measures the uptake fraction of ingestion of a radionuclide into the body.

[b] 1E-9 μCi/ml = 0.037 Bq/L = 1 pCi/L.

[c] Inhaled air DCGs are expressed as a function of time. D, W, and Y represent a measure of the time required for contaminants to be removed from the system (D represents 0.5 day; W represents 50 days; and Y represents 500 days). Times listed for contaminant removal depend on chemical form and dust particle size.

[d] DOE is reassessing the DCGs for radon. Until review is completed and new values issued, the values given in the chart above will be used.

SOIL GUIDELINES

Guidelines for residual radioactivity in soil established for FUSRAP are shown below.

Radionuclide	Soil Concentration (pCi/g) Above Background
Radium-226 Radium-228 Thorium-230 Thorium-232	5 pCi/g, averaged over the first 15 cm of soil below the surface; 15 pCi/g when averaged over any 15-cm-thick soil layer below the surface layer.
Total uranium (site-specific)	35 pCi/g for any 15-cm-thick soil layer
Other radionuclides[a]	Soil guidelines will be calculated on a site-specific basis using the DOE manual developed for this use (see DOE 1989).

Source: DOE 1987.

APPENDIX H Distribution List for Colonie Interim Storage Site Environmental Report for Calendar Year 1992

The Department of Energy distributes this report to local, state, and federal agencies; U.S. Congress; the public; and the media (upon request).

END

DATE FILMED

10/13/93