NY/NFSS
DOE/OR/21949-309

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-91OR21949

ENVIRONMENTAL MONITORING PLAN FOR THE NIAGARA FALLS STORAGE SITE

Lewiston, New York

November 1991

Bechtel National, Inc.

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DOE/OR/21949-309

ENVIRONMENTAL MONITORING PLAN

FOR THE NIAGARA FALLS STORAGE SITE

LEWISTON, NEW YORK

NOVEMBER 1991

Prepared for

United States Department of Energy

Field Office, Oak Ridge

Under Contract No. DE-AC05-91OR21949

By

Bechtel National, Inc.

Oak Ridge, Tennessee

Bechtel Job No. 14501

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NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFSS	Niagara Falls Storage Site
NIST	National Institute of Standards and Technology
NPDES	National Pollutant Discharge Elimination System
PMC	project management contractor
PQAS	project quality assurance supervisor
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RPD	relative percent difference
SRM	standard reference material
TETLD	tissue-equivalent thermoluminescent dosimeter
TMA/E	Thermo Analytical/Eberline
TOC	total organic carbon
TOX	total organic halides

UNITS OF MEASURE

cm	centimeter
ft	foot
g	gram
h	hour
ha	hectare
km	kilometer
L	liter
m	meter
mg	milligram
mi	mile
μg	microgram
ml	milliliter
μmhos	micromhos
μR	microroentgen
mR	milliroentgen
mrem	millirem
pCi	picocurie
ppm	parts per million
yd	yard
yr	year

1.0 INTRODUCTION

This plan establishes the environmental monitoring program required to be conducted by the project management contractor (PMC) for the Niagara Falls Storage Site (NFSS), effective January 1, 1992. NFSS is assigned to the Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), a program to 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. DOE maintains an environmental monitoring program for NFSS to ensure that the public and the environment are adequately protected from site contamination and to determine whether activities at the site are in compliance with applicable federal, state, and local standards and requirements. The program is designed to detect and quantify any unplanned releases and to provide high-quality data to enable the evaluation of potential contaminant migration pathways.

1.1 SCOPE OF PLAN

Under DOE Orders 5400.1 ["General Environmental Protection Program" (DOE 1988a)] and 5400.5 ["Radiation Protection of the Public and the Environment" (DOE 1990a)], all DOE-owned and -operated facilities are required to have an environmental monitoring plan (EMP) in place by November 9, 1991. EMPs address chemical and radioactive contaminants (in support of the DOE orders), provide the basis for identifying potential contaminant release pathways, and document the rationale for the sampling frequency and program scope. This plan satisfies the requirements of the DOE orders.

The EMP fits into the overall environmental monitoring program as shown in Figure 1-1. The program is further implemented by the FUSRAP integrated environmental monitoring field activities instruction guide and the annual site environmental report (ASER) for NFSS. These three elements of the program implement the

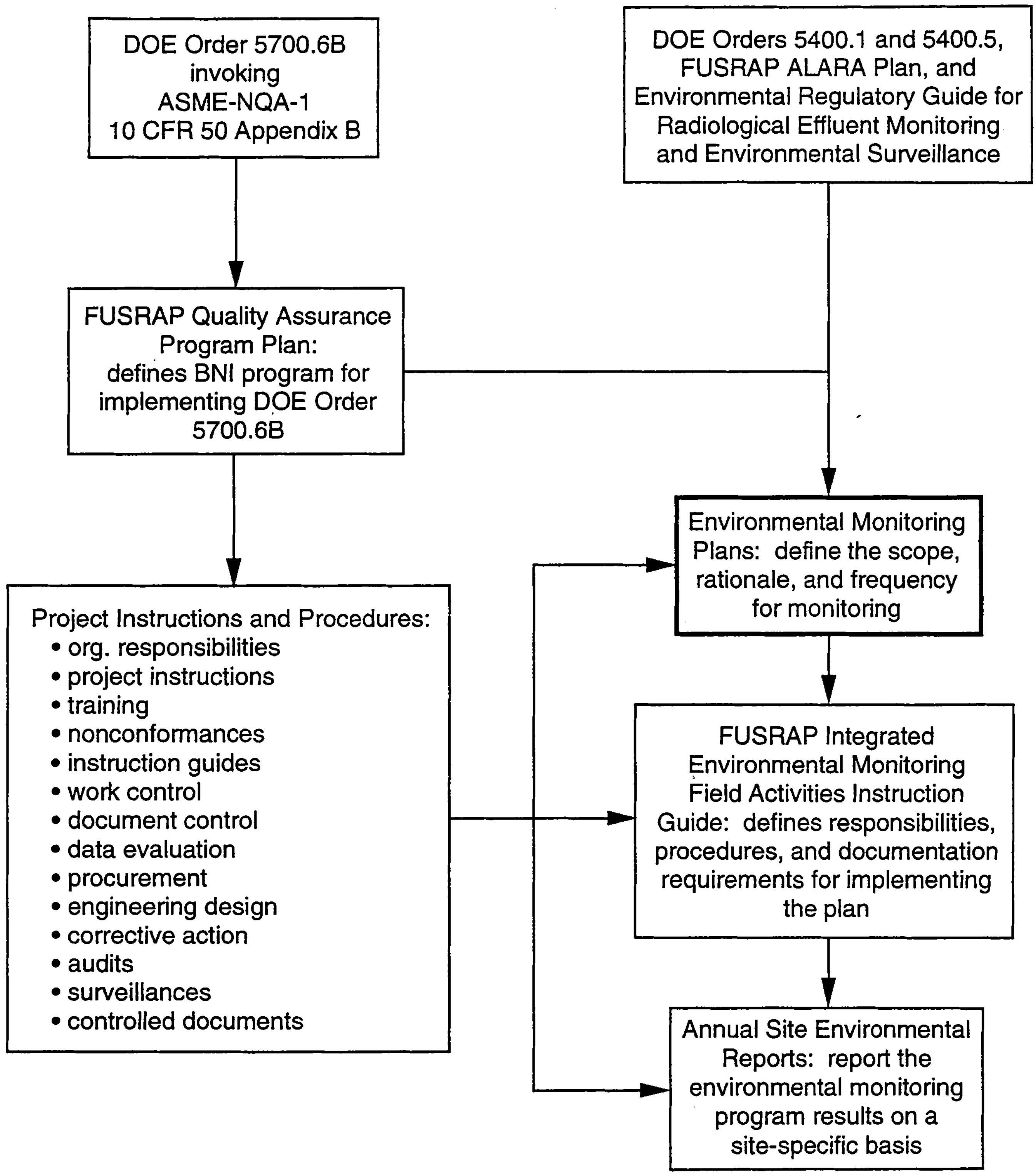

Figure 1-1
Relationship Among Environmental Monitoring Program Elements

requirements of DOE Orders 5400.1 and 5400.5 and the FUSRAP ALARA plan (BNI 1991b) and have been developed to meet quality assurance program requirements of DOE Order 5700.6B ["Quality Assurance" (DOE 1989)], ASME-NQA-1 (ASME 1989), and 10 CFR 50 Appendix B, as defined in the FUSRAP quality assurance program plan (BNI 1990). Specific quality criteria implementation requirements particular to the three program elements are either stated in these documents or are invoked by applying project instructions and procedures.

This EMP has also been written to comply with appropriate sections of the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE 1991) (hereafter referred to as the "regulatory guide"), which establishes the elements of a program that is acceptable to DOE. The regulatory guide addresses desirable procedures and activities that "should" be performed and prescribes specific high-priority procedures and activities (indicated in the regulatory guide by "should*"). A matrix that shows compliance with the "should*" requirements is provided in Appendix A.

The objective of this EMP is to establish monitoring and sampling strategies that will:

- Provide information to determine compliance with applicable environmental regulations
- Adequately represent the NFSS environment
- Establish background levels
- Detect contaminant migration and unplanned releases from the site to the environment
- Generate information to be made available to the public (e.g., distribution of the ASERs)

DOE has conducted environmental monitoring at NFSS and the surrounding area since 1981. Based on the strategies outlined in this EMP and on existing data, the environmental monitoring program will be optimized. This plan establishes the components of the NFSS environmental monitoring program, which is implemented and controlled by FUSRAP instruction guides and project instructions. (The terms "monitoring" and "surveillance" are used synonymously in this plan.)

The following subsections briefly describe NFSS and the information known about the contaminants onsite. Sections 2.0 through 5.0 discuss features of the environmental monitoring program at NFSS. Sections 6.0 through 10.0 describe procedures for analysis of samples and for handling and reporting of analytical data, and the quality assurance (QA)/quality control (QC) techniques that are used in the program for NFSS.

1.2 SITE LOCATION AND DESCRIPTION

NFSS is in northwestern New York within the township of Lewiston (Niagara County) (Figure 1-2). The NFSS property includes a three-story building (Building 401) with three adjacent silos, an office building, a small storage shed, and the 4-ha (10-acre) Interim Waste Containment Facility (IWCF) (Figure 1-3). The property is entirely fenced and public access is restricted.

As shown in Figure 1-4, land use in the vicinity of the site is predominantly rural. The site is bordered by a chemical waste disposal facility (C.W.M. Chemical Services) to the north, a solid waste disposal facility (Modern Disposal) on the east and south, and a Niagara Mohawk Power Corporation right-of-way to the west. The nearest residential areas are approximately 1.1 km (0.68 mi) southwest of the site; the residences are primarily single-family dwellings. The total population of the area lying within an 80-km (50-mi) radius of NFSS is over 250,000 (BNI 1991).

The principal sources of potable water in the NFSS area are Lake Erie (65 percent), the Niagara River (25 percent), and groundwater (10 percent); approximately 90 percent of the population of Lewiston uses the first two sources. Surface water discharges from the site via the Central Drainage Ditch, which empties into Fourmile Creek, which in turn discharges into Lake Ontario [approximately 6 km (4 mi) north of NFSS] (BNI 1991).

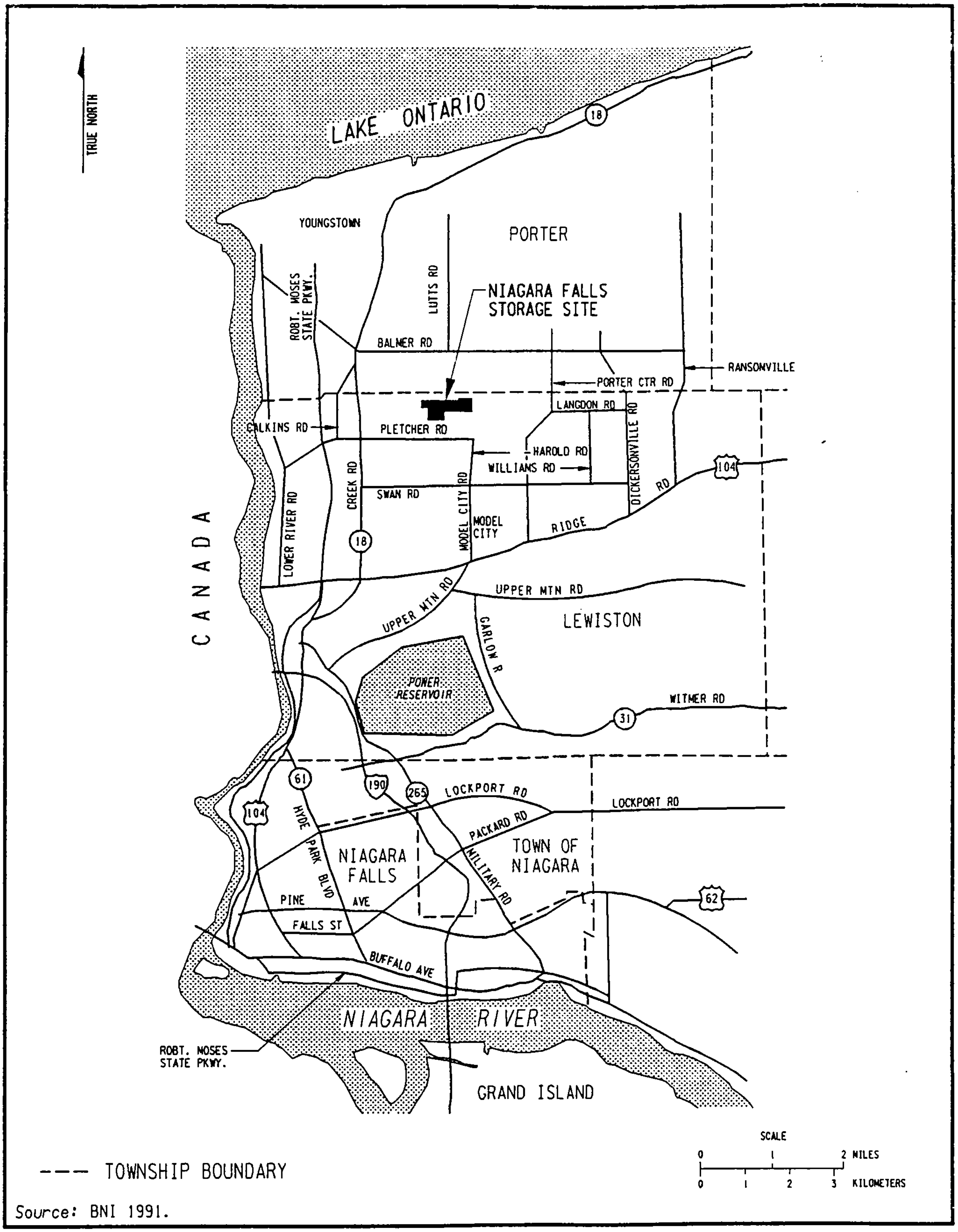

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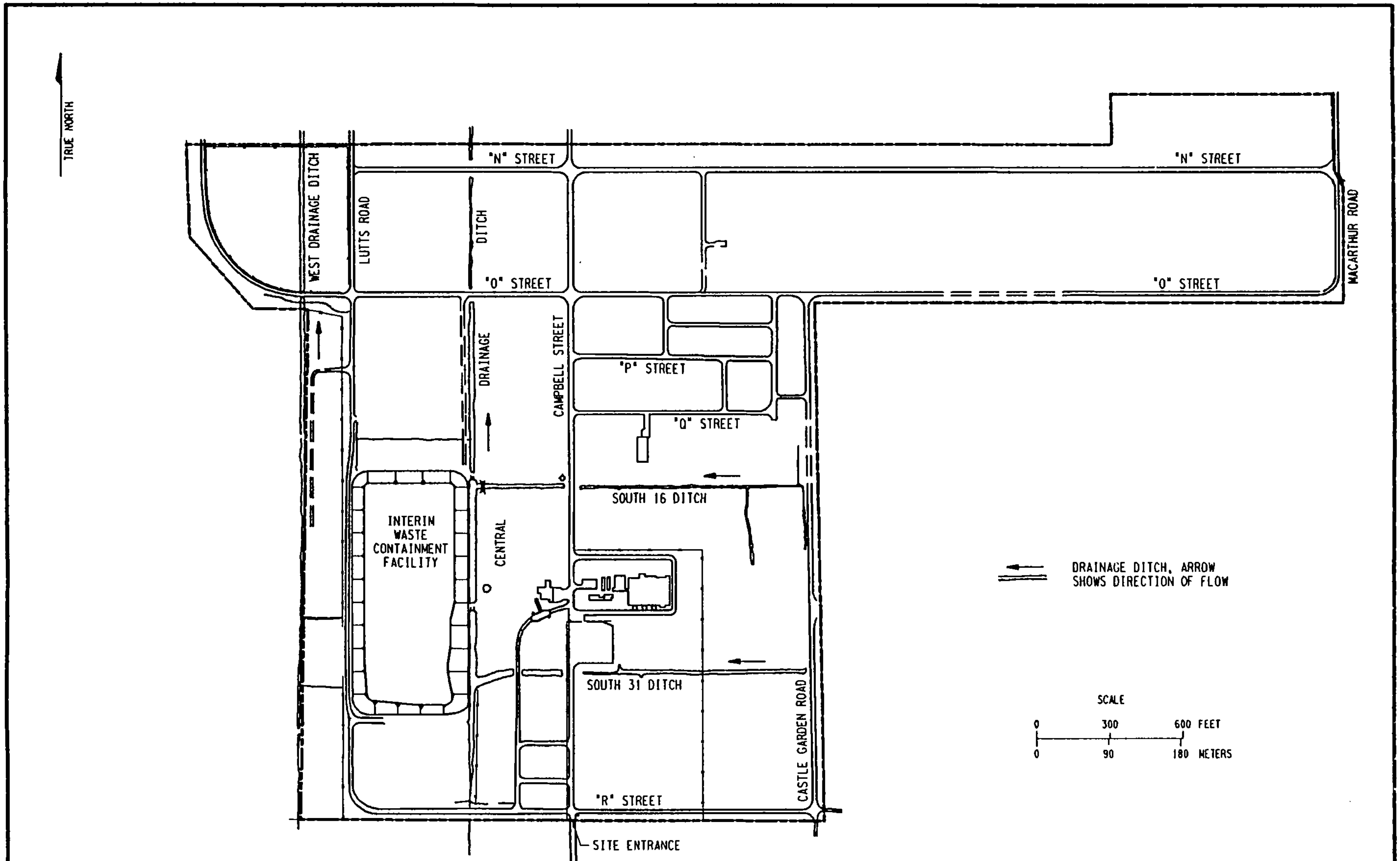
Figure 1-2
Location of NFSS



Source: BNI 1991.

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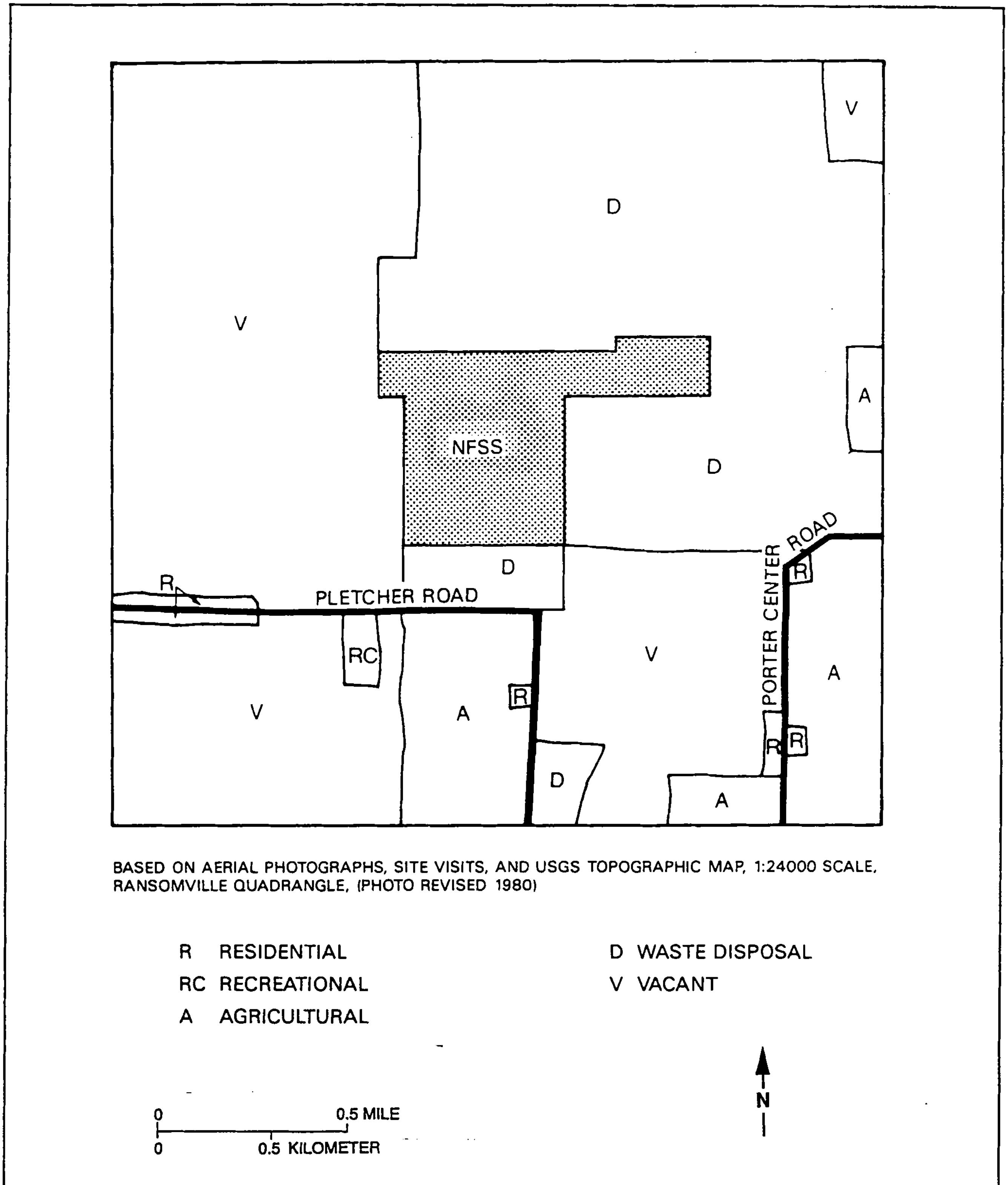
Figure 1-3
Site Plan of NFSS



Source: BNI 1991.

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

1.3 SITE HISTORY

During World War II, the Manhattan Engineer District, predecessor to the Atomic Energy Commission, used part of the Army's Lake Ontario Ordnance Works (LOOW) as a transshipment and storage site for radioactive materials. The site was also used for enriching nonradioactive boron-10 (1954 through 1958 and 1964 through 1971). The primary use of the site, however, was for storage of radioactive residues produced as a by-product of uranium production (1944 to present). As a result of storage operations, portions of the former LOOW (other than the present NFSS) became contaminated when some of the radioactive materials stored at NFSS migrated due to erosion, chiefly through drainage ditches.

Today, NFSS consists of 77 ha (191 acres) of the LOOW's original 611.5 ha (1511 acres). Radiological surveys and characterization of NFSS were performed in 1979 and 1980, and radiological surveys of vicinity properties were conducted from 1981 to 1985 (Battelle 1981; ORAU 1982, 1983a-f, 1984a-s, 1986, 1989, 1990). Remediation of vicinity properties began in 1981 and continued until 1986. Remediation at NFSS began in 1982 and continued until 1986. Contaminated materials moved between 1981 and 1986 (including K-65 material resulting from uranium extraction) were stored in the IWCF, a clay-lined, clay-capped storage pile. One localized onsite area [approximately 100 m^2 (1100 ft^2)] was remediated in mid-1991. All areas of residual radioactivity on the site have now been remediated; materials generated during remedial actions are stored in the IWCF [approximately 193,930 m^3 (253,500 yd^3)].

1.4 CONTAMINANTS OF CONCERN

The primary radioactive contaminants stored at NFSS are radium-226 (half-life of 1602 yrs) and uranium-238 (half-life of 4.51×10^9 yrs). Uranium-234 (half-life of 2.47×10^5 yrs) and uranium-235 (half-life of 7.1×10^8 yrs) are also present and in equilibrium with the uranium-238. The radioactive contaminants of concern are listed in Table 1-1.

Because of the large amounts of radium-226 present at the site, radon-222 (radon) is also a primary contaminant of concern. Before remedial action began in 1981, radon emissions were very high; however, the contaminated waste was consolidated in the IWCF from 1981 to 1986, which has effectively controlled emissions.

In 1987, 16 monitoring wells were selected for baseline chemical monitoring for one year (once per quarter) pursuant to 40 CFR 261, Appendix IX. This program included analysis for 54 volatile organic compounds; 65 semivolatile compounds on the Target Compound List; 64 semivolatile compounds not on the Target Compound List; 26 pesticides and polychlorinated biphenyls from the Environmental Protection Agency (EPA) Contract Laboratory Program list; 12 organophosphate pesticides and 4 herbicides; 24 toxic or potentially toxic metals; and sulfides, fluorides, and cyanides. Concentrations of most of these compounds were below detectable limits. Heavy metal concentrations in groundwater have also been monitored; results indicate that several metals warrant further monitoring. The chemical contaminants of concern are listed in Table 1-1.

Table 1-1

Contaminants of Concern Identified at NFSS

Contaminant	Concentration[a] Average	Maximum
Radionuclides (pCi/g)		
Radium-226	3,800	540,000
Uranium (-234, -235, -238)	1,305	20,000
Radon-222[b] (pCi/L)	22,357	67,000
Metals (ppm)		
Aluminum	0.2	47
Copper	950	5,000
Iron	19,000	100,000
Manganese	15,225	100,000
Mercury	0.40	0.5
Lead	11,517	95,000
Vanadium	798	3,000

Source: Battelle 1981.

[a]Background values have not been subtracted.

[b]Concentrations are for the residues in the pile.

2.0 LIQUID EFFLUENT MONITORING

Liquid effluent monitoring is required to ensure compliance with DOE Orders 5400.1 and 5400.5. These orders also require surveillance of surface water, sediment, and stormwater, addressed in Subsection 5.5 of this plan. Because NFSS is not an operating facility, no liquid effluents are produced.

3.0 AIRBORNE EFFLUENT MONITORING

No airborne effluents are generated as a result of routine site operations. No major field activities are planned for the site in the near future; therefore, the release of airborne effluents is not anticipated. However, radionuclides could be released as particulates by wind erosion or as radon. These potential forms of release are addressed in Subsection 5.3.

4.0 METEOROLOGICAL MONITORING

Because NFSS is not an operating facility, meteorological monitoring requirements differ from those required for an operating processing facility. Airborne contaminant levels and the calculated effective dose equivalent from NFSS are low (Section 8.0) and even accidental releases would have minimal environmental impact; therefore, detailed onsite meteorological data are not required.

The Environmental Protection Agency (EPA) AIRDOS computer model will be used to show compliance with 40 CFR 61, Subpart H under the National Emission Standards for Hazardous Air Pollutants (NESHAPs). This computer model calculates doses from contaminant migration via the airborne pathway. Data will be collected by the National Oceanographic and Atmospheric Administration, National Weather Service in Niagara Falls.

Given the low concentrations of contaminants at the site and the similarity between climatological conditions at the site and data from observational stations that are included in the AIRDOS model, these data are considered sufficient to support any necessary modeling. Input to this model includes joint frequency distribution of wind direction and atmospheric stability, and an average wind speed for each combination of wind direction and stability. The model also uses an average mixing-layer and average temperature. Potential release modes, distances from release points to receptors and climatological conditions are considered in the model. Supplemental measurements will not be required.

Compliance techniques, which will be based on conservative assumptions and few climatological data, are outlined in Screening Techniques for Determining Compliance with Environmental Standards (NCRP 1986). QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.0 ENVIRONMENTAL SURVEILLANCE

Regulatory requirements for environmental monitoring of radioactive materials are found in DOE Orders 5400.1 and 5400.5. Site releases must comply with specific DOE orders [5400 series and DOE Order 5820.2A, "Radioactive Waste Management" (DOE 1988b)] that establish quantitative limits, derived concentration guidelines, and dose limits for radioactive releases from DOE facilities. Special studies at NFSS are not covered in this EMP; they are reported in the ASER.

5.1 EVALUATION OF NEED

Environmental surveillance activities are necessary at NFSS to ensure that the waste in the IWCF is not posing a threat to human health or the environment. The overall goal of the environmental monitoring program at NFSS is to determine whether contaminants are released and, if so, to determine the impact on human health and the environment. To achieve this goal, the program has been designed to meet the requirements of DOE Orders 5400.1 and 5400.5 and the applicable criteria outlined in the regulatory guide.

The goal will be achieved by implementing:

- Routine surveillance for all credible pathways
- Sample collection and analysis designed to obtain representative samples or measurements and high-quality data
- Monitoring capable of detecting unanticipated migration of contaminants from the site

Figure 5-1 is an exposure pathway analysis that illustrates the potential sources of contamination at NFSS and identifies the means by which contaminants could migrate offsite. As shown, contaminants are contained within the IWCF, which is closed, capped with clay, covered with topsoil, and vegetated. Invalid exposure mechanisms are ingestion of contaminated livestock or foodstuffs, overland migration of contaminants from the site to soils on

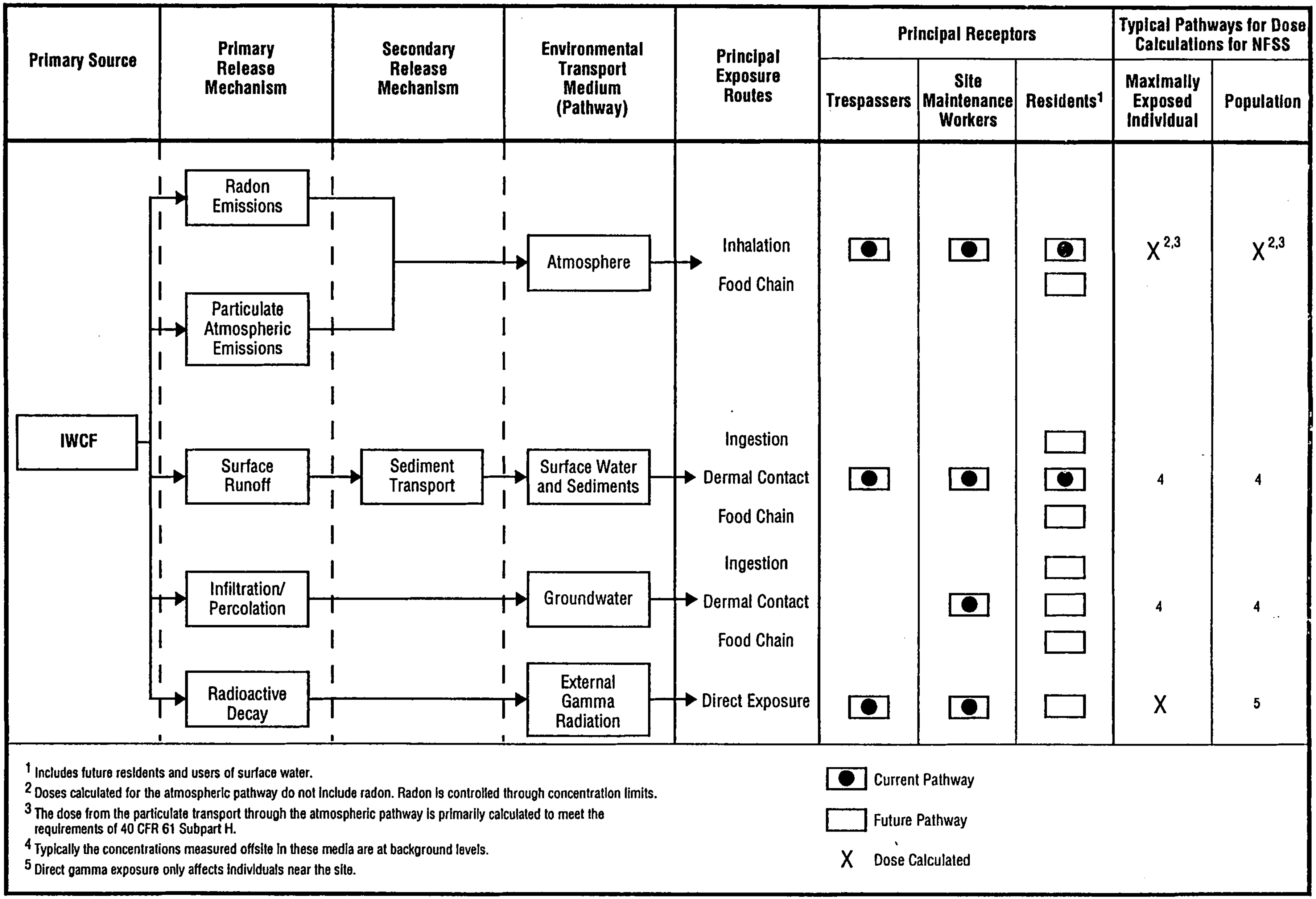


Figure 5-1
Exposure Pathway Analysis

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adjacent properties, and ingestion of fish. Previous sampling results indicate that contaminant concentrations are at background levels for offsite surface water and groundwater. Therefore, ingestion is not considered a current exposure route.

The following exposure routes currently contribute to the exposure of principal receptors:

- Inhalation of contaminated particulates transported from the site via the atmospheric pathway
- Dermal contact with contaminated sediment
- Dermal contact with contaminated groundwater by workers collecting samples
- Direct exposure to gamma radiation to individuals near the site

Contamination within the IWCF could potentially migrate through infiltration of surface water to the waste stored in the pile and subsequent leaching of contaminants from the waste into the groundwater. Groundwater could then migrate from the site and be used in a variety of ways, leading to potential exposures to the contaminants via ingestion or dermal contact.

The design of the IWCF cap minimizes erosion from surface runoff; however, there is a slight possibility that contaminants could migrate to surface water if groundwater were to recharge to surface water or if surface water infiltrated the cell and then seeped back out. Any contamination in surface water could be transported offsite via runoff onto adjacent properties, or into the NFSS stormwater drainage system. Surface water could carry either dissolved contaminants or contaminated sediments from the site, primarily via the Central Drainage Ditch. Water from this ditch is accessible to the public and could, therefore, possibly result in ingestion or dermal contact. Surface water and groundwater modeling are not conducted because the environmental monitoring program includes groundwater and surface water sampling.

The majority of the radium-226 at NFSS originated from the storage of K-65 residues, a by-product of uranium processing of rich ores from the Belgian Congo. When radium-226 radioactively decays, it generates radon-222, which can migrate from the soil, become airborne, disperse, and be transported offsite. The general public could inhale the diffused radon.

Because all contamination is within the capped and vegetated IWCF, resuspension of particulate contaminants followed by atmospheric transport offsite is not realistic. This pathway could only exist in the future following loss of institutional control of the site. Plant and biota samples are not collected because there are no foodstuffs (i.e., gardens), livestock, or endangered species near the site.

Another exposure route, direct exposure to external radiation emitted from the contamination within the IWCF, could only exist on NFSS or on adjacent properties.

This exposure pathway analysis indicates that contamination could leave the site via groundwater, surface water, or sediments carried by the surface water. Additionally, the general population could theoretically receive direct radiological exposure from the contaminated soils within the IWCF. The NFSS environmental monitoring program is designed to monitor these potential pathways to the public by monitoring current contaminant levels and detecting trends in levels that may indicate a developing problem. This information will be documented in the ASER. Upon approval from DOE, any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, will be documented in the ASER and in future revisions of the appropriate instruction guide and this EMP.

Appendix B is a table that compares the program as it existed in 1991 with the program described in this plan. The table references the specific sections of this plan that present the rationale for the changes made to the program. The following sections establish the programs for monitoring the aforementioned pathways.

5.2 BASIS AND CRITERIA FOR EXTERNAL GAMMA RADIATION SURVEILLANCE

The primary objective of external gamma radiation exposure monitoring is to estimate the potential radiation dose to members of the public from contaminants at the site. The primary radioactive contaminant at NFSS is radium-226, a gamma emitter. This form of radiation travels several yards in air and penetrates the skin to deliver a radiological dose to internal organs. Evaluation of monitoring results indicates that direct exposure to external gamma radiation represents the only plausible route of public exposure. (Dose contributions from drinking water and other pathways are negligible.)

Alpha and beta decay emissions are also present at the site but pose little risk because their energies are low, they only travel short distances in air, and they do not typically penetrate human skin.

The extent of the surveillance program is based on applicable regulations, hazard potential, contaminant quantities, and contaminant concentrations at the site. The program is designed to provide data to:

- Estimate potential dose to a hypothetical maximally exposed individual and to the general population within an 80-km (50-mi) radius

- Quantify maximum fenceline and onsite exposure levels

- Monitor for potential exposure to the environment and the public to determine whether near-term response actions will be required

5.2.1 Surveillance Requirements

The requirements for the external gamma radiation surveillance program are that timely information be received on exposures to the public from both stable site conditions and unexpected releases.

The information obtained from this program should be adequate to estimate the potential dose to a hypothetical maximally exposed individual and to workers and the public in case of an accidental release.

5.2.2 Dosimeter Location Rationale

Dosimeter locations were selected based on the ability to detect maximum exposure levels from the IWCF, accessibility to the public, and previous tissue-equivalent thermoluminescent dosimeter (TETLD) results (BNI 1991). Dosimeters will be placed 1 m (3 ft) above the ground (approximately at gonad level) to represent exposure to the critical organ nearest the contamination. There will be 12 fenceline, 7 onsite, and 6 background locations (Figures 5-2 and 5-3).

Based on the data collected from the external gamma radiation monitoring program, dosimeter locations may be added or deleted. When making these changes, the following factors will be considered:

- Proximity to naturally occurring radiation in geologic formations
- Proximity to buildings or structures that could alter measurements
- Differences in local topography that could shield the dosimeters from the possible passage of airborne effluents
- Meteorological conditions such as prevalent wind direction
- Security (vandalism or theft) for offsite dosimeters
- Access (legal) to offsite locations

Background dosimeter stations will be located at distances where contributions from the site do not affect the readings. Prevalent wind direction is not applicable in locating the background dosimeter stations.

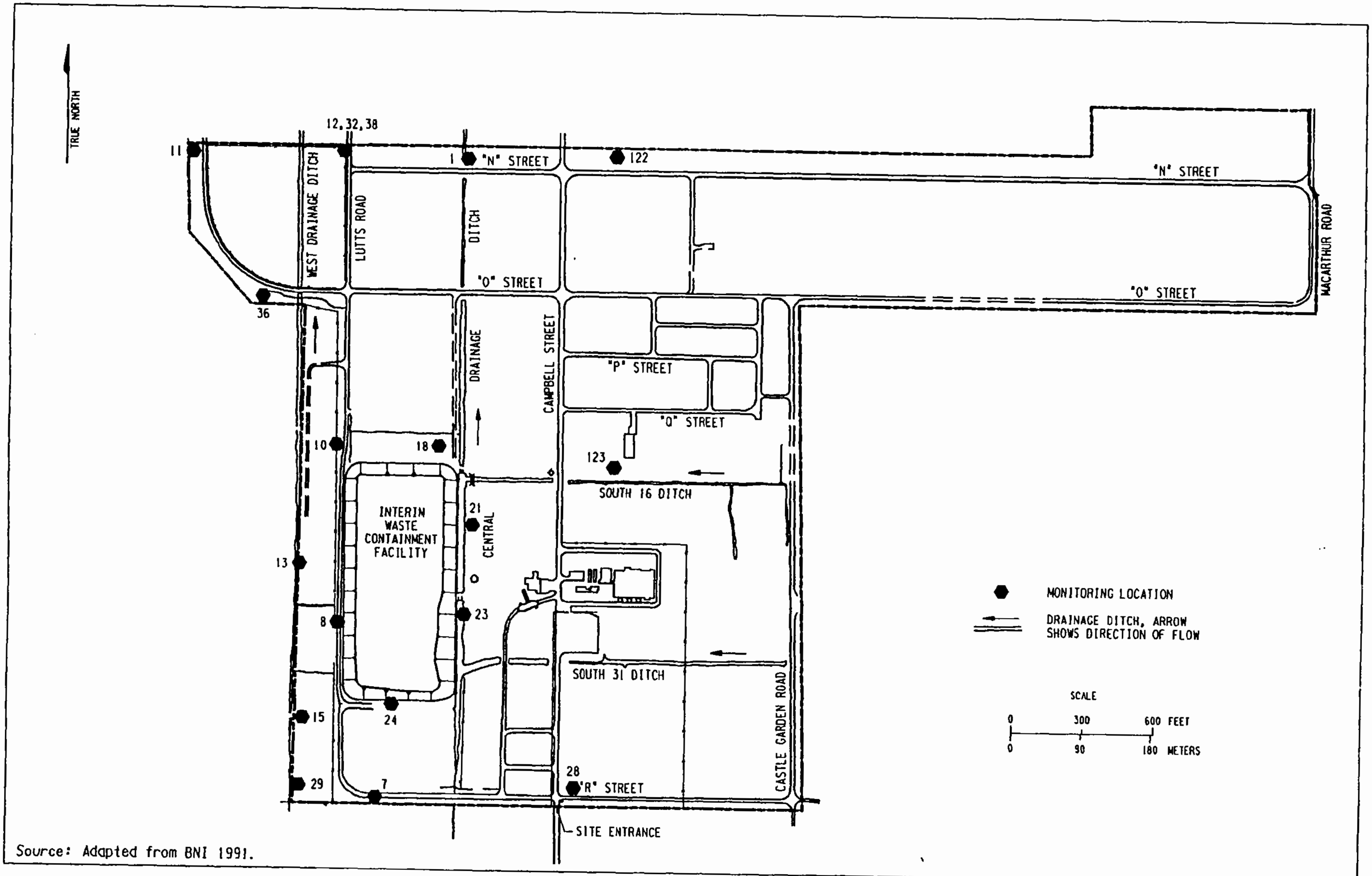

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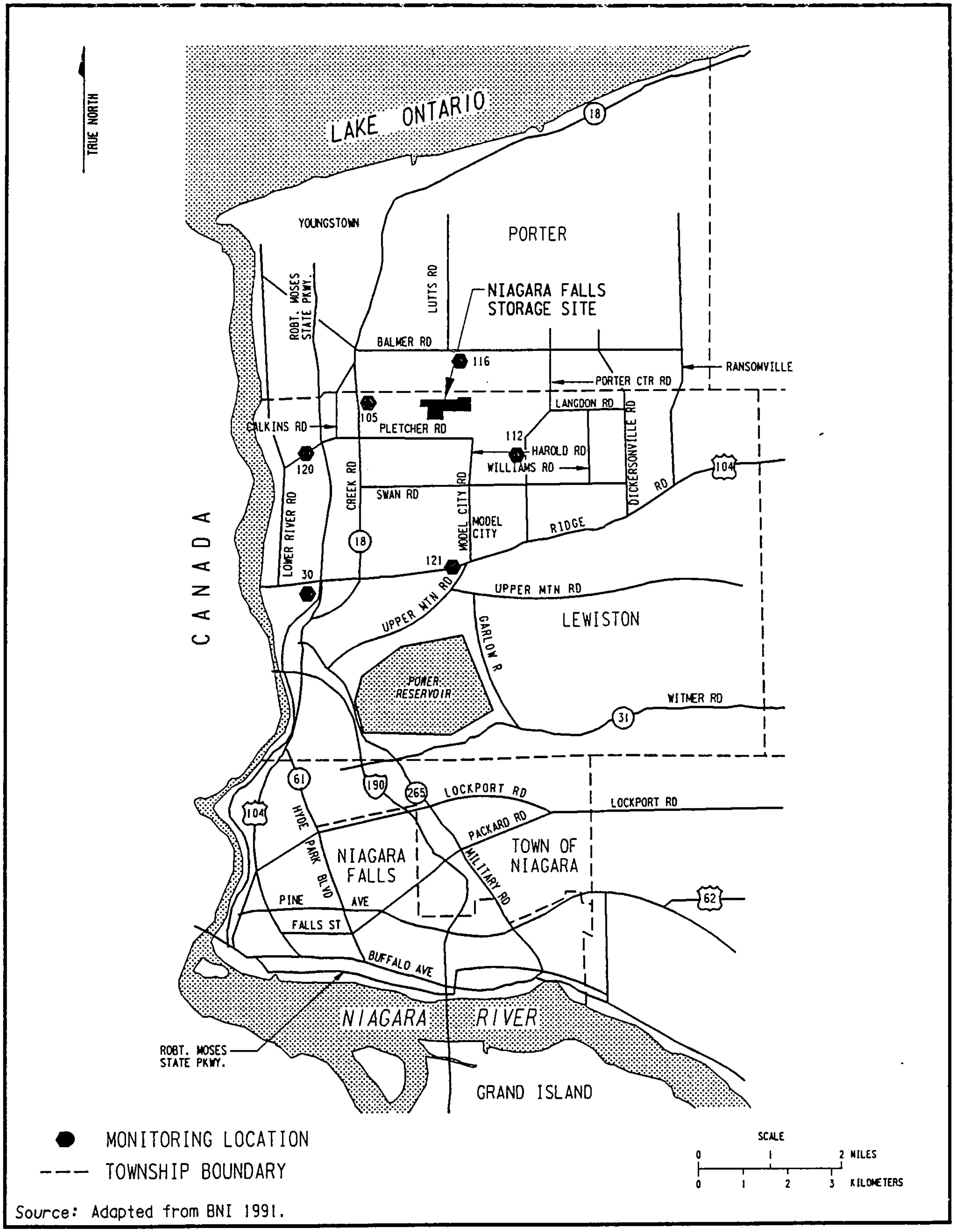
Figure 5-2
Onsite and Property-Line Radon and External Gamma Radiation Monitoring Locations



Source: Adapted from BNI 1991.

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Figure 5-3
Offsite Radon and External Gamma Radiation
Monitoring Locations

5.2.3 Sampling Frequency

The sampling frequency is based on the following:

- No individual lives within 1 km (0.6 mi) of the site.
- Workers are not onsite for long periods of time.
- There are no plans for any major field work or remedial actions at the site in the near future.
- The site is inactive. Waste has been stored at NFSS for many years, and past monitoring has not indicated substantial changes in levels of gamma radiation.

Based on these factors, dosimeters that provide real-time measurements are not considered necessary. The dosimeter appropriate for the monitoring program is an integrating dosimeter that will provide the total exposure at one location for the entire time the dosimeter is onsite.

Four dosimeters will be placed at each station in January. Two of the four dosimeters will be retrieved and analyzed in July to reveal changes that might have occurred at the site during the first six months of the year. The other two will be retrieved and analyzed in the following January and will be used for dose calculations. The dosimeters will be removed in pairs to provide a duplicate measurement for each station. Additionally, the two extra dosimeters will be available for immediate analysis in case of an emergency without compromising the integrity of the monitoring network. Each January, a new set of four dosimeters will be placed in the housing for monitoring in the subsequent year. This semiannual sampling frequency will also be applicable for any new sampling stations established around the site.

5.2.4 Sampling Methods and Dosimeters

Each TETLD station consists of a vertical support and a polyvinyl chloride (PVC) holder assembly. An individual TETLD consists of a polyethylene sphere containing five individual lithium fluoride chips that were selected on the basis of having a reproducibility of ±4 percent across a series of laboratory exposures; this reproducibility is traceable to National Institute of Standards and Technology (NIST) criteria. Values are reported with a 95 percent confidence level. Attached to the TETLD are a chain leader, a snap swivel, and an aluminum identification tag. When exposed to penetrating radiation (such as gamma or cosmic), the lithium fluoride chips absorb and store a portion of the radiation energy. When the chips are heated, this stored energy is emitted as light, which can be measured and used to calculate an equivalent dose. The responses of the five chips are averaged to provide a single value, which is corrected for the shielding effect of the housing (approximately 8 percent); this corrected value is the radiation dose, expressed in mR/yr.

The procedures to be followed for exchanging dosimeters are documented in a FUSRAP instruction guide that provides information concerning identification of dosimeters and their removal and replacement during each sampling period.

5.2.5 Field Activities Quality Assurance

The specific QA requirements for external gamma radiation monitoring will be as follows:

- Chain-of-custody (COC) records for the dosimeters will be maintained, and COC seals will be placed on the shipping containers.

- A "ship" dosimeter will accompany each shipment of gamma radiation dosimeters to and from the site to reveal any exposure incurred prior to installation or after dosimeter removal.

- Fresh dosimeters will be installed as soon as practicable after shipment. Meanwhile, they will be stored in an area with a general gamma radiation field of less than 7 μR/h.

Storage area radiation exposure rates will be verified by instrument surveys every six months, and a record of the surveys will be maintained in the site files.

- After dosimeters are removed, they will be shipped immediately for analysis.

- By design, duplicate QC measurements will be taken at each sampling station, which will also protect against data losses due to faulty, damaged, or lost dosimeters.

- Dosimeter sampling locations will be inspected weekly for dosimeter loss, damage, proper housing height, signs of vandalism, theft, etc.

QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0. Details on procedures and documentation of field QA activities can be found in an instruction guide.

5.2.6 Emergency Provisions

Because radioactively contaminated materials are stabilized in the IWCF, unexpected releases are highly unlikely. Trained site operations personnel and/or the site safety officer will notify appropriate personnel of DOE and Bechtel National, Inc. (BNI) (the PMC for FUSRAP) of any accidental release and will immediately take steps to minimize the potential for contaminant migration. FUSRAP safety and health procedures will be followed.

To provide immediate information on the magnitude of any accidental release, one of the TETLDs from each of the two stations nearest the release point may be removed and analyzed. Should conditions warrant, a health physics technician will evaluate site conditions with appropriate instrumentation.

5.3 BASIS AND CRITERIA FOR ATMOSPHERIC PATHWAY SURVEILLANCE

As discussed in Subsection 5.1, radon could emanate from the IWCF and be transported via the atmosphere to offsite receptors. Radon is the only contaminant of concern for the atmospheric pathway.

5.3.1 Surveillance Requirements

Potential receptors of possible radon releases include members of the public who reside or work near the site (see Subsection 1.2). The radon monitoring program at NFSS is designed to:

- Determine radon levels at the fenceline for comparison with regulatory limits
- Determine background radon levels
- Provide site-specific radon data to the public

5.3.2 Detector Location Rationale

Placement rationale was primarily based on the fact that the areas of residual radioactivity on the site have been remediated and contaminated materials are in a stable storage facility. The site is considered stable because the waste has been present for many years and monitoring has not shown significant contaminant migration.

The detector system should detect continuous releases of radon. The wind direction varies enough that several detectors along the fenceline would detect a continuous release. Therefore, detectors will be spaced along the fenceline (Figure 5-2) to ensure adequate detection capabilities; the fenceline area is accessible to the public. Six of the seven onsite stations will be adjacent to the IWCF to detect the maximum exposure levels to workers. Background stations (Figure 5-3) will be located at distances where contributions of radon from the site will not affect the readings.

All detectors will be 1.5 to 1.7 m (5.0 to 5.5 ft) above the ground surface to detect radon concentrations in the breathing zone for the average person.

To determine radon flux from the IWCF, charcoal canisters will be placed on the pile at 15.2-m (50-ft) grid intersections. The canisters will remain on the pile for 24 h. The activated charcoal absorbs the radon and daughter products. After the 24-h sampling period, the canisters are sealed and sent for analysis. The canisters are opened in the lab, and the charcoal is removed, weighed, and put in a sample jar. The sample jar is then placed in a shielded detector and counted by gamma spectroscopy to determine radon activity emitted from the pile. The pile will be covered with plastic sheeting while the radon flux is measured.

5.3.3 Sampling Frequency

The primary factor that affects sampling frequency is whether the source is stable; because the IWCF is considered stable, the monitoring period can be relatively long, especially given the low occupancy of the site and the fact that no major field work is planned for the near future. Therefore, the sampling frequency will be quarterly. Detectors will remain at the sampling locations for an entire quarter to determine the integrated average radon concentration for the quarter.

The charcoal canisters to measure radon flux will be set out on the pile semiannually (spring and fall), consistent with NESHAPs requirements.

5.3.4 Sampling Methods and Detectors

Radon concentrations will be measured using an integrating alpha track detector that contains a piece of alpha-sensitive film enclosed in a small two-piece cup. Radon diffuses through a membrane of the cup until the concentrations inside the cup are in equilibrium with atmospheric concentrations. Alpha particles from the radioactive decay of radon and its daughters create tiny tracks when they collide with the film. After they are collected, the films are placed in a caustic etching solution to enlarge the tracks; under strong magnification, the tracks are counted. The number of tracks per unit area is related through calibration to the radon concentration in air.

5.3.5 Field Activities Quality Assurance

Various QA controls will be part of the radon surveillance program:

- Detectors will be shipped to the site in airtight Tedlar bags that will remain unopened until installation.
- Exposed (removed) detectors will be immediately sealed to halt the period of exposure.
- Detector COC will be maintained and documented; COC seals will be placed on shipping containers.
- Duplicate (QC) stations will be used at a frequency of 1 QC station for each 20 sampling stations.
- Stations will be inspected weekly for loss, damage, housing height, and signs of vandalism.

QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.3.6 Emergency Provisions

Unexpected releases of radon from NFSS could occur only if the site configuration were modified. Because there are no major field activities planned for the site in the near future, an unexpected release is unlikely. However, if there is evidence of a release, trained site operations personnel and/or the site safety officer will notify appropriate BNI and DOE personnel and will immediately take steps to minimize the potential for contaminant migration. FUSRAP safety and health procedures will be followed.

To provide immediate information on the magnitude of any accidental release, detectors from the two stations nearest the release point will be removed and analyzed.

5.4 BASIS AND CRITERIA FOR GROUNDWATER SURVEILLANCE

DOE Order 5400.1 requires that groundwater potentially affected by DOE operations be monitored to determine and document the effects of such operations on groundwater quality and to demonstrate compliance with applicable federal and state laws and regulations.

5.4.1 Surveillance Requirements

The goals established to provide effective groundwater surveillance will be to:

- Provide data to use in determining basic groundwater quality
- Demonstrate compliance with applicable regulations and DOE orders
- Provide data for early detection of groundwater contamination

5.4.2 Well Location Rationale

Groundwater monitoring at NFSS will be conducted in accordance with DOE Order 5400.1. Requirements for groundwater monitoring programs are not typically included in DOE Order 5400.1 or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the only specific requirement is that the number of monitoring wells sampled be sufficient for adequate characterization of the groundwater.

The three groundwater systems monitored at NFSS have been referred to as "upper," "lower," and "bedrock" by previous investigators. The lower and bedrock systems are thought to be hydraulically connected; for the purposes of this discussion, the lower and bedrock systems will be designated the lower system.

The current groundwater monitoring program at NFSS exceeds EPA's groundwater monitoring recommendations, which suggest a minimum of one background location and not less than three locations downgradient of possible contaminant sources.

Figure 5-4 shows sampling locations around the IWCF, which is the only source of contaminants at NFSS. Wells adjacent to the IWCF boundary are considered inner ring wells, and wells approximately 61 m (200 ft) from the IWCF boundary are considered outer ring wells. When the final cap is in place, the inner ring wells will be removed, and the outer ring wells will be incorporated in the IWCF boundary.

Sampling locations were based on groundwater modeling results and current flow conditions. Because the flow direction of the upper system fluctuates, the outer ring wells will be used to sample the upper system. These wells are in the optimum positions to intercept potential contaminant migration.

Because flow direction in the lower system has been constant since monitoring began in 1985, lower system wells will be located in the expected flow path of potential IWCF contaminants.

Upper groundwater system

The upper system occurs in discontinuous permeable lenses within the unconsolidated clayey overburden material, which is approximately 1.5 to 8.5 m (5 to 28 ft) below ground surface. Wells in this zone are screened in unconsolidated silts and sands at depths of 2.4 to 6.7 m (8 to 22 ft).

The upper system has recently undergone a flow reversal as a result of dewatering from an adjacent landfill operation. Natural flow in the upper system is to the northwest; however, dewatering caused the flow direction to change toward the east. Groundwater flow gradient is approximately 0.006, which is significantly steeper than the lower system gradient.

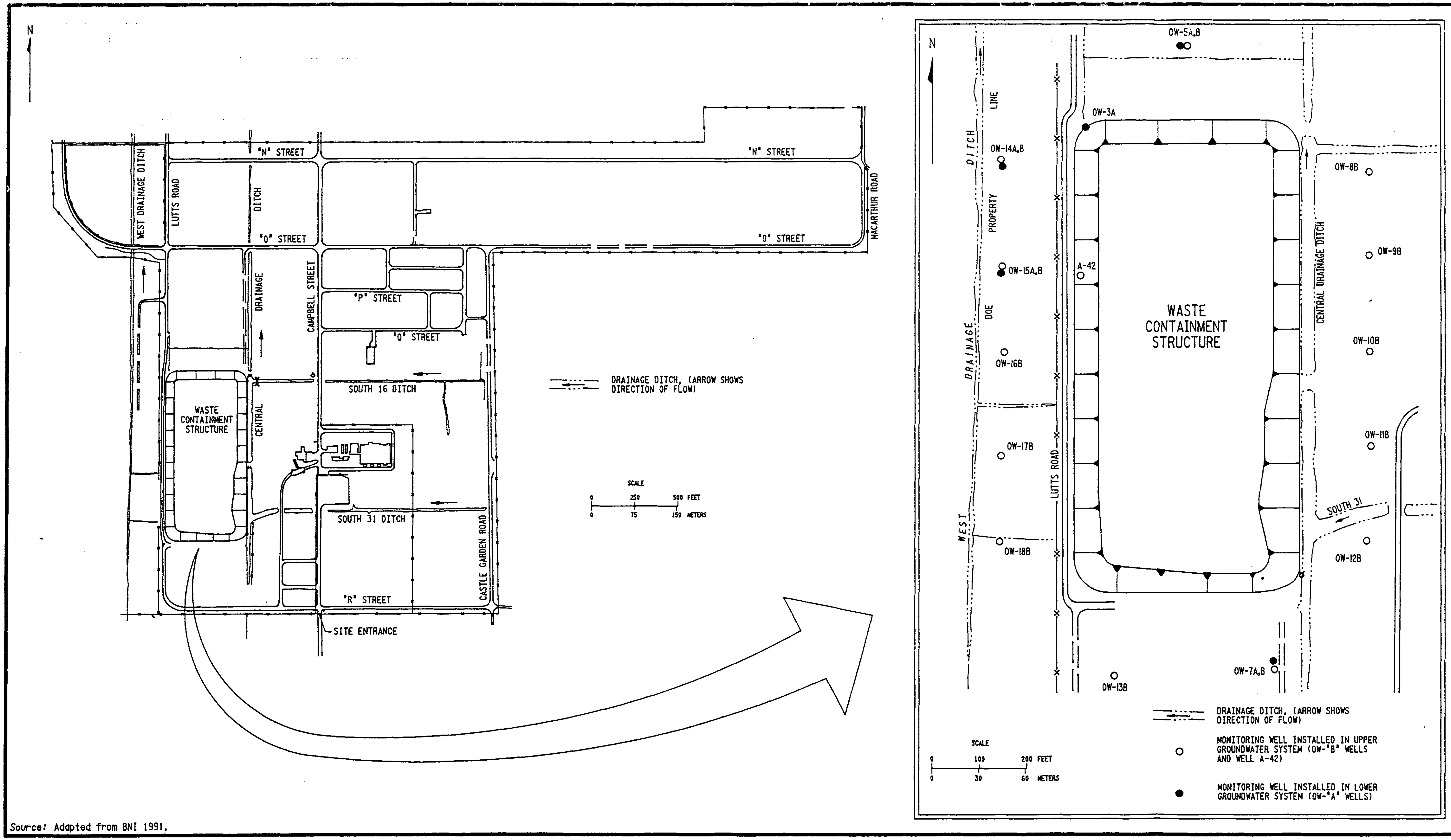

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Figure 5-4
Wells Used for Radiological and Chemical Sampling

Samples for radiological and chemical analysis will be collected from OW-"B" wells and well A-42 in the upper system. Background samples will be collected from OW-7B.

Lower groundwater system

The lower groundwater system occurs in the basal contact of the overburden and the bedrock. The basal contact zone is encountered at approximately 9.2 to 14 m (30 to 45 ft) below ground surface and consists of silts and sands. The bedrock system occurs in the Queenston Formation, more than 13.7 m (45 ft) below ground surface at the site. The Queenston Formation consists of shales, siltstone, and mudstone and is slightly to moderately weathered along its upper surface.

Groundwater in the bedrock is hydraulically connected to the basal contact zone, and the clayey overburden above the basal contact zone acts as an aquiclude. The lower system is therefore considered to be a confined aquifer. All wells in the lower system are in hydraulic connection. Flow direction is toward the northwest, and the hydraulic flow gradient is 0.001 (Figure 5-5). Available data do not indicate any change in water levels resulting from dewatering of the adjacent property.

Groundwater samples will be collected from OW-"A" wells downgradient of the IWCF. Background samples will be collected from OW-7A.

Water level measurements

Monitoring of groundwater levels at NFSS is necessary to detect changes in groundwater flow conditions to ensure that potential contaminant migration pathways are being monitored. Water levels will be measured manually every three months (quarterly) from 24 wells in the upper system and from 41 wells in the lower system, 14 of which are in bedrock (see Figure 5-6). Automatic well recorders will measure water levels daily in six upper and three lower system wells.

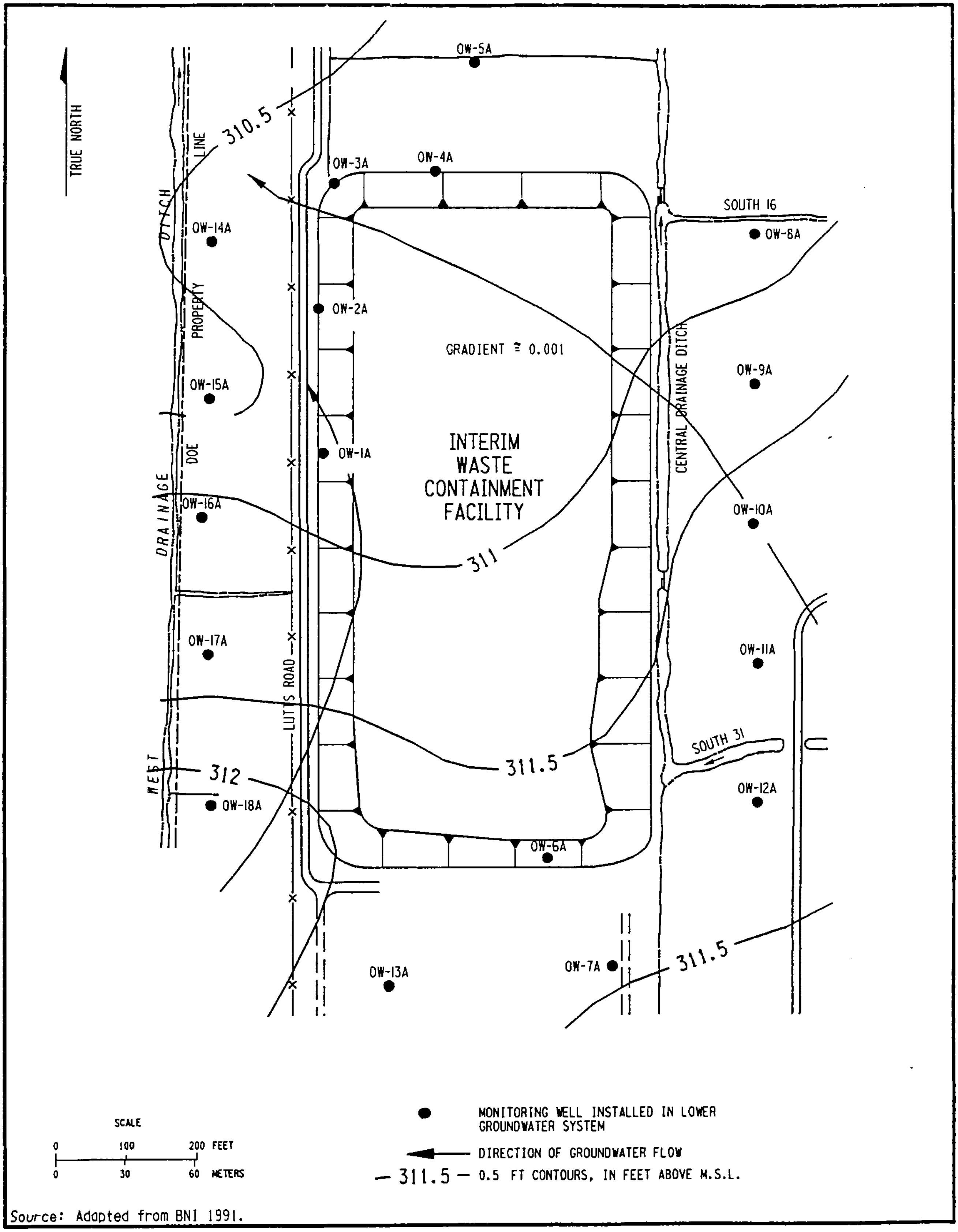

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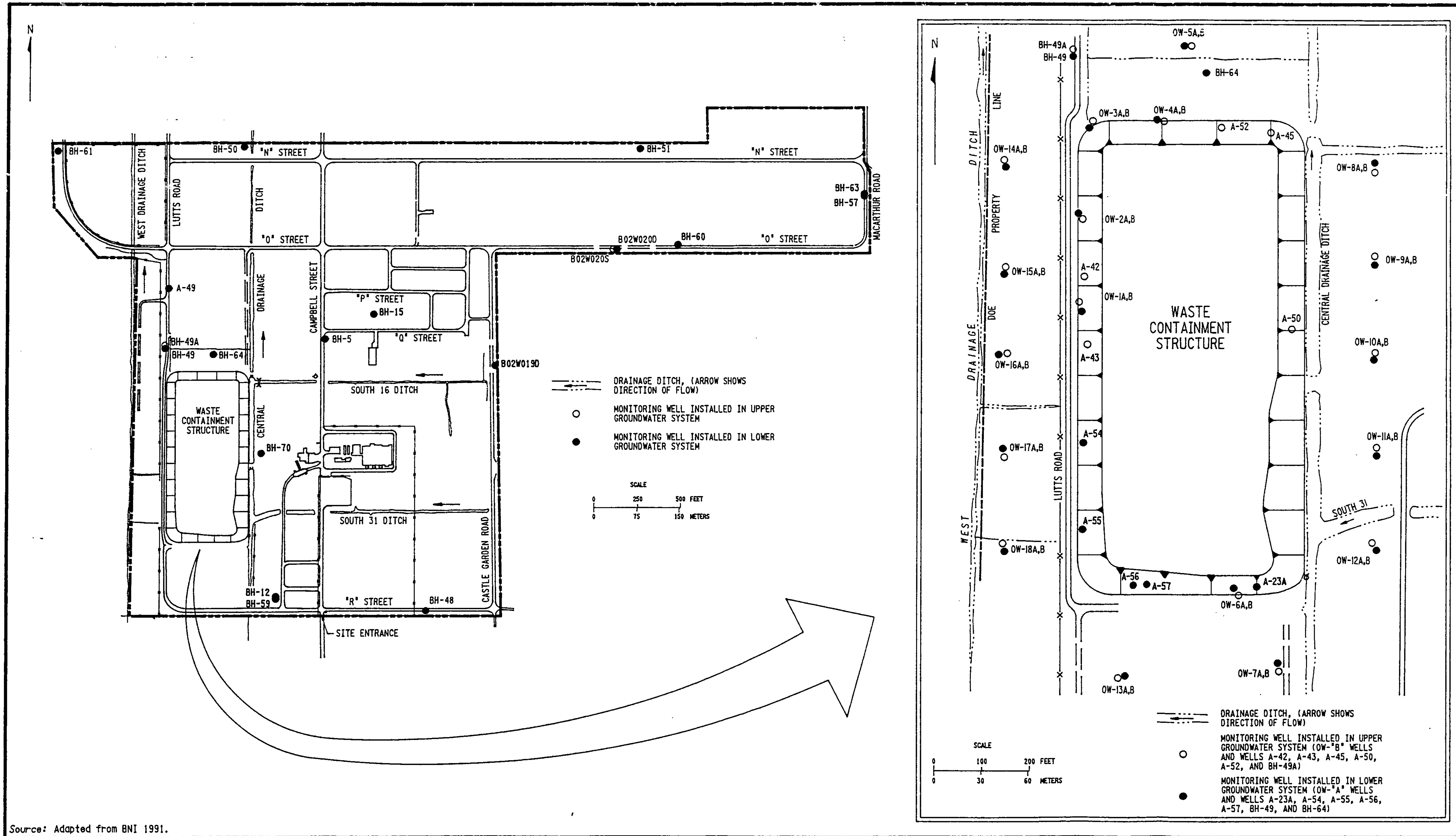
Figure 5-5
Potentiometric Map of Lower Groundwater System (2/2/90)



Source: Adapted from BNI 1991.

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Figure 5-6
Wells Used for Water Level Measurements

5.4.3 Sampling Frequency

Table 5-1 lists wells being sampled and the frequency of sampling and water level measurement. Wells at NFSS will be sampled annually. This frequency was selected based on the fact that groundwater is estimated to travel less than 1 m/yr (3 ft/yr). Annual sampling will be conducted during the period of the year when potentiometric surfaces of the groundwater are between peak highs and lows.

5.4.4 Analytical Parameters and Sampling Methods

As discussed in Subsection 1.4, the primary contaminants of concern at NFSS are radium-226, uranium-238, and heavy metals. Therefore, groundwater will be analyzed for radium-226, total uranium, and metals (aluminum, copper, iron, lead, manganese, vanadium, and mercury). All groundwater samples will be collected as grab samples.

Groundwater will also be monitored for pH, specific conductance, total organic halides (TOX), and total organic carbon (TOC). These parameters will be used as indicators to determine whether the groundwater chemistry has changed enough to affect the mobility of the waste at the site and whether chemicals that could impact future remedial action activities are migrating onto the site. Specific conductance and pH measurements of groundwater will be taken in the field annually.

Monitoring well sampling procedures (including equipment, techniques, and decontamination methods) are described in detail in an instruction guide that governs sampling activities at NFSS. The instruction guide is based on protocols recommended in Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Analytical procedures will be in accordance with EPA-approved methods as described in Section 6.0. In accordance with best management practices, upgradient wells will be sampled before downgradient wells.

Table 5-1

Frequency of Sampling and Water Level Measurement in Wells at NFSS

Well No.[a]	Sampling	Water Level Measurement
Upper Groundwater System		
OW-1B[b]	–[c]	Quarterly
OW-2B[b]	–	Quarterly
OW-3B[b]	–	Quarterly
OW-4B[b]	–	Quarterly
OW-5B[d]	Annually	Quarterly
OW-6B[b,e]	–	Quarterly
OW-7B[d,e]	Annually	Quarterly
OW-8B[b]	Annually	Quarterly
OW-9B[b]	Annually	Quarterly
OW-10B[b]	Annually	Quarterly
OW-11B[b]	Annually	Quarterly
OW-12B[b,e]	Annually	Quarterly
OW-13B[d]	Annually	Quarterly
OW-14B[d]	Annually	Quarterly
OW-15B[d,e]	Annually	Quarterly
OW-16B[d,e]	Annually	Quarterly
OW-17B[d]	Annually	Quarterly
OW-18B[d]	Annually	Quarterly
A-42[b,e]	Annually	Quarterly
A-43[b]	–	Quarterly
A-45[b]	–	Quarterly
A-50[b]	–	Quarterly
A-52[b]	–	Quarterly
BO2W20S	–	Quarterly
Lower Groundwater System		
OW-1A[b]	–	Quarterly
OW-2A[b]	–	Quarterly
OW-3A[b]	Annually	Quarterly
OW-4A[b]	–	Quarterly
OW-5A[d]	Annually	Quarterly
OW-6A[b]	–	Quarterly
OW-7A[d,e,f]	Annually	Quarterly
OW-8A[b]	–	Quarterly
OW-9A[b,e]	–	Quarterly
OW-10A[b]	–	Quarterly
OW-11A[b]	–	Quarterly

Table 5-1

(continued)

Page 2 of 2

Well No.[a]	Sampling	Water Level Measurement
Lower Groundwater System (continued)		
OW-12A[b]	-	Quarterly
OW-13A[d]	-	Quarterly
OW-14A[d]	Annually	Quarterly
OW-15A[d,e]	Annually	Quarterly
OW-16A[d]	Annually	Quarterly
OW-17A[d]	-	Quarterly
OW-18A[d]	-	Quarterly
A-23A[b]	-	Quarterly
A-49	-	Quarterly
A-54[b]	-	Quarterly
A-55[b]	-	Quarterly
A-56[b]	-	Quarterly
A-57[b]	-	Quarterly
BH-5	-	Quarterly
BH-12	-	Quarterly
BH-15	-	Quarterly
BH-48	-	Quarterly
BH-49[d]	-	Quarterly
BH-49A	-	Quarterly
BH-50	-	Quarterly
BH-51	-	Quarterly
BH-57	-	Quarterly
BH-59	-	Quarterly
BH-60	-	Quarterly
BH-61	-	Quarterly
BH-63	-	Quarterly
BH-64	-	Quarterly
BH-70	-	Quarterly
B02W19D	-	Quarterly
B02W20D	-	Quarterly

[a]Well locations are shown in Figures 5-4 and 5-6.
[b]Located in the inner ring.
[c](-) = well not sampled.
[d]Located in the outer ring.
[e]Automatic monitoring.
[f]Background well - four samples will be taken per sampling event as duplicates for statistical analysis.

5.4.5 Field Activities Quality Assurance

Sampling techniques, types of equipment, and decontamination procedures to be used for groundwater monitoring will be based on SW-846 (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a) and are implemented through the use of FUSRAP instruction guides. Information on QC samples and data use is provided in Section 7.0 of this EMP.

A geologist will inspect all wells annually to ensure their integrity. Based on these inspections, damage or deterioration will be documented and repairs made if necessary. Water level data will be entered into a database, and any irregularities will be noted and reported. QA/QC procedures will be followed in accordance with requirements outlined in Section 10.0.

5.4.6 Emergency Provisions

In the event that a contaminated area is disturbed or a release occurs, site operations personnel and the site safety officer will notify appropriate BNI and DOE personnel in accordance with applicable FUSRAP project instructions. Any sampling required to investigate the extent of contamination will be initiated in accordance with these instructions.

5.5 BASIS AND CRITERIA FOR SURFACE WATER AND SEDIMENT SURVEILLANCE

This subsection describes the rationale and requirements for conducting surface water and sediment sampling as described in DOE Orders 5400.1 and 5400.5 and Subsections 5.10 and 5.12 of the regulatory guide.

5.5.1 Surveillance Requirements

The objective of surface water and sediment sampling at NFSS is to provide data to:

- Determine quality of naturally occurring surface water and sediment
- Assess compliance with all applicable regulations and DOE orders
- Determine whether contamination that may pose a threat to human health or the environment is migrating offsite
- Estimate radiation doses to the public from surface water sources

5.5.2 Sampling Location Rationale

Based on past sampling results (BNI 1991), contaminants are not migrating offsite via the surface water and sediment pathways. The most likely occurrence of contaminant movement from NFSS by surface water or sediments is during storm events, especially if the IWCF has been disturbed by remedial action. Currently, no plans for remedial action are scheduled for the site during fiscal year 1992; therefore, there is little potential for exposure to the public via these pathways.

Surface water features and drainage in the vicinity of NFSS are shown in Figure 5-7. Drainage at the site is collected in a system of ditches that eventually transport surface water to the Central Drainage Ditch, which has a drainage area of approximately 1.3 km^2 (0.5 mi^2). After crossing the NFSS boundary, the Central Drainage Ditch flows northward 4.7 km (2.9 mi) before discharging into Fourmile Creek. From its confluence with the Central Drainage Ditch, Fourmile Creek travels 3.6 km (2.2 mi) before discharging into Lake Ontario.

Five locations will be sampled for both surface water and sediment to monitor the migration of contaminants from NFSS. Three of these sampling stations (locations 9, 10, and 11) will be located onsite, as shown in Figure 5-8. Location 9, at the site boundary in the South 31 Ditch, will be used to measure background conditions. Location 10, in the Central Drainage Ditch, will sample runoff from the IWCF. Location 11 will be in the Central Drainage Ditch at the northern site boundary.

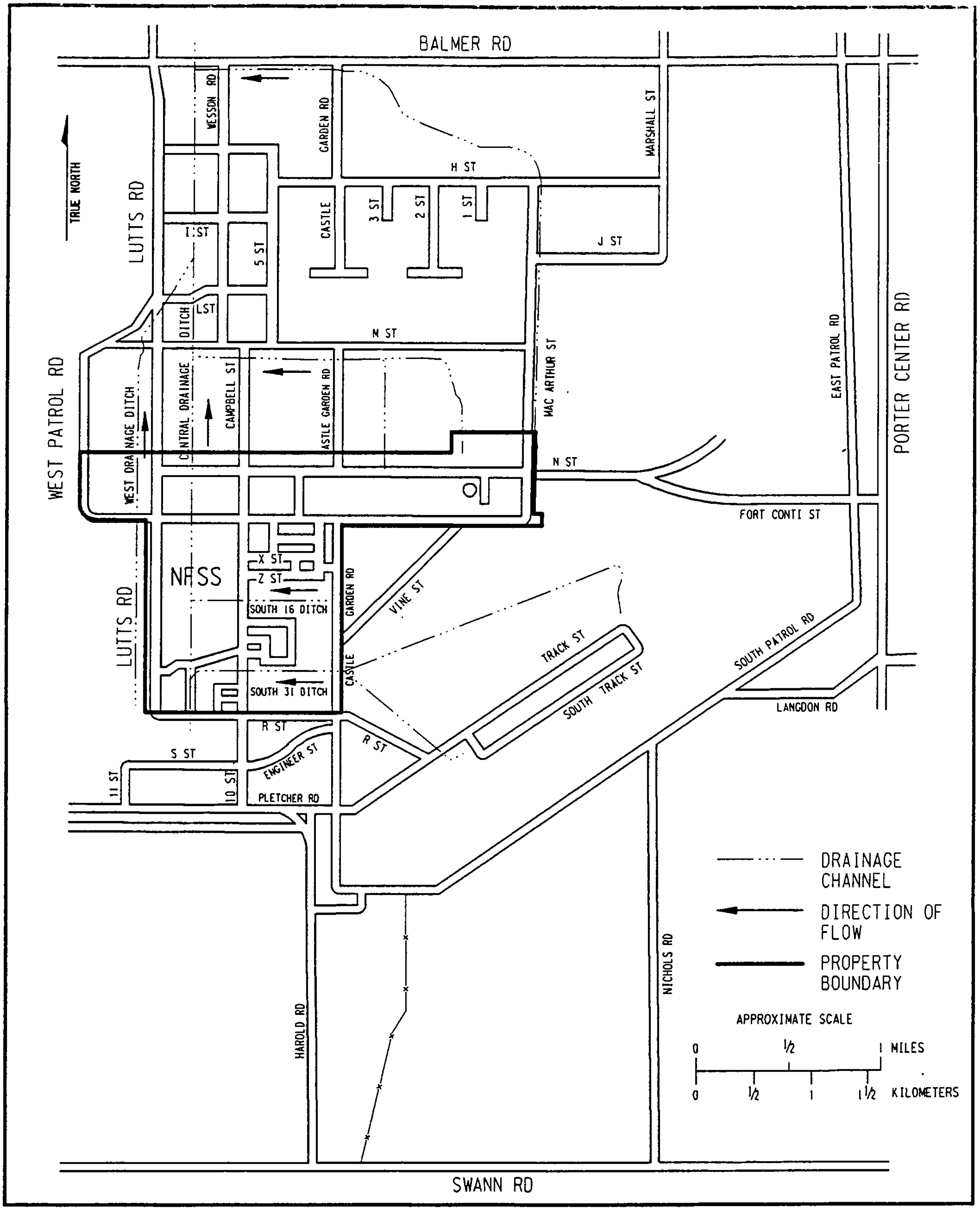

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Figure 5-7
Stormwater Drainage at NFSS

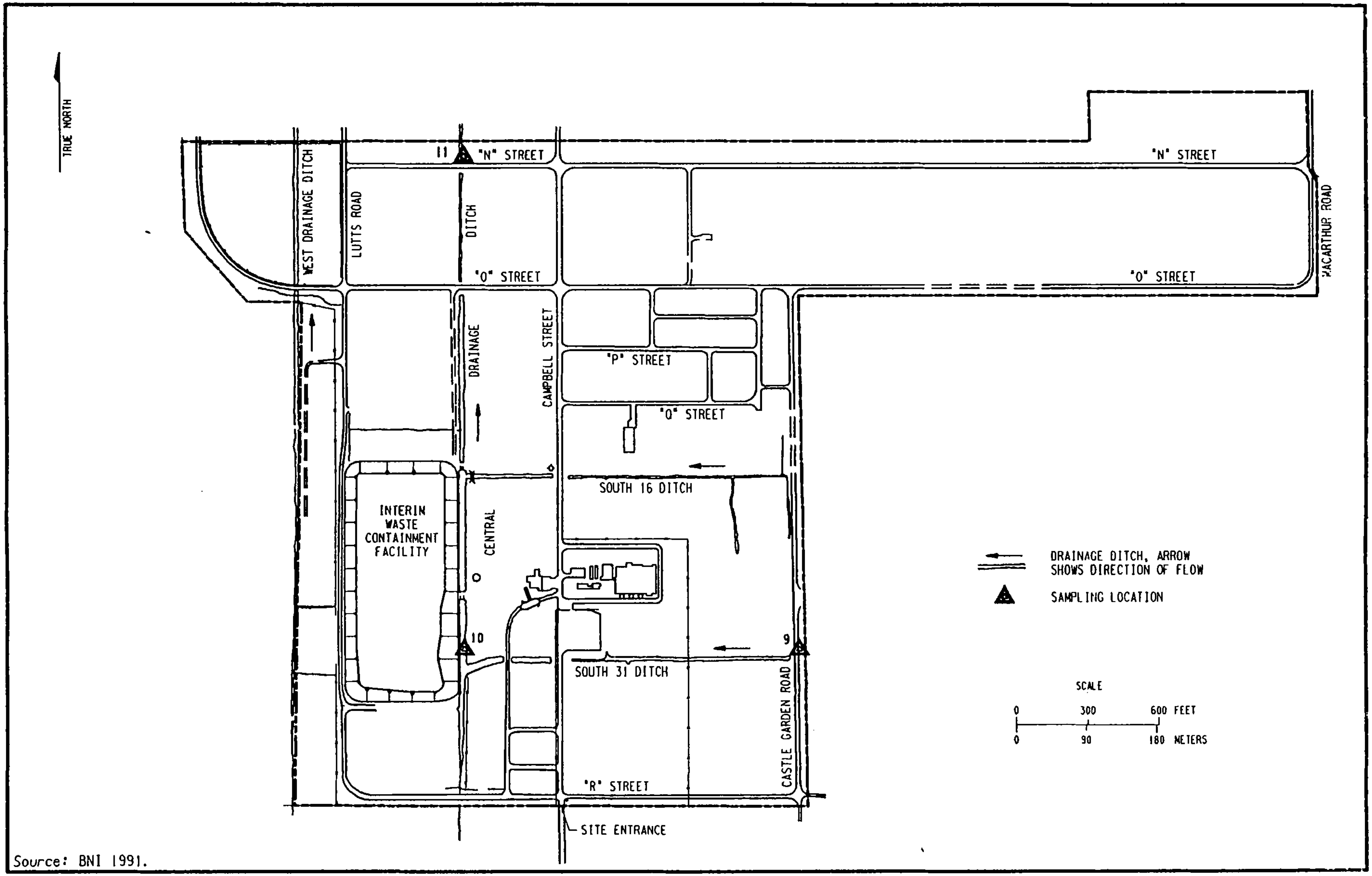

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Figure 5-8
Onsite Surface Water and Sediment Sampling Locations

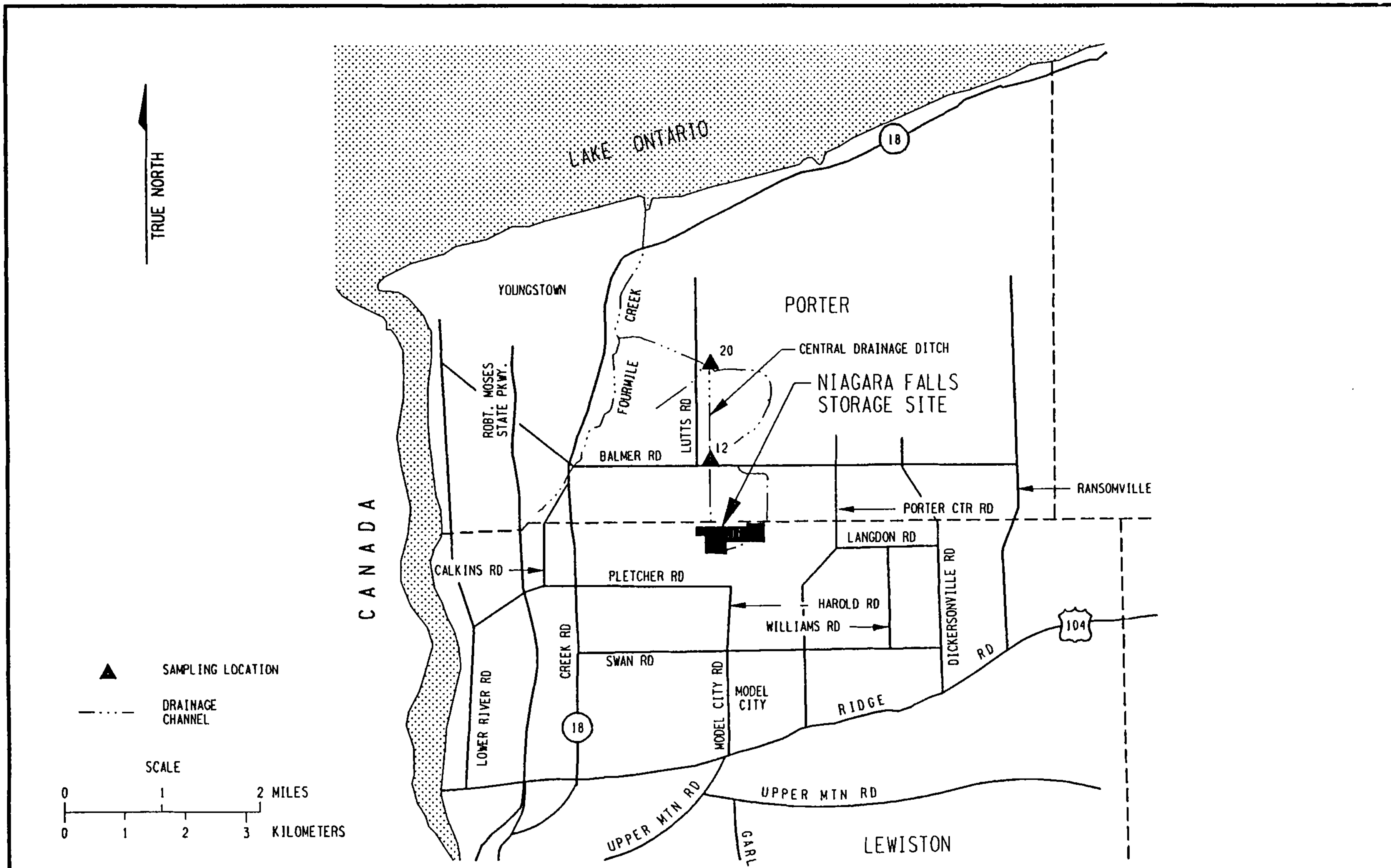
Two offsite sampling stations (locations 12 and 20) are in the Central Drainage Ditch north of the site (Figure 5-9). These monitor the offsite migration of contamination downstream of the site.

Additional surface water sampling at NFSS may be required as a result of stormwater discharge regulations (55 FR 47990 et seq., 56 FR 12098 et seq.) recently promulgated by EPA. In response to these provisions, the site has been evaluated, and a permit application for the stormwater discharge from NFSS will be prepared and submitted to the New York State Department of Environmental Conservation. A permit will likely require stormwater discharge monitoring on a regular basis; any monitoring conducted will comply with permit requirements. If a stormwater discharge permit is required, analytical parameters and sampling methods will be conducted in accordance with EPA guidelines and DOE Order 5400.1.

5.5.3 Sampling Frequency

The surface water and sediment sampling frequency was determined based on the following rationale. Because most of the wastes are in the oxide form, they are relatively insoluble. Additionally, any soluble contaminants would have already migrated from the site during the past 20 years. Because the waste is not soluble, most of the contaminants that would migrate from the site would be attached to particulates, which would tend to settle in the drainage ditches. Therefore, annual sampling should be sufficient to determine whether NFSS is negatively impacting the public and the environment via the surface water and sediment pathway. Sampling will be performed during August or September, when high-intensity storms are expected to occur more frequently.

This sampling frequency may be modified based on EPA requirements for sampling stormwater discharge.



Source: Adapted from BNI 1991.

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Figure 5-9
Offsite Surface Water and Sediment Sampling Locations

5.5.4 Analytical Parameters and Sampling Methods

The primary contaminants at the site are radium-226 and uranium, radionuclides from uranium ore processing operations. Therefore, surface water and sediment grab samples will be analyzed for radium-226 and total uranium.

Surface water and sediment sampling procedures (including equipment, techniques, and decontamination methods) will be based on protocols recommended in SW-846 (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Analytical procedures will be in accordance with EPA-approved methods as described in Section 6.0.

5.5.5 Field Activities Quality Assurance

Sampling techniques, type of equipment, and decontamination procedures to be used for surface water and sediment surveillance will be based on SW-846 (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). Sample QA and QC are addressed in Section 7.0 of this EMP. QA/QC procedures will be followed in accordance with the requirements in Section 10.0.

5.5.6 Emergency Provisions

Because of the stability of site conditions, there is little probability that a release will occur that could affect surface water or sediment in the vicinity of the site. However, in the event of a release, site operations personnel and/or the site safety officer will notify appropriate BNI and DOE personnel and will immediately take steps to minimize the potential for contaminant migration, as specified in FUSRAP project instructions. Conditions will be monitored until the release has been stabilized.

6.0 ANALYTICAL PROCEDURES

Chemical laboratory analyses performed on samples collected for the environmental monitoring program will be subcontracted to Roy F. Weston, Inc.; radiological analyses will be performed by Thermo Analytical/Eberline (TMA/E). Laboratory methods, analytical requirements, and reporting formats for analyses performed by Weston and TMA/E are specified in the BNI chemical and radiological analytical services contracts, respectively. Compliance with subcontract requirements will be verified through routine audits of the subcontractors' analytical data and facilities.

6.1 SUMMARY OF LABORATORY PROCEDURE REQUIREMENTS

The scope of this section is to identify acceptable laboratory analytical methods and protocols required for the environmental monitoring program at NFSS. These methods were selected for their ability to detect the maximum number of analytes and to meet the required detection limits. This section also addresses the specific laboratory procedures and practices used to maintain sample integrity and achieve consistently high-quality analytical results.

6.1.1 Sample Identification System

A standard sample identification (ID) system that tracks water, soil, and sediment samples will be used to maintain sample traceability and facilitate data retrieval. Sequentially numbered sample tags will be accountable documents after they are completed and attached to a sample or other physical evidence. The following information will be included on the sample tag:

- Site name
- Field ID or sampling station number
- Date and time of sample collection

- Designation of the sample as a grab or composite
- Type of sample (matrix)
- Signature of the sampler
- Type of preservative used, if applicable

The ID system is described in an instruction guide. It will be used to label all samples taken for the program and will also be used in the environmental monitoring database to track information. Subcontract laboratories may use their own unique identifiers for in-house tracking of samples, but they will use the ID system described above to report the analytical results. All environmental monitoring data will be retrievable by this sample ID convention.

Samples collected for the program will be packaged, and the packages will be monitored for contamination and radiation levels and then shipped in a manner that meets applicable transportation regulations and requirements. COC forms will be used to track samples from the collection locations to the laboratories.

6.1.2 Documentation of Methods

Standard analytical methods approved and published by EPA and the American Society for Testing and Materials (ASTM) will be used in the FUSRAP environmental monitoring program for chemical samples. TMA/E will adhere to procedures developed by the Environmental Measurements Laboratory (EML) (DOE 1990b) and to EPA-approved methods for analyzing groundwater and surface water samples; these requirements are listed in the radiological analytical services subcontract. Specific chemical and radiological analytical methods and the detection limits required for each method used in this monitoring program are given in Table 6-1. These methods have been selected to identify contaminants and determine their concentrations in environmental media in the site area.

Water samples will be analyzed for total uranium and radium-226. Total uranium in water will be measured using the

Table 6-1

Analyses Performed on Samples from NFSS

Parameter	Analytical Technique	EPA Method No.	Detection Limit
Water Samples			
Total uranium[a]	Fluorometric	U-01[b,c]	5.0 µg/L
Radium-226	Emanation/Scintillation	Ra-03[b,c]	0.1 pCi/L
Total organic carbon	Carbonaceous analyzer	415.1	0.5 mg/L
Total organic halides	Coulometric determination	450.1	20 µg/L
Specific conductance	Electrometric	120.1	1.0 µmhos/cm
pH	Electrometric	150.0	0.1 standard units
Metals	Inductively coupled plasma atomic emission spectrophotometry and/or atomic absorption	200.7	Varies with analyte
Sediment Samples			
Total uranium	Fluorometric	U-01[b,c]	5.0 µg/L
Radium-226	Gamma spectroscopy	C-02[b]	0.5 pCi/g

[a]Well location A-42 requires the same analysis as other wells except dissolved/total isotopic uranium is analyzed instead of total uranium.

[b]TMA/E uses laboratory procedures developed by Environmental Measurements Laboratory-300 (EML-300) (DOE 1990b).

[c]Modified EML procedure to accommodate the matrix.

fluorometric method, which has proven to be a very sensitive and dependable means of determining trace concentrations of uranium. The first step is to dispense a measured aliquot of the sample onto a flux pellet made of sodium fluoride (98 percent) and lithium fluoride (2 percent). After the flux pellet is dried, the uranium is fused to the pellet by a rotary fusion burner. After cooling, the fluorescence of the fused pellet is measured by a fluorometer; the measured fluorescence is directly proportional to the concentration of total uranium in the sample as compared with spikes, standards, and blanks.

Radium-226 concentrations are determined by radon emanation. This method consists of precipitating radium-226 as sulfate and transferring the treated sulfate to a radon bubbler, where radon is allowed to come to equilibrium with its radium-226 parent. The radon is then withdrawn into a scintillation cell and counted by the gross alpha technique. The quantity of radon detected in this manner is directly proportional to the quantity of radium-226 originally present in the sample.

Sediment samples will be analyzed for total uranium and radium-226. Total uranium will be measured using the fluorometric method, and radium-226 will be analyzed by gamma spectroscopy.

In general, chemical analysis methods are based on standard methods given in the EPA SW-846 manual (EPA 1990). Analyses requested for NFSS are based on previous site characterizations. Detailed laboratory requirements and the list of chemical methods performed are documented in the chemical analytical services subcontract.

TETLDs containing lithium fluoride chips are used to measure external gamma radiation; they have a lower detection limit of 20 mR.

Radon flux has been monitored at the IWCF since 1990 to ensure that the radon release rate does not exceed the regulatory requirement of 20 $pCi/m^2/L$. EPA method EPA-520/5-87-005 (EPA 1987c) is used to quantify the radon flux from the NFSS waste pile.

6.1.3 Procedures to Prevent Cross-Contamination

The BNI subcontractor laboratories will establish and adhere to an internal laboratory QA plan to help minimize the possibility of cross-contamination between samples. Typical requirements are as follows:

- **General:** All samples will be preserved and shipped to the laboratory as soon as possible to help maintain sample quality from the time of collection to analysis and to meet the "holding time" guidelines. Concentrated nitric acid will be used to preserve radiological groundwater samples by lowering the sample pH to between 1 and 2. Preservatives and holding times for chemical samples will depend on the analytical method selected. Specific guidance on sample preservatives, holding times, and container sizes is provided in an instruction guide.

- **Chemical:** Weston is required to follow standard laboratory practices pertaining to the levels of decontamination for glassware and equipment. To reduce the introduction of contaminants during sample preparation, reagents used in preparing standards and samples must meet levels of purity appropriate to the analyses performed. To minimize cross-contamination, sample preparation, handling, and analyses will be performed according to applicable EPA methods. Method blanks and duplicates will be used to monitor for contamination that may have occurred during analysis.

- **Radiological:** Samples will be segregated in the TMA/E laboratory according to predetermined radioactivity levels. These samples will be prepared and analyzed within their groups to minimize cross-contamination in the laboratory. Each sample will be tracked during the analytical process to detect possible cross-contamination.

6.1.4 Calibration

Generally, laboratory equipment will be calibrated as often as recommended by the manufacturers. The internal QA program for each subcontract laboratory provides applicable equipment calibration procedures and specifies appropriate maintenance requirements for all equipment.

The subcontractor's QA procedures for performing chemical analyses will include identification and control of equipment calibration record requirements, frequency of calibration and calibration checks, corrective action required when equipment is out of calibration, and specific calibration and calibration check instructions. The QA procedures for performing radiological analyses will include routine calibration of counting instruments, source and background counts, routine yield determination of radiochemical procedures, and replicate analyses to check for precision.

Calibration standards for equipment used during a chemical or radiological analysis will be compatible with NIST or other acceptable laboratory standards. Documentation supporting the validity of the calibration standards used (e.g., calibration log books or calibration and maintenance files for all instruments used) will be maintained and will be accessible for auditing purposes. Field equipment calibration will be handled in accordance with TMA/E operational procedures.

6.2 QUALITY ASSURANCE

In addition to the general QA program provisions of Section 10.0 of this EMP, each subcontracted laboratory will maintain its own internal QA program that will be audited annually by BNI to ensure that the analytical results for samples collected at NFSS are valid and appropriate for use. Technical experts in radiological and chemical analyses may be invited to participate in these audits to fully evaluate the laboratories' performance.

Independent verification of compliance with the requirements of this section will be accomplished through BNI QA audits of the subcontracted laboratory facilities, personnel, and documentation. The scope of the auditing program will include the use of preplanned checklists and the freedom to pursue lines of inquiry to ensure that laboratory activities comply with calibration procedures set forth in the subcontract agreements, maintain sample integrity, and minimize cross-contamination during the analytical process. Discrepancies identified during these annual audits will be documented and tracked through the BNI corrective action program.

7.0 DATA ANALYSIS AND STATISTICAL TREATMENT

Using EPA guidance on data quality objectives (DQOs), FUSRAP has established acceptable data analysis and statistical treatment practices to ensure that analytical results comply with DOE Orders 5400.1 and 5400.5.

For both radiological and chemical analyses, the DQOs at NFSS will be comparable to EPA analytical level III, which is used for chemical analysis (EPA 1987b). Radiological analyses will be subject to the applicable requirements of Nuclear Regulatory Commission guidance (NRC 1979).

The data QC will be maintained to ensure defensibility and integrity of the analytical data to DOE, peer reviewers, and regulatory agencies. Sampling techniques and sample-handling procedures are documented in an instruction guide that includes detailed instructions for sampling activities and provides guidance to reduce data variability. In addition, project instructions provide for consistency in analysis and management of environmental monitoring data.

7.1 SUMMARY OF DATA ANALYSIS AND STATISTICAL TREATMENT REQUIREMENTS

The data analysis and statistical treatment procedures implemented in the NFSS environmental monitoring program will be designed to comply with the DOE regulatory guide. The methods described in the following subsections will be employed in the data validation process to ensure that analytical results are valid and appropriate for use.

7.1.1 Accuracy

Spikes and standard reference materials (SRMs) will be used to evaluate data accuracy. Analytical results for spiked samples will be reported in the monthly QC report from the laboratory.

The reported value for radiological parameters will be an average of the number of spikes analyzed by the laboratory ±2 standard deviations of the mean.

Recovery limits for each chemical parameter will be within the guidelines set forth by the method selected from those available and documented by EPA. Ten percent recovery will be used for radiological samples.

7.1.2 Precision

Duplicate samples will be used to measure the precision of sample collection and analysis. The precision of the analytical data for chemical analysis will be evaluated by the relative percent difference (RPD) for the duplicate pair:

$$RPD = 100\ (X_1 - X_2)/X_{avg}$$

where: X_1 = concentration of sample 1 of duplicate
X_2 = concentration of sample 2 of duplicate
X_{avg} = average value of samples 1 and 2

For metals, the RPD must be 20 percent or less; environmental duplicates for radiological analysis will be evaluated within 2 to 3 standard deviations of the mean for all duplicates analyzed by the laboratory. If the results are not within 3 standard deviations of the mean, a more detailed evaluation will be performed. As applicable, the precision of radiological analytical results will be reported ±2 standard deviations to provide a 95 percent confidence interval.

7.1.3 Comparability

Comparability expresses the confidence with which one data set can be compared with another. Comparability will be ensured through use of the EPA-designated reference or equivalent sampling procedures and analytical methods and certified calibration standards.

7.1.4 Data Evaluation

Raw data will be submitted to BNI in data transmittal packages and electronic data files. The transmittal packages will be subject to data verification by BNI. The verification process will consist of a review of data documentation, QC, and statistical information provided by each subcontract laboratory. Checklists will be used during the review process in accordance with FUSRAP project instructions. The original packages and the reviewer comments will remain in the BNI Project Document Control Center.

Electronic data files received from the analytical contractor will be entered into the environmental monitoring database in a timely manner. The structure and detailed specifications applicable to the environmental monitoring database are included in the environmental monitoring data management project instruction guide.

Upon completion of the data review, BNI will either approve the data for inclusion in a final data report, declare the data unacceptable as is and then seek to resolve issues that render the data unacceptable, or include an explanation for data rejection. Nonconformance reports (NCRs) will be issued by the data reviewer for rejected data.

Analytical results will be reported in the ASER after the data review is completed. All data will be compared with relevant and applicable standards and background concentrations to quantify levels of contaminants. All valid data including outliers will be reported. Data will be excluded only after investigation confirms that an error has been made in the sample collection, preparation, or measurement or data analysis process. If, by a process of probability plotting, time plotting, or control charting, outliers and temporal irregularities cannot be identified, both results (i.e., possible outliers and the exclusion of possible outliers) will be reported if a significant difference between the two results is found. As each data point is collected, it will be compared with previous data to identify unusual results that require investigation.

Standard deviations of analytical results for samples collected at NFSS over the past five years will also be calculated for trend analysis. The formula for standard deviation is as follows:

$$S = \sqrt{S^2} = \sqrt{\frac{\sum_{i=1}^{N} (x_i - x)^2}{N - 1}}$$

where: S = Standard deviation

x = Average of values

x_i = Individual values

N = Number of values

(Note: When mean values rather than actual measurements are being evaluated, the standard deviation equals $S/\sqrt{N}$.) Expected concentration ranges will be those values included within ±2 standard deviations using historic data from the past five years.

Current annual values will then be compared with the expected upper and lower ranges to indicate the presence or absence of outliers. Seasonal variations (periodicities) and contaminant concentration averages will be examined when needed. If necessary, running averages will be calculated using data from previous years for comparative purposes. Where appropriate, a regression analysis of data will be performed to support trend analysis. Results of the trend analysis will be used to determine whether investigation or further statistical evaluation is needed.

7.1.5 Less-Than-Detectable Values

Less-than-detectable values for radiological and chemical environmental monitoring data will be reported in accordance with Section 7.3.4 of the DOE regulatory guide. Additionally, all data will be reported as received from the laboratory; however, the averages, standard deviations, and expected ranges will be reported using the smallest number of significant figures from the quarterly data (e.g., the numbers 3.2 and 32 both have two significant figures). Some of the data will be reported using powers of ten (e.g., 1×10^9).

7.2 QUALITY ASSURANCE

Calculations and independent data verifications will be performed and documented in accordance with FUSRAP project instructions. Discrepancies identified during the review process will be documented and tracked through an NCR.

In addition to the standard QA/QC criteria discussed in Section 10.0 of this document, a summary of results from participation in interlaboratory comparison programs will be included in the NFSS ASER to satisfy the requirements specified in DOE Order 5400.1.

QC samples will be analyzed to determine whether QA program objectives are being met. If a QC sample is contaminated, all samples associated with that QC sample will be checked by an independent reviewer to determine whether the sample results can be used after appropriate annotation. QC sample requirements are listed in Table 7-1. The ten types of QC samples used in the environmental monitoring program are described below.

A **method blank** (or reagent blank) measures the positive interferences that may be introduced during laboratory analysis and will be used to establish method detection limits. It consists of laboratory-grade deionized (DI) water that is carried through all steps of an analytical process; it is analyzed randomly during

Table 7-1
Quality Control Sample Requirements for Environmental Monitoring

QA Objective	Type of Analysis	QC Sample	Frequency
Accuracy	Chemical	Method spike	5% or 1 minimum for all matrices
		Matrix spike	5% or 1 minimum for all matrices
		SRMs	5% or 1 minimum for all matrices
	Radiological	SRMs	5% or 1 minimum for all matrices
Precision	Chemical	Field duplicate	5% or 1 minimum for all matrices
		Laboratory duplicate	5% or 1 minimum for all matrices
	Radiological	Field duplicate	5% or 1 minimum for all matrices
Sample handling	Chemical	Rinse blank	5% or 1 minimum for all matrices
		Method blank	5% or 1 minimum for all matrices

analysis of a sample batch sequence. For soil analyses, a sample may be used as a method blank if previous analyses have established that the soil is not contaminated.

A **laboratory duplicate** (a separate aliquot of a sample received for analysis) indicates the precision of an analytical procedure but not matrix interferences or analytical accuracy.

A **method spike** (fortified method blank/blank spike) is a method blank to which a known concentration of analyte(s) is added. Analysis of a method spike provides a measure of analytical precision and accuracy (e.g., percent analyte recovery).

An **SRM** is a standard reference material used to validate a particular analytical procedure. SRMs usually originate from EPA, NIST, or the National Institute of Occupational Safety and Health. To meet the QA objective of accuracy, SRMs will be used at a frequency of 5 percent of the samples or one for every 20 samples taken for all matrices.

A **trip blank** (travel blank/transport blank) is a laboratory-grade DI water sample (acidified to a pH of less than 2 with 1:1 hydrochloric acid) prepared at the laboratory, shipped to the site (where it remains unopened), and shipped back to the laboratory. These samples will be handled and processed in the same manner as others and will be identified clearly on sample tags and COC records. Trip blanks can provide an indication of interferences introduced in the field, during shipment, or in the laboratory. They do not, however, provide information on matrix effects, accuracy, or precision.

When sampling for volatile organics, a trip blank consisting of demonstrated analyte-free water sealed in two 40-ml Teflon-lined septum vials must be taken into the field where sampling is occurring. The frequency for trip blanks will be one per day when aqueous volatile organics in an aqueous matrix are being collected.

A **rinse blank** (field blank) is a sample of DI water that proceeds through the sample collection and analytical steps and some sampling equipment (e.g., automatic samplers and bailers) after the sample collection equipment has been decontaminated. The rinse blank will be handled and treated in the same manner as the other field samples.

Rinse blanks will be obtained by collecting demonstrated analyte-free water that has been poured into and/or over decontaminated sampling equipment. It will serve as a check to determine whether the decontamination procedure works and has been properly performed. Analysis of rinse blanks will be performed for all analytes of interest.

Rinse blanks will be required for bowls and pans used to homogenize samples and any filtration device used on aqueous samples being analyzed for dissolved constituents. The same aliquot of water may be used on all equipment associated with a particular sample matrix and analysis.

Rinse blanks will be collected at a frequency of 5 percent of the samples or one for every 20 samples taken for all matrices.

The **matrix spike and matrix spike duplicate** (or fortified field sample) are field samples to which a known concentration of the analyte(s) of interest is added. Typically, an analyte is added to a sample at approximately 10 times the background concentration or at 2 to 5 times the detection limit of the analyte. Analysis of this sample will provide information about the performance of an analytical method relative to a particular sample matrix (e.g., the presence or absence of analytical interferences).

The amount of spike material recovered from a matrix spike indicates the best result expected from the analytical method. The recovery of these spikes is compared with the accuracy determined from the method spikes as an indication of matrix effects. The laboratory liaison will work with the laboratory QA officer to establish an acceptable deviation range. Matrix spikes falling outside this range will be reanalyzed to determine whether an actual matrix effect is present or whether corrective action is required by the subcontractor.

When sampling water for base/neutral and acid extractables, TOX, and/or TOC, the sampler will collect a triple volume from at least 1 sampling location for every 20 locations sampled. This enables the laboratory to spike two samples and analyze them with the original sample. These are the matrix spike and matrix spike duplicate.

A **field duplicate** indicates the reproducibility of the analytical results and representativeness of the samples collected. Field duplicates should not be confused with splits or replicates, in that field duplicates require collection of a second sample using the same procedures employed for collecting the first sample. For groundwater samples, however, it is not necessary to purge the well a second time; the duplicate may be collected immediately after the first sample.

A field duplicate sample will be taken for every matrix sampled and analyzed for all the same analytes. Field duplicates will be taken at a frequency of at least 5 percent (1 for every 20 samples taken). Field duplicate sample ID and location numbers will be designated by the environmental monitoring coordinator and conveyed to the sample teams via a memo before sampling begins.

A **"ship" dosimeter** will accompany radiation dosimeters during transport to and from monitoring locations to measure any exposure incurred before or after the monitoring period.

8.0 RADIOLOGICAL DOSE CALCULATIONS

Exposure pathways are discussed in Section 5.0 and shown in Figure 5-1. Radiological input data, dose calculations and modeling, assumptions, and comparisons with DOE guidelines are concisely reported in the ASER.

The following subsections outline the goals for calculating doses and the methodology that will be used.

8.1 PERFORMANCE STANDARDS FOR PUBLIC DOSE CALCULATIONS

The overall goal in calculating public doses is to verify that contamination at the site is not negatively impacting the residents or workers near the site. The calculated effective dose for a maximally exposed individual (MEI) will be determined using the distance that is closest to the site to obtain the most conservative dose estimate. DOE has established a basic dose limit of 100 mrem/yr above background (DOE 1990a) for the MEI. Additionally, 40 CFR 61 Subpart H requires that the dose to the MEI be less than 10 mrem/yr from radioactive particulates transported via the atmospheric pathway. This requirement currently does not apply to NFSS; however, it is considered the best management practice for the site. The collective dose for the population within 80 km (50 mi) of the site will also be evaluated as required by DOE Order 5400.5.

Therefore, the goals of the public dose calculations are to:

- Calculate the dose to the MEI (both total dose and dose from radioactive particulates)
- Calculate the dose to the population within 80 km (50 mi) of the site

8.2 PATHWAYS

To estimate the dose to the general population and the hypothetical MEI at NFSS, direct gamma radiation will be measured, and radionuclide concentrations will be determined for various environmental media: air, surface water and sediment, and groundwater. As stated in Section 5.0, the potential pathways at NFSS are radioactive particulate transport via the atmosphere, surface water and sediment, and groundwater and direct exposure to external gamma radiation (Table 5-1). Under normal site conditions, atmospheric particulates do not constitute a viable pathway at NFSS because all known radioactively contaminated materials are stabilized in the IWCF. However, modeling will be conducted for this pathway to show compliance with 40 CFR 61 Subpart H.

The input data will be calculated for direct exposure and water transport and modeled for the atmospheric pathway. This procedure will be followed to determine the dose to a hypothetical MEI and a collective dose to the general population [within a 80-km (50-mi) radius].

Surface water and sediment will be evaluated as a potential pathway, although no surface water bodies exist onsite or in the immediate vicinity. The only surface water that migrates offsite is stormwater that enters Fourmile Creek, which discharges into Lake Ontario approximately 6 km (4 mi) north of the site. If surface water monitoring data do not show concentrations above background levels, dose calculations will not be performed.

The groundwater system at NFSS will be assessed as a potential exposure pathway. Previous groundwater studies indicate that radionuclide concentrations in offsite monitoring wells are near or below background levels. Sampling will be conducted during routine monitoring and, if radionuclide concentrations are detected at above-background levels, estimates will be made of exposure levels. Onsite groundwater sources are not considered a viable exposure pathway because the site is fenced and wells are capped. Therefore, exposure models will not be developed for the groundwater and surface water and sediment pathways at this time. However, if monitoring results reveal contaminants in either of these transport media, models will be developed.

Because NFSS is in an industrial setting with no nearby sources of livestock or cultivation of foodstuffs, the foodchain pathway is not applicable. If future information indicates that livestock or foodstuffs are cultivated in the area, these exposure routes will be reconsidered.

8.3 DOSE CALCULATION METHOD

Dose calculation methods are presented for the credible exposure routes: direct exposure from gamma radiation and inhalation of radioactive particulates. Dose calculation methodologies will be added for other exposure routes if the data indicate a potential for exposure. The combined exposures from all pathways will be summed to produce an effective dose equivalent and compared with the DOE guideline. A total population dose will be determined by summing the doses from all potential exposure pathways.

8.3.1 Direct Exposure

Direct exposure will be considered in determining the dose to a hypothetical MEI assumed to work continuously at a location near the site. Exposure data for this individual will be collected through the TETLD program, which will provide an average fenceline exposure rate at 1 m (3 ft) above the ground surface. The assumption that the individual works at one location for an entire year will provide a maximum dose value for this scenario. An exposure will then be calculated at a distance of 10 m (30 ft) from the fenceline using the following equation (Cember 1983).

$$\textit{Exposure at } 10\ m = (\textit{Exposure at } 1\ m) \times \frac{h_1}{h_2} \times \frac{\tan^{-1}\ (L/h_2)}{\tan^{-1}\ (L/h_1)}$$

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

h_2 = Distance to the MEI [10 m (30 ft)]

L = Half the length of the NFSS/landfill fenceline [700 m (2100 ft)]

The average exposure rate used in the model will be from the area displaying the highest radiation readings. Additionally, the radiation readings from the TETLDs will be adjusted due to shielding from the dosimeter housing.

The effective dose equivalent will be calculated for the hypothetical MEI. Based on this dose, an evaluation will be made to calculate the effective dose equivalent for the general population living within an 80-km (50-mi) radius of NFSS.

8.3.2 Pathway for Airborne Particulates

To estimate a maximum dose to the hypothetical MEI from airborne particulates from the site, it will be assumed that the individual lives and works within 300 m (1000 ft) of the site. Environmental monitoring data will be incorporated into the EPA AIRDOS model (ORNL 1989) to calculate the effective dose equivalent.

To determine the collective dose to the general population from airborne particulates, the EPA AIRDOS model will be applied at varying distances from the site to a maximum of 80 km (50 mi). The collective dose will be calculated using the effective dose equivalents and the population density.

Atmospheric particulate release rates, used in the AIRDOS model, are determined by using an unlimited wind erosion mode (EPA 1985) for the site and radionuclide concentrations determined during soil characterization efforts. Other input parameters required by the model are size of the site, mixing height and meteorological information. Default values are usually used for meteorological input parameters.

8.4 QUALITY ASSURANCE

Applicable QA standards (Section 10.0) will be followed throughout the calculation procedure. All calculation procedures will be documented in accordance with FUSRAP project instructions. Project calculations will be checked by a qualified person, reviewed by the group leader, and approved by project department supervisors. Additionally, benchmark problems will be used to verify any computer modeling codes.

9.0 RECORDS AND REPORTS

This section identifies and outlines the reporting and record-keeping requirements of the major federal regulations and DOE orders applicable to the environmental and effluent surveillance programs at NFSS. Environmental statutes and regulations change frequently and are often amended or superseded; the monitoring program will be updated as necessary.

Proper record-keeping and reporting are essential to FUSRAP's overall compliance strategy. Appropriate FUSRAP personnel and other responsible authorities will be promptly notified of occurrences and information involving activities at NFSS, as required. Records pertaining to in-house, DOE, EPA, or state agency audits of the monitoring program will be maintained; calculations, computer programs, and other data will be recorded and/or referenced.

9.1 APPLICABLE DOE ORDERS

Record-keeping and reporting requirements applicable to FUSRAP are listed and summarized below.

- **Order 1324.2:** Compliance with general DOE requirements for records disposition and retention

- **Order 5400.1:** Maintenance and retention of auditable records relating to the environmental surveillance and effluent monitoring programs; records of calculations, computer programs, and other information (e.g., raw data and procedures); protection of records against damage or loss, which generally entails ensuring that a duplicate of records is stored in a separate location; description in the ASER of the status of the environmental monitoring program; preparation, annual review, and update (at least every three years) of the EMP

- **Order 5400.4:** Preparation of reports describing the extent and/or status of the CERCLA efforts; reporting of releases of radionuclides that exceed "reportable quantities" to the National Response Center

- **Order 5400.5:** Compliance with general requirements for record-keeping and reporting

- **Order 5484.1:** Preparation of reports on information having environmental protection, safety, or health protection significance

- **Order 5000.3A:** Preparation of occurrence reports, as required, on failure of effluent monitoring systems, inadvertent release of radionuclides, or discovery of significant radioactive contamination in the onsite or offsite environment attributable to current or past FUSRAP operations

- **Order 5700.6B:** Compliance with general QA requirements

- **Order 5820.2A:** Preparation of annual updates of the waste management plan

9.2 APPLICABLE ENVIRONMENTAL REGULATIONS

General reporting and record-keeping requirements for effluent and environmental surveillance activities at NFSS are contained in numerous regulations. Applicable requirements found under CERCLA, Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), Clean Air Act (CAA), National Environmental Policy Act (NEPA), and NESHAPs are explained below.

- **CERCLA:** CERCLA is the primary statutory authority for response actions conducted at NFSS to the extent that DOE Order 5400.4 requires integration of procedural and documentation requirements of CERCLA and NEPA. EPA record-keeping requirements under CERCLA are contained in Subpart I of the National Oil and Hazardous Substances Contingency Plan. Subpart I requires that an administrative record be established and maintained at or near the site to contain documents that form the basis for selecting response actions.

In general, any permits required by federal or state law must be kept onsite. However, CERCLA Section 121 provides an exception to the administrative requirement of obtaining a permit, with a few exceptions such as NPDES stormwater requirements. All substantive conditions required under a permit must still be met.

- **CWA:** Any site that acquires a permit pursuant to the provisions of the CWA should have a copy of the permit onsite. CWA permits issued under the NPDES program contain record-keeping and monitoring requirements. Records and monitoring data required in the permit should be kept onsite. Uncertainty as to inclusion of specific documents may be resolved through negotiations with the permit writer. Recent developments in the regulation of water discharges require stormwater discharge permits for sites associated with past industrial activities. Stormwater discharges are regulated by the NPDES under the CWA and are administered and monitored by the state. DOE is considered the operator of NFSS and plans to prepare a permit application for discharges at the site. If DOE determines that a permit is necessary, a copy of the permit will be kept by the PMC. Documentation of the permitting process will be subject to record-keeping requirements.

- **CAA:** Although an air permit is not currently required for NFSS under CERCLA Section 121, all applicable permit requirements will be met. No permit applications are pending.

- **NEPA:** Many NEPA documents will be placed in the administrative record pursuant to CERCLA. For example, the environmental impact statement (EIS) will be part of the administrative record. Mitigation action plans (MAPs) will be prepared when a finding of no significant impact for an action reviewed in an environmental assessment is based in significant part on a commitment to mitigate adverse environmental impact. An MAP is also prepared for implementation of commitments made in an EIS/record of decision.

- **NESHAPS:** Records are maintained for monitoring, data, monitoring system calibration checks, and the occurrence and duration of any period during which the monitoring system is malfunctioning or inoperative. Records must be stored at the site and maintained for two years (Subpart A, 40 CFR 61.14). Some record-keeping and reporting requirements applicable to NFSS are found under 40 CFR Part 61. Current site information indicates that NFSS is subject to Subpart Q of NESHAPs, which regulates atmospheric radon emissions. Dose calculations to estimate the potential radon flux rate indicate that the radium content at NFSS is insufficient to generate radon-222 flux rates in excess of the Subpart Q standards. Documentation of these calculations will be provided to EPA upon request.

Because neither hazardous waste nor radioactive mixed waste is present, NFSS is not subject to regulation under the Resource Conservation and Recovery Act.

New York regulates asbestos as an industrial waste. Before any asbestos is removed from NFSS, the applicable provisions contained in the New York Rules on Collection and Transport of Industrial Wastes and in NESHAPs Subpart M will be evaluated and complied with.

Applicable QA strategies (Section 10.0) will be followed throughout the reporting and record-keeping procedures, which are documented in FUSRAP project instructions.

10.0 QUALITY ASSURANCE

10.1 IMPLEMENTATION

The comprehensive QA program for NFSS is based on the FUSRAP QA program. The basic QA requirements described in ASME-NQA-1 and the 18 QA criteria of 10 CFR Part 50 Appendix B are individually identified, addressed, and committed to in the QA program and satisfy the requirements of DOE Order 5700.6B. The requirements of the QA program are further detailed and implemented through project procedures, project instructions, specifications, drawings, plans, and work control documents. Adherence to the QA program will be required for all services in support of NFSS. QA requirements will also be incorporated into contracts, work orders, and purchase orders issued for work and services at NFSS by adherence to this QA program.

10.2 SOVEREIGNTY

The FUSRAP project quality assurance supervisor (PQAS) maintains organizational independence by functionally reporting to off-project QA management. The PQAS will be responsive, however, to the FUSRAP program manager for coordination of activities in the implementation of the QA program. The PQAS will be responsible for:

- Assessing the adequacy and implementation of the QA program
- Contributing to the development of QA project plans
- Providing independent surveillances and audits of work activities, including environmental compliance assessments
- Review and approval, as required, of implementing procedures, instructions, and major reporting documents
- Identifying the need for corrective actions and verifying implementation of solutions

- Reporting on the effectiveness of the QA program implementation and providing recommendations to management
- Providing QA indoctrination and training to all project personnel
- Participating in the planning of all work to ensure that QA program requirements are addressed

10.3 SUBCONTRACTORS

Subcontractors to BNI will be an integral group in performing work on and for NFSS. Sampling and sample analysis will be performed by two subcontractors, TMA/E and Weston. Other subcontractors will perform labor, supply material, and assist in the many ongoing phases of the work.

10.3.1 Compliance with FUSRAP QA Program

Each BNI subcontractor's QA system will be implemented in a manner that is compatible with and equal to the FUSRAP QA program. Subcontractors not having their own QA program will work under the requirements of the FUSRAP QA program.

TMA/E and Weston maintain their own respective internal QA programs, and their standard practices manuals have been reviewed and accepted by BNI. Both TMA/E and Weston will be audited at least annually by BNI to determine their compliance with QA requirements.

10.3.2 Participation in Laboratory QA Assessment Programs

TMA/E will participate in the collaborative testing and interlaboratory comparison program with EPA at Las Vegas, Nevada. In this program, samples of various environmental media (water, milk, air filters, soil, foodstuffs, and tissue ash) containing one or more radionuclides in known amounts will be prepared and distributed to participating laboratories. Results will be forwarded to EPA for comparison with known values and with the results from other laboratories. This program will enable the laboratory to regularly evaluate the accuracy of its analyses and take corrective action, if needed. TMA/E will also participate in the DOE EML interlaboratory QA program, which consists of receiving and analyzing environmental samples (air filters, vegetation, water, and soil) quarterly for specific radiochemical analyses. TMA/E has been approved for accreditation by the American Association for Laboratory Accreditation.

Interlaboratory comparison of the TMA/E TETLD results will be provided by participation in the International Environmental Dosimeter Project sponsored jointly by DOE, EPA, and the Nuclear Regulatory Commission.

Weston will participate in drinking water, wastewater, and/or hazardous waste certification programs and is certified (or pending) in 35 such state programs. Weston's QA program will also include an independent overview by its project QA coordinator and a corporate vice president.

10.4 AUDITS AND CORRECTIVE ACTIONS

Quality audits and surveillances, as defined in ASME-NQA-1, will be performed throughout the year on many areas of FUSRAP. Audits and surveillances will be scheduled so that performance-based assessments of project activities related to NFSS are examined to review, evaluate, and report on the effectiveness and status of the project QA program. Audits will be led by an ASME-NQA-1 certified audit team leader appointed by the BNI QA manager. Audit team members will be selected based on technical expertise, qualification in the area being audited, and lack of direct responsibility for performing the activities being audited. These audits will be conducted, using checklists, in accordance with written procedures in the QA department standards. Surveillances, similar to audits, will be performed by QA personnel with the use of checklists and will focus on performance assessments for scope-specific QA program elements.

Results of the QA audits and surveillances will be documented and reported to BNI management. Findings requiring corrective actions will be documented in accordance with QA department standards, clearly reported, assigned to a responsible individual, and tracked until effective solutions are implemented. The PQAS will verify the implementation of corrective actions and will report the results to project management and the BNI QA manager.

10.5 CONTROL OF SAMPLING

Control of field sampling and monitoring activities will be established through implementation of FUSRAP environmental health and safety procedures and instruction guides. The objective of sampling procedures will be to ensure that samples obtained are representative of the environment being investigated. Calculations will be performed in accordance with approved procedures. For sampling of air, water, sediments, soils, or wastes, there is an instruction guide for the sampling program that includes:

- Techniques or guidelines used to select sampling sites
- Specific sampling procedures to be used
- Charts, flow diagrams, or tables delineating sampling program operations
- Containers, procedures, and reagents used for sample collection, preservation, transport, and storage (including holding times)
- Special preparation of sampling equipment and containers to avoid sample contamination
- Control of samples and COC
- Establishment of DQOs

Laboratory and instrument control will be established by implementation of field and laboratory procedures including:

- Preservation of samples
- Receipt and handling of samples

- Processing and analysis of samples
- Analytical equipment calibrations
- Data verification
- Data reporting
- Data and record retention
- Sample retention

10.6 RADIATION AND CHEMICAL MEASURING EQUIPMENT

Radiation and chemical measuring equipment will be calibrated and operated in accordance with the QA program requirements implemented through project procedures. Included in the program will be laboratory and field instruments, sampling equipment, and dosimeters. Calibration will be traceable to recognized national standards, using techniques recognized by ASTM, NIST, the nuclear industry, and EPA.

10.7 DATA MANAGEMENT

Data reviews will be performed and documented in accordance with FUSRAP project instructions. Discrepancies identified during the review process will be documented and tracked through an NCR.

10.8 CALCULATIONS AND MODELING

Applicable QA standards will be followed throughout the calculation and modeling procedure. All procedures will be documented in accordance with FUSRAP project instructions. Project calculations will be checked by a qualified person, reviewed by the group leader, and approved by project department supervisors. Additionally, benchmark problems will be used to verify any computer modeling codes.

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APPENDIX A

Cross-Reference Showing EMP Compliance with DOE Regulatory Guide

Appendix A is provided as a cross-reference to show how this environmental monitoring plan (EMP) complies with the specific "high-priority" elements listed in the "Summary of Effluent Monitoring and Environmental Surveillance Program Elements" section (pp. ix-xxvi) of the DOE regulatory guide. Where high-priority elements are judged to be not applicable to the scope of this EMP, the justification for not implementing them is shown by using a capital-letter code in the "EMP Section or Justification Code" column of this Appendix. These codes are explained in Table A-1 below.

Table A-1
Justification for Not Implementing
High-Priority Elements

A. NFSS is not an operating facility. No stack emissions or liquid effluents are generated.

B. Because NFSS is an inactive facility, continuous monitoring will not be performed.

C. NFSS is neither a new nor a modified facility; therefore, a preoperational assessment is not required.

D. No radioiodides are present.

E. NFSS is not a multi-facility site.

F. No endangered or protected species are known to occur in the site area.

G. There are no neutron sources.

H. Because NFSS is located in an industrial area where no livestock is raised and there is no cultivation for producing foodstuffs, this requirement is not applicable.

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
	Liquid Effluent Monitoring		
a.	All liquid effluent streams **should*** be evaluated and their potential for release of radioactive material assessed. Based on this assessment, decisions **should*** be made regarding necessary effluent monitoring systems and the rationale **should*** be documented in the Environmental Monitoring Plan.	2.0	A 2.0
b.	Liquid effluents from DOE-controlled facilities that have the potential for radioactive contamination **should*** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	2.0	A
c.	Facility operators **should*** provide monitoring of liquid waste streams adequate to (1) demonstrate compliance with the requirements of DOE 5400.5, Chapter II, paragraphs 1a, 1d, 2a, and 3, (2) quantify radionuclides released from each discharge point, and (3) alert affected process supervisors of accidents in processes and emission controls.	2.1	A
d.	When continuous monitoring or continuous sampling is provided, the overall accuracy of the results **should*** be determined (±% accuracy and the % confidence level) and documented in the Environmental Monitoring Plan.	2.1	B
e.	Provisions for monitoring of liquid effluents during an emergency **should*** be considered when determining routine liquid effluent monitoring program needs.	2.1	A 5.5.6

NFSS EMP Summary Matrix

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
f. The selection or modification of a liquid effluent monitoring system **should*** be based on a careful characterization of the source(s), pollutant(s) (characteristics and quantities), sample-collection system(s), treatment system(s), and final release point(s) of the effluents.	2.2	A, B
g. For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of the monitoring or surveillance systems, a preoperational assessment **should*** be made and documented in the Environmental Monitoring Plan to determine the types and quantities of liquid effluents to be expected from the facility and to establish the associated effluent monitoring needs of the facility.	2.2	A, C
h. The performance of the effluent monitoring systems **should*** be sufficient for determining whether effluent releases of radioactive material are within the Derived Concentration Guides specified in DOE 5400.5 and to comply with the reporting requirements of Chapter II, paragraph 7, of that Order.	2.2	A
i. The required detection levels of the analysis and monitoring systems **should*** be sufficient to demonstrate compliance with all regulatory requirements consistent with the characteristics of the radionuclides that are present or expected to be present in the effluent.	2.2	A

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j.	Sampling systems **should*** be sufficient to collect representative samples that provide for an adequate record of releases from a facility, to predict trends, and to satisfy needs to quantify releases.	2.2.2	A, B
k.	Continuous monitoring and sampling systems **should*** be calibrated before use and recalibrated any time they are subject to maintenance, modification, or system changes that may affect equipment calibration.	2.2.3	B
l.	Sampling and monitoring systems **should*** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	2.2.3	B
m.	Environmental conditions (e.g., temperature, humidity, radiation level, dusts, and vapors) **should*** be considered when locating effluent monitoring systems to avoid conditions that will influence the operation of the system.	2.2.4	A, B
n.	Off-line liquid transport lines **should*** be replaced if they become contaminated (to the point where the sensitivity of the system is affected) with radioactive materials or if they become ineffective in meeting the design basis within the established accuracy/confidence levels.	2.2.4	A, B
o.	If continuous monitoring/sampling and recording of the effluent quantity (stream flow) are not feasible for a specific effluent stream, the extenuating circumstances **should*** be documented in the Environmental Monitoring Plan.	2.3.2	A, B 2.0

NFSS EMP Summary Matrix

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
p. Sampling/monitoring lines and components **should*** be designed to be compatible with the chemical and biological nature of the liquid effluent.	2.3.7	A, B
q. The output signal instrumentation, monitoring system recorders, and alarms **should*** be in a location that is continuously occupied by operations or security personnel.	2.4	B
r. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures from exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems are required, they **should*** have alarms set to provide timely warnings.	2.5	B
s. As they apply to the monitoring/sampling of liquid effluents, the general quality assurance program provisions described in Chapter 10 of this guide **should*** be followed.	2.6	A
Airborne Effluent Monitoring		
a. All airborne emissions from each facility (DOE site) **should*** be evaluated and their potential for release of radionuclides assessed. Based on this assessment, decisions **should*** be made regarding necessary effluent monitoring systems and the rationale **should*** be documented in the site Environmental Monitoring Plan. The potential for emissions **should*** include consideration of the loss of emission controls while otherwise operating normally.	3.0	B 5.3, entire section

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
b.	Airborne emissions from DOE-controlled facilities that have the potential for causing doses exceeding 0.1 mrem (effective dose equivalent) to a member of the public under realistic exposure conditions from emissions in a year **should*** be monitored in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	3.0	A
c.	The criteria for monitoring listed in Chapter 3 of this guide **should*** be used to establish the airborne emission monitoring programs for DOE-controlled sites.	3.1	A
d.	For all new facilities or facilities that have been modified in a manner that could affect effluent release quantity or quality or that could affect the sensitivity of monitoring or surveillance systems, a preoperational assessment **should*** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of airborne emissions to be expected from the facility, and to establish the associated airborne emission monitoring needs of the facility.	3.3	C
e.	The performance of the airborne emission monitoring systems **should*** be sufficient for determining whether the releases of radioactive materials are within the limits or requirements specified in DOE 5400.5.	3.3	5.1, ¶ 1
f.	Sampling and monitoring systems **should*** be calibrated before use and recalibrated any time they are subject to maintenance or modification that may affect equipment calibration.	3.3	A, B

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
g.	Sampling and monitoring systems **should*** be recalibrated at least annually and routinely checked with known sources to determine that they are consistently functioning properly.	3.3	A, B
h.	Provisions for monitoring of airborne emissions during accident situations **should*** be considered when determining routine airborne emission monitoring program needs.	3.3	5.3.6, ¶ 2
i.	Diffuse sources (i.e., area sources or multiple point sources in a limited area) **should*** be identified and assessed for their potential to contribute to public dose and **should*** be considered in designing the site emissions monitoring and environmental surveillance program. Diffuse sources that may contribute a significant fraction (e.g., 10%) of the dose to members of the public resulting from site operations **should*** be identified, assessed, documented, and verified annually.	3.3.2	A
j.	Airborne emission sampling and monitoring systems **should*** demonstrate that quantification of airborne emissions is timely, representative, and adequately sensitive.	3.4	A
k.	To the extent practicable, samples **should*** be extracted from the effluents from a location and in a manner that provides a representative sample, using multiport probes if necessary.	3.5.2	A, B
l.	Where a significant potential (greater than once per year exists for approaching or exceeding average fraction of the emission standard (e.g., 20%), continuous monitoring **should*** be required.	3.5.8	A, B

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
m. The design of radioiodine monitors will be such that replacement of sorbent and filter **should*** not disturb the geometry between the collector and detectors.	3.5.8.3	A, D
n. To signal the need for corrective actions that may be necessary to prevent public or environmental exposures exceeding the limits or recommendations given in DOE 5400.5, when continuous monitoring systems (as required by the criteria in Chapter 3) are required, they **should*** have alarms set to provide timely warnings.	3.6	B
o. As they apply to the monitoring of airborne emissions, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	3.7	5.3.5, ¶ 2
Meteorological Monitoring		
a. Each DOE site **should*** establish a meteorological monitoring program that is appropriate to the activities at the site, the topographical characteristics of the site, and the distance to critical receptors.	4.0	4.0, ¶ 1, 2, and 3
b. The scope of the program **should*** be based on an evaluation of the regulatory requirements, the meteorological data needed for impact assessments, environmental surveillance activities, and emergency response, considering the mathematical procedures, models, and input data requirements necessary for computing atmospheric transport and diffusion computations and performing dose assessments.	4.0	4.0, entire section

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c.	The program **should*** be documented in a meteorological monitoring section of the Environmental Monitoring Plan in compliance with DOE 5400.1.	4.0	4.0, entire section
d.	For data from an offsite source to be acceptable, the data **should*** be representative of conditions at the DOE facility and provide statistically valid data consistent with onsite monitoring requirements.	4.0	4.0, ¶ 2
e.	Specific meteorological information requirements for each facility **should*** be based on the magnitude of potential source terms, the nature of potential releases from the facility, possible pathways to the atmosphere, distances from release points to critical receptors, and the proximity of the site to other DOE facilities.	4.0	4.0, ¶ 3
f.	Meteorological information requirements for facilities **should*** be sufficient to support environmental monitoring and surveillance programs.	4.0	4.0, ¶ 3
g.	The meteorological monitoring program for each DOE site **should*** provide the data for use in atmospheric transport and diffusion computations that are appropriate for the site and application.	4.1.2	4.0, ¶ 2
h.	Before any model is deemed appropriate for a specific application, the assumptions upon which the model is based **should*** be evaluated and the evaluation results documented.	4.1.2	4.0, ¶ 4

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
i.	Meteorological programs for sites where onsite meteorological measurements are not required **should*** include a description of climatology in the vicinity of the site and **should*** provide ready access to representative meteorological data.	4.1.2	4.0, ¶ 2 and 3
j.	Potential release modes, distances from release points to receptors, and meteorological conditions **should*** be considered in assessments for DOE facilities required to take onsite measurements.	4.1.3	4.0, ¶ 3
k.	Meteorological measurements **should*** be made in locations that, to the extent practicable, provide data representative of the atmospheric conditions into which material will be released and transported.	4.4	4.0, ¶ 3
l.	The instruments used in the monitoring program **should*** be capable of continuous operation in the normal range of atmospheric conditions at the facility.	4.4	B
m.	Wind measurements **should*** be made at a sufficient number of altitudes to adequately characterize the wind at potential release heights.	4.4.1	A, B 4.0, ¶ 3
n.	If instruments are mounted on booms extending to the side of a tower, the booms **should*** be oriented in directions that minimize the potential effects of the tower on the measurements. The instruments **should*** be at least two tower diameters from the tower, but **should** be three to four tower diameters from the tower.	4.4.2	A, B

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
o.	The meteorological monitoring program **should*** provide for routine inspection of the data and scheduled maintenance and calibration of the meteorological instrumentation and data-acquisition system at a minimum, based on the calibration frequency recommendations of the manufacturers.	4.6	A, B
p.	Inspections, maintenance, and calibrations **should*** be conducted in accordance with written procedures, and logs of the inspections, maintenance, and calibrations **should*** be kept and maintained as permanent records.	4.6	A, B
q.	The instrument system **should*** provide data recovery of at least 90% on an annual basis for wind direction, wind speed, those parameters necessary to classify atmospheric stability, and other meteorological elements required for dose assessment.	4.6	A, B
r.	The topographic setting of a facility and the distances from the facility to points of public access **should*** be considered when evaluating the need for supplementary instrumentation.	4.7	4.0, ¶ 3
s.	If meteorological measurements at a single location cannot adequately represent atmospheric condition for transport and diffusion computations, supplementary measurements **should*** be made.	4.7	4.0, ¶ 3
t.	A site-wide meteorological monitoring program **should*** be established at each multi-facility site to provide a comprehensive data base that can be used for all facilities located within the site.	4.8	E

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
u. As they apply to meteorological monitoring, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	4.11	4.0, ¶ 4
Environmental Surveillance		
a. An evaluation **should*** be conducted and used as the basis for establishing an environmental surveillance program for all DOE-controlled sites. The purpose of the surveillance program is to characterize the radiological conditions of the offsite environs and, if appropriate, estimate public doses related to these conditions, confirm predictions of public doses based on effluent monitoring data, and, where appropriate, provide compliance data for all applicable regulations. The results of this evaluation **should*** be documented in the site Environmental Monitoring Plan.	5.0	1.0, ¶ 1 1.1, ¶ 1, 2, 3, and 4
b. The environmental surveillance program for DOE-controlled sites **should*** be conducted in accordance with the requirements of DOE 5400.1 and DOE 5400.5.	5.0	5.0, ¶ 1 5.1, ¶ 1
c. The criteria for environmental surveillance programs listed in Chapter 5 **should*** be used for establishing the environmental surveillance program for DOE-controlled sites. Additional site-specific criteria **should*** be documented in the site Environmental Monitoring Plan.	5.1	1.1, ¶ 1, 2, 3, and 4 5.1, ¶ 1

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d.	The need for environmental sampling and analysis **should*** be evaluated, by exposure pathway analysis, for each site radionuclide effluent or emission (liquid or airborne). This analysis with appropriate data, references, and site-specific assumptions, along with site-specific criteria for selection of samples, measurements, instrumentation, equipment, and sampling or measurement locations **should*** be documented in the site Environmental Monitoring Plan.	5.1.1	5.1, entire section
e.	A critical pathway analysis (radionuclide/media) **should*** be performed, documented, and referenced in the Annual Site Environmental Report.	5.1.1	5.1, ¶ 10
f.	If the projected dose equivalent from inhalation of particulates exceeds the criteria of Chapter 5, particle-size analysis of the emission **should*** be conducted at least annually.	5.1.1	A 5.1, ¶ 8
g.	Further provisions **should*** be made, as appropriate, for the detection and quantification of unplanned releases to the environment of radioactive material, including radionuclides that may be transported by stormwater runoff, flooding, or resuspension of ground-deposited material.	5.1.2	5.2.6, ¶ 2 5.3.6, ¶ 2 5.5.6
h.	For all new or modified facilities coming on-line, a preoperational assessment **should*** be made and documented in the site Environmental Monitoring Plan to determine the types and quantities of effluents to be expected from the facility and to establish the associated environmental surveillance program.	5.2	A, C
i.	Calibration of dosimeters and exposure-rate instruments **should*** be based on traceability to NIST standards.	5.2	5.2.4, ¶ 1

NFSS EMP Summary Matrix

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j.	Gross radioactivity analyses **should*** be used only as trend indicators, unless documented supporting analyses provide a reliable relationship to specific radionuclide concentrations or doses.	5.2	5.2, ¶ 1
k.	The overall accuracy (±% accuracy) **should*** be estimated, and the approximate Environmental Detection Limit at a specified % confidence level for environmental measurements of beta-gammas, alphas, and neutrons, as appropriate, **should*** be determined and documented.	5.2	5.2.4, ¶ 1
l.	Sample preservation methods **should*** be consistent with the analytical procedures used.	5.2	6.1.3
m.	All environmental surveillance techniques **should*** be designed to take a representative sample or measurement of the important radiation exposure pathway media.	5.2	5.1, ¶ 2
n.	Sampling or measurement frequencies for each significant radionuclide or environmental medium combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) **should*** take into account the half-life of the radionuclides to be measured and **should*** be documented in the site Environmental Monitoring Plan.	5.2.1	1.4, ¶ 1
o.	"Background" or "control" location measurements **should*** be made for every significant radionuclide and pathway combination (e.g., those contributing 10% or more to offsite dose greater than 0.1 mrem EDE from emissions in a year) for which environmental measurements are used in the dose calculations.	5.2.1	1.1, ¶ 4 5.2.2, ¶ 1 and 3 5.3.2, ¶ 2 5.4.2, ¶ 9 and 12 5.5.2, ¶ 3

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
p.	An annual review of the radionuclide composition of effluents or emissions **should*** be made and compared with those used to establish the site Environmental Monitoring Plan. Any deviations from routine environmental surveillance requirements, including sampling or measurement station placement, **should*** be documented in an approved revised site Environmental Monitoring Plan.	5.2.1	5.1, ¶ 10 7.1.4, ¶ 6
q.	The air sampling rate **should*** not vary by more than ±20% and total air flow or total running time **should*** be indicated; air sampling system **should*** be leak-tested, flow-calibrated, tested, and inspected on a routine basis at a minimum, using the calibration frequency recommendations of the equipment manufacturers.	5.2.2	A, B
r.	State and local game officials **should*** be consulted when selecting appropriate protected species to sample.	5.2.3	F 5.1, ¶ 8
s.	DOE Field Office and contractor staff **should*** ensure that groundwater monitoring plans are consistent with state and regional EPA groundwater monitoring requirements under RCRA and CERCLA to avoid unnecessary duplication. DOE Field Office and contractor staff **should*** consult with state and regional EPA offices, as needed, to ensure that the requirements are incorporated into the Radiological Monitoring Plan.	5.2.4	5.4, ¶ 1
t.	Any changes in the site-specific or generic factors **should*** be noted in the Environmental Monitoring Plan and the retired or replaced values preserved for historical purposes.	5.3.2	5.1, ¶ 10

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
u.	When neutron monitoring is required, the method of measurement **should*** be based on the anticipated flux and energy spectrum.	5.6.2	G
v.	The sample exchange frequency for non-particulate sampling **should*** be determined on a site-specific basis and **should*** be documented in the environmental surveillance files.	5.7.5	5.3.3, ¶ 1 and 2
w.	The analytical procedure to be used **should*** be considered when choosing a method for preserving milk samples.	5.8.2.1	H
x.	As they apply to environmental surveillance activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	5.10	5.2.5, ¶ 2 5.3.5, ¶ 2 5.4.5, ¶ 2 5.5.5
	Laboratory Procedures		
a.	Laboratory procedures and practices **should*** be documented in the site Environmental Monitoring Plan.	6.0	6.1, ¶ 1
b.	Each monitoring and surveillance organization **should*** have a sample identification system that provides positive identification of samples and aliquots of samples throughout the analytical process. The system **should*** incorporate a method for tracking all pertinent information obtained in the sampling process.	6.1.1	6.1.1, ¶ 1 and 2

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c.	Each laboratory **should*** establish and adhere to written procedures to minimize the possibility of cross-contamination between samples. High-activity samples **should*** be kept separate from low-activity samples.	6.1.2	6.1.3, entire section
d.	The integrity of samples **should*** be maintained (i.e., minimize degradation of samples by using proper preservation and handling practices that are compatible with analytical methods.	6.1.2	6.1.3
e.	Specific analytical methods **should*** be identified, documented, and used to identify and quantify all radionuclides in the facility inventory or effluent that contribute 10% or more to the public dose or environmental contamination associated with the site.	6.1.3	6.1.2, ¶ 1
f.	Standard analytical methods **should*** be used for radionuclide analyses (when available). Any modification of standard methods **should*** be documented.	6.1.3	Table 6-1
g.	Methods, requirements, and necessary documentation **should*** be specified in analytical contracts.	6.1.3	6.0, ¶ 1
h.	All sites that release or could release gamma-emitting radionuclides **should*** have the capability (either in-house or outside) of having samples (routine, special, or emergency) analyzed by gamma-ray spectroscopy systems.	6.1.4	Table 6-1 6.1.2, ¶ 4
i.	Counting equipment **should*** be calibrated using, at a minimum, the calibration frequency recommendations of the manufacturers to obtain accurate results.	6.1.5	6.1.4, ¶ 1, 2, and 3

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
j. Check sources **should*** be counted periodically on all counters to verify that the counters are giving correct results.	6.1.5	6.1.4, ¶ 2
k. Samples that are sent offsite for analysis or for laboratory intercomparison **should*** be monitored for contamination and radiation levels and **should*** be packaged in a manner that meets applicable transportation regulations and requirements.	6.2.2	6.1.1, ¶ 3
l. As they apply to laboratory procedures, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	6.13	6.2, ¶ 1
Data Analysis and Statistical Treatment		
a. The statistical techniques used to support the concentration estimates, to determine their corresponding measures of reliability, and to compare radionuclide data between sampling and/or measurement points and times **should*** be designed with consideration of the characteristics of effluent and environmental data.	7.0	7.1, entire setion
b. Documented and approved sampling, sample-handling, analysis, and data-management techniques **should*** be used to reduce the variability of results.	7.0	7.0, ¶ 3
c. The level of confidence in the data due to the radiological analyses **should*** be estimated by analyzing blanks and spiked pseudo-samples and by comparing the resulting concentration estimates to the known concentrations in those samples.	7.1	7.1.1, ¶ 1 and 2 7.1.2 7.1.3

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d.	The precision of radionuclide analytical results **should*** be reported as a range, a variance, a standard deviation, a standard error, and/or a confidence interval.	7.1	7.1.2, ¶ 2
e.	Data **should*** be examined and entered into the data base promptly after analysis.	7.1	7.1.4, ¶ 1 and 2
f.	Outliers **should*** be excluded from the data only after investigation confirms that an error has been made in the sample collection, preparation, measurement, or data analysis process. As each data point is collected, it **should*** be compared to previous data, because such comparison can help identify unusual measurements that require investigation or further statistical evaluation.	7.1	7.1.4, ¶ 4
g.	As they apply to data analysis and statistical treatment activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	7.7	7.2, ¶ 2
Dose Calculations			
a.	Except where mandated otherwise (e.g., compliance with 40 CFR Part 61), the assessment models selected for all environmental dose assessments **should*** appropriately characterize the physical and environmental situation encountered. The information used in dose assessments **should*** be as accurate and realistic as possible.	8.1.1	4.0, ¶ 2 8.1, ¶ 1
b.	Complete documentation of models, input data, and computer programs **should*** be provided in a manner that supports the annual site environmental report or other application.	8.1.1	8.3, entire section

	High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
c.	Default values used in model applications **should*** be documented and evaluated to determine appropriateness to the specific modeling situation.	8.1.2	4.0, ¶ 3 8.3.2, ¶ 3
d.	When performing human foodchain assessments, a complete set of human exposure pathways **should*** be considered, consistent with current methods, and **should*** be documented supporting the site Environmental Monitoring Plan.	8.1.2	H 5.1, ¶ 3 and 8 8.2, ¶ 5
e.	Surface- and groundwater modeling **should*** be conducted as necessary to conform with the applicable requirements of the state government and the regional office of the EPA.	8.1.2	5.1, ¶ 6 8.2, ¶ 4
f.	The general quality assurance program provisions of Chapter 10 of this guide **should*** be followed as they apply to performing calculations that assess dose impacts.	8.7	8.4
Records and Reports			
a.	DOE officials and DOE Management and Operating Contractors **should*** identify and comply with the relevant reporting requirements.	9.0	9.0, entire setion
b.	Timely notification of occurrences and information involving DOE and its contractors **should*** be made to the appropriate DOE officials and to other responsible authorities.	9.0	9.0, ¶ 2
c.	Auditable records relating to environmental surveillance and effluent monitoring **should*** be maintained. Calculations, computer programs, or other data handling **should*** be recorded or referenced.	9.0	9.0, ¶ 2 9.1, bullet 2

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
d. As they apply to records and reporting activities, the general quality assurance program provisions of Chapter 10 of this guide **should*** be followed.	9.3	9.2, last ¶
Quality Assurance		
a. A QA Plan **should*** be prepared and included as a section of the Environmental Monitoring Plan and **should*** cover the monitoring activities at each site, consistent with applicable elements of the 18-element format in ANSI/ASME NQA-1.	10.0	10.1
b. Periodic audits **should*** be performed to verify compliance with operational procedures, QC procedures, and all aspects of the QA program.	10.1.2	10.3.1, ¶ 2 10.4, ¶ 1 and 2
c. Audits **should*** be performed independently in accordance with written procedures or checklists by personnel who do not have direct responsibility for performing the activities being audited (i.e., supervisors cannot audit their own facilities).	10.1.2	10.4, ¶ 1
d. Audit results **should*** be documented and reported to and reviewed by responsible management. Follow-up action **should*** be taken where indicated.	10.1.2	10.4, ¶ 2
e. The elements of a QA program **should*** be derived from the 18 criteria in ANSI/ASME NQA-1 and those stipulated in 10 CFR Part 50.	10.1.3	10.1

High-Priority Element	Regulatory Guide Section	EMP Section or Justification Code
f. Radiation measuring equipment, including portable instruments, environmental dosimeters, in situ monitoring equipment, and laboratory instruments, **should*** be calibrated with standards traceable to NIST calibration standards.	10.3.2	10.6

APPENDIX B

Comparison of the Scope of Environmental Monitoring at NFSS (1991 Versus 1992)

APPENDIX B

NIAGARA FALLS ENVIRONMENTAL MONITORING

	1991 FREQUENCY	1991 LOCATIONS	1991 ANALYSES/YR* or MEASUREMENTS/YR	1992 FREQUENCY	1992 LOCATIONS	1992 ANALYSES/YR* or MEASUREMENTS/YR	RATIONALE (EMP SECTION)
GROUNDWATER SAMPLING							
RADIOLOGICAL PARAMETERS		47	461		19	51	
Ra-226	Quarterly			Annually			5.4.2
Total uranium	Quarterly			Annually			
Isotopic uranium (1 well)	Quarterly			Annually			
CHEMICAL PARAMETERS		47	1056		19	108	
TOX	Quarterly			Annually			5.4.3
TOC	Quarterly			Annually			
ICPAES (6 metals)	Quarterly			Annually			
AA (mercury)	Quarterly			Annually			
GEOLOGICAL PARAMETERS		64	1664		64	256	
Water Level Measurements	Biweekly			Quarterly	(Plus 9 automatic well recorders)		5.4.2
SURFACE WATER SAMPLING							
RADIOLOGICAL PARAMETERS		5	72		5	12	
Ra-226	Quarterly			Annually			5.5.2
Total uranium	Quarterly			Annually			
SEDIMENT SAMPLING							
RADIOLOGICAL PARAMETERS		5	72		5	18	
Ra-226	Quarterly			Annually			5.5.2
Isotopic uranium	Quarterly			-			
Total uranium	-			Annually			
FIELD MONITORING							
PARAMETERS		47	188		24 (2 each)	96	
Gamma radiation	Quarterly			Semiannually			5.2.3
RADON MONITORING							
PARAMETERS		47	188		26	104	
Radon + daughters	Quarterly			Quarterly			5.3.2

* Includes QC samples.