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Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for Maywood, New Jersey

U.S. Department of Energy

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Bechtel

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U.S. Department of Energy
Oak Ridge Field Office
P.O. Box 2001
Oak Ridge, TN 37831-8723

Attention: Lester K. Price, Director
Former Sites Restoration Division

Subject: Publication of the Environmental Monitoring Plans

Dear Mr. Price:

Enclosed are five copies of environmental monitoring plans (EMPs) for each of the following sites:

- Colonie Interim Storage Site
- Hazelwood Interim Storage Site
- Wayne Interim Storage Site
- Niagara Falls Storage Site
- Middlesex Sampling Plant
- Maywood Interim Storage Site
- New Brunswick Laboratory Site

Two sets are for distribution to SAIC, one copy of each EMP is for the appropriate site managers, one set is for the FSRD library, and one set is for DOE-Headquarters. This distribution is based on a telecon with Steve Oldham on November 14 (CCN 082865). Also enclosed is the resolution package for DOE-Headquarters' comments on the EMPs for SLAPS and CISS. Per direction from Mr. Oldham as confirmed with Libby Gilley of our office on December 2, the SLAPS EMP will be finalized as a surveillance plan and provided to you at a later date.

These plans and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that the information submitted was properly gathered and evaluated. To the best of my knowledge and belief, they are true, accurate, and complete.

If you have any questions, please call me at 576-1699 or J. D. Fletcher at 576-5207.

Very truly yours,

G. K. Hovey
Program Manager - FUSRAP

GKH:bjb:LR_0417

Enclosures

Concurrence: J. D. Fletcher @ ______ M. A. Southern ______
G. P. Crotwell ______

cc: J. G. Hart, Jr., w/o
G. S. Hartman, w/o
S. K. Oldham, w/o
W. M. Seay, w/o

**Comment Resolutions for DOE-Headquarters'
Generic Comments on Environmental Monitoring Plans
Based on the Draft (9/26/91) SLAPS Plan**

General

1. The plan does not maintain a balanced approach to the potential radioactive versus chemical contaminants (and, also, physical conditions, such as meteorology and location and magnitude of populations). Although the entire plan should be examined and edited to restore the balance, here are a couple of examples:

   - Page 1, Section 1.1 Make a better transition between the first and second paragraph. While "potential contaminant" is neutral, the reference to only the radiological regulatory guide (DOE 1991) is unbalanced. Instead refer to Order 5400.1 initially; then refer to the regulatory guide as a supplemental guidance for the radiological aspects.

     Response: An introductory sentence was added to page 3, first complete paragraph, stating that in support of DOE Orders 5400.1 and 5400.5, this EMP will address chemical and radiological contaminants. However, at the present time Manhattan Engineer District (MED) and Atomic Energy Commission (AEC) chemicals are not a concern at SLAPS.

   - Page 17, Section 5.1 In a paragraph near the bottom of the page, the "chemical indicator parameters" in groundwater are discussed, (and water level is discussed in 5.4.2), they are not addressed in the Appendix B, which summarizes the environmental monitoring.

     Response: Geological parameters were added to Appendix B. After 1991, indicator parameters will not be monitored.

2. The plan does not systematically and consistently identify and provide sampling rationale for the radiological "potential contaminant release pathways" (Section 1.1). Particularly Chapter 5 (Environmental Surveillance--starts on page 15) and Chapter 8 (Dose Calculations--starts on page 58) need to use consistent terminology and to ensure that all pathways are accounted for. Once the terms are chosen, make a complete list of the pathways. Use the list both to introduce and revisit through out the plan. Ensure a formal analysis of all pathways in one section of the plan. Some examples can illustrate this concern about being systematic and consistent:

   Response: Consistency of terms has been checked. All pathways have been accounted for.

- <u>Page 15, Section 5.1</u> The discussion "to identify the potential migration pathways" does not use the same terminology as the related Figure 5-1. The four "pathways" listed in the text are closest, but not identical, to the four pathways listed under "environmental transport medium" in the figure.

  Response: Figure 5-1 has been modified.

- <u>Page 16, Figure 5-1</u> This figure of the exposure pathway analysis for the site does not account for all pathways. It should present all the pathways and identify those applicable for the site. When the figure is complete, the "invalid exposure mechanisms" of page 17 would be easier to identify.

  Response: Figure 5-1 has been modified.

- <u>Page 58, Section 8.2</u> The discussion begins by listing *five* "environmental media." However, by the next page, the discussion has reduced them to only two. In the subsequent paragraphs the discussion refers to some previously listed as well as others not listed (e.g., foodchain). Then before accounting for all pathways, the text says that "the combined effect from all pathways" will be summed for the next total dose.

  Also, it would seem appropriate in Chapter 8 to be able to refer to principal receptors depicted in Figure 5-1.

  Response: This section has been modified to list four "environmental media," and the negation of some possible pathways is explained before the statement is made that "the combined effect from all pathways" will be summed.

- <u>Page 12, Appendix A.</u> Item e, "critical pathway analysis," which is cross referenced to Section 5.1, emphasizes the need to make this pathway analysis rather formal and complete. The ASERs have rightly indicated that the plan would contain the full analysis.

  Response: Two additions have been made to Section 5.1 to make the pathway analysis more complete, and Figure 5-1 has been modified.

3. The plan properly gives a great deal of attention to sampling and laboratory analysis with respect to quality assurance (QA). However, attention to other functions is still needed whenever QA is addressed. In addition, there are four areas (DOE 1991 page 10-4) that need better coverage in Chapter 10:

   - Data management and calculations (particularly post-laboratory evaluation and interpretation of data)

- Transport and pathway modeling
- Dose calculations (e.g. software QA, input currency, input accuracy)
- Review and reporting results

Response: Section 10.7 (Data Management) was added to the EMP, and Section 8.0 has been revised to reflect better coverage of the topics above.

4. Refer to the sources of all figures and tables. In the text, reference all sources of information that will be used for making assessments (e.g. populations, locations of public water intakes).

   Response: References have been added to the figures and tables that were taken or adapted from other documents. References were not added to the figures and tables that were generated for the EMPs.

5. This plan is to keep a record of changes in environmental monitoring as well as present practices (Item t on page 14 and Item f on page 16, Appendix A). Make sure the plan identifies changes already made over the years. Establish what procedures will be followed to establish comparability, where possible, if a sampling location (nearby or background) will be moved. Likewise, identify changes in sampling or analytical methods and associated comparability analyses (e.g., new technique for direct gamma radiation).

   Response: The current EMP does not include pre-1991 historical data nor procedures because this information may be found in the ASERs.

   - Page 23, Subsection 5.2.4 Supposing that the presently-used TETLD method replaced an earlier method used at the site, then the text and/or related tables (Appendix B?) should capture the fact. Of course, the results of any comparability analyses should be presented.

     Response: If a method is replaced, the text will be modified during the annual review of the EMP.

6. The frequency of sampling is described well for all samples and measurements. However, more information about sampling time is needed. Describe each as a grab or instantaneous sample, an integrated sample (continuous or discontinuous), or as a composite sample. Describe the averaging or integration time for non-grab samples or measurements.

   Response: Sampling time information has been added to the text.

7. The traditional field sampling is obvious and also summarized in the table of Appendix B. However, other measurements and needed data and their sources are not thoroughly addressed. Some examples:

   - Population and land use data (page 3)-- needed for pathway analysis and dose estimation. For example, population out beyond 1 km might be based on the decade census data, but within 1 km, on an annual walk-by and a conversation with the city planner.

     Response: Population data are based on decade census.

   - Offsite groundwater wells accessible to the public (page 59).

     Response: Information about groundwater wells accessible to the public may be found in the ASER.

   - Joint frequency distributions of wind and atmospheric stability (page 14).

     Response: Section 4.0 concerning meteorology has been rewritten to address this comment and specific comment No. 1 (below).

Specific

1. <u>Page 14, Chapter 4.0</u> The discussion of meteorology needs to address all the issues identified in Order 5400.1 and the regulatory guide DOE 1991.

   - Identify exactly what parameters are required and for what use.

   - Specify whether the data need to be concurrent to the year or long term (climatological).

   - Describe what sampling time is needed (e.g., instantaneous grab, 15-minute average, one-hour average).

   - Specify whether the data need to be statistical information or sequential individual observations. For example, is the average wind speed needed, or the speed every hour of the year, or the frequency distribution in conjunction with one or more other parameters?

   - Given the specific requirements of the data (first four bullets, here) either demonstrate that available offsite data are representative or specify an onsite monitoring program.

Response: Section 4.0 has been rewritten to address these concerns.

2. Page 28, Subsection 5.3.3 Clarify that the detector is to be left out for the entire quarter to determine an integrated average *over* the quarter.

   Response: The last sentence in the section was deleted and two sentences were added: "Sampling will be conducted quarterly. The detectors will remain at the sampling locations for the entire quarter to determine integrated average radon concentrations over the quarter."

3. Page 28, Subsection 5.3.5 Consider also using a "ship" or "field blank" detector as part of QA for the radon surveillance program as is being done for the gamma-radiation program.

   Response: The procedures for radon detectors is different than those for TETLDs. Therefore, the only insurance for the radon detectors is to seal them in Tedlar bags and check them if the bag has been damaged. A "ship" or "field blank" would yield no useful QA information.

4. Page 54, Subsection 7.1.4 Some clarification on data evaluation is needed.

   - The middle paragraph on page 55 begins with "Analytical results..." and seems to be introducing the review of individual data points before being collected into a statistic (e.g., an average). Make the last sentence, "As each data..." the next-to-last sentence, and add some examples of unusual results to the sentence.

     Response: Unusual results will be discussed in the ASERs as they occur.

   - In this same paragraph, the third sentence, "Outliers will be excluded...," refers to abnormally high or low values. Include in the discussion the methods of identification and treatment of other suspect data points besides "outliers," such as temporal irregularities, unexpected rates of change from previous values, and disparity with values at neighbor locations.

     Response: The following sentence was added: "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."

- The next paragraph, "Standard deviations...," appears to address the portion of evaluation dealing with statistically-combined data. Insert a lead sentence to the paragraph that explains this and transitions from the individual data points.

  Response: The following sentence was added: "Annual averages will be determined for all locations from the individual data points."

- The last sentence of the last paragraph on page 55 explains that the standard deviations will be based on "data from the past five years." Insert "historic" before "data" so that it is clear that current-year data should not be used in calculating the standard deviation.

  Response: The word 'historic' has been inserted.

- The last paragraph of the section begins with "Current annual values..." Add to the discussion some other suspect characteristics besides outliers, such as runs and periodicities. Discuss the use of moving averages as a tool in assessment.

  Response: The following sentences were added: "Seasonal variations (periodicities) and contaminant concentration averages will be examined when needed. If necessary, running averages will be conducted using data from previous years for comparative purposes."

5. <u>Page 57, Section 7.2</u> In the discussion of QC samples, explain how the results of the QC samples will be used. Explain what would happen to all the sample data that might be associated with an unexpected result in a QC sample.

   Response: The following sentence was added to paragraph 3: "If a QC sample is contaminated, all the samples associated with that QC sample will be reviewed by an independent reviewer to determine whether the sample results can be used with appropriate annotation."

6. <u>Page 57, Section 7.2</u> In this discussion of QC samples include the "ship" or "field blank," such as used for TETLDs (page 24) or radon detectors.

   Response: The following sentence was added as the last paragraph: "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."

7. Page 58, Section 8.1 This discussion of performance standards for public dose calculations needs to be reorganized. Focus on the (1) how and (2) why. For example, explain that one of the reasons for performing "dose calculation" [(chapter title) estimates is that usually offsite concentrations are too low to measure (DOE 1991, Section 8.0)] in order to demonstrate compliance with performance standards. Actually, this Section 8.1 might better be integrated into the introduction (Section 8.0) to the chapter. Delete reference to specific models at this point. However, do specify the comparative performance standards that will be used.

   Response: This section was revised.

8. Page 58, Section 8.2 Retitle the section to "Pathways." The discussion of pathways in this section should correspond to Chapter 5. If appropriate, refer to Chapter 5 for complete pathway analysis, and just summarize the results (but do not account for all pathways).

   Response: The section title has been modified to read "Pathways," and minor modifications have been made to ensure that this section more readily follows information presented in Section 5.0.

   The 1st paragraph was modified to include potential pathways at SLAPS and to include the sentence: "As stated in Section 5.0, the potential pathways at SLAPS are radioactive particulate transport via the atmospheric pathway, surface water and sediment, groundwater and direct exposure to external gamma radiation (Table 5.1)." Radiological input data, dose calculations and modeling, assumptions, and comparisons with DOE guidelines are concisely reported in the ASER. A sentence was added to paragraph 5: "If future information indicates that livestock or foodstuffs are cultivated in the area, these exposure routes will be reconsidered."

9. Page 59, Section 8.3 This discussion of the dose calculation method needs text for Section 8.3 prior to 8.3.1. Begin with a tie to the previous section, the concept of summing doses over all pathways (pull in the sentence from the very end of 8.3.2), and introduction of the models to be used. Include a table that summarizes all pathways, those applicable for the site, the model to be applied for each, and the performance standard to apply to each (alone or in combination with other pathways). This table would, in turn, have direct applicability to the summary table of calculated doses that are required in the ASER. Include sufficient detail to be able to differentiate, for example, radon gas versus particulate in the air pathway because of differing comparative standards.

Response: The following sentences were added to the introductory paragraph: "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."

With the changes made in Table 5-1 and the information provided in Section 8.3, the intent of the request for a table summarizing pathways, models, and performance standards has been met.

10. Page 59, Subsections 8.3.1, etc. These subsections address the calculation method for a specific pathway. If a computer program, rather than a hand calculation, is being employed for the chosen model, make sure the text addresses all aspects of the program (Item b, page 18, Appendix A from the reg guide). As last year's ASER's implied and Section 8.1 states, evaluate and document the appropriateness of all values (including default) used in the calculations. Add a table or an appendix, if a text description is not ideal. Be sure to address special site-specific complications, such as intervening contaminated material from the source between the site source and the offsite receptor [e.g. the relatively-high contamination in the ditches between the SLAPS and the receptor on the ball field (page 59)].

    Response: The following information was added as the final paragraph of Subsection 8.3.2: "Atmospheric particulate release rates, used in the AIRDOS model, are determined by using an unlimited wind erosion model (EPA 1985) for the site and soil concentration values obtained during 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."

11. Page 59, Section 8.2 For this industrial setting, address the potential for employee food gardens on adjacent or nearby properties in the pathway analysis.

    Response: A sentence has been added to clarify this.

12. Page 70, Section 10.5 Rather than part of a lower-level sampling procedure, the "document evaluations of the parameters and modeling used in selecting locations" are supposed to be part of the environmental monitoring plan. Reword the first paragraph to reflect this.

    Response: The sentence "These procedures will include documented evaluations of the parameters" has been deleted.

Readability

1. Page 43, Figure 5-9 This figure of offsite surface water locations also includes the background locations. One might consider a key or table inset to identify the start and end dates at each location.

   Response: We feel this information is unnecessary because it has been provided in the ASERs.

2. Various types of sample locations are described in the text for each part of the monitoring program. However, in order to get a physical picture, the reader has to try and locate each individual sampling station in the related figure. It would be useful to differentiate the types of sampling location (background, up-gradient, down-gradient, etc.).

   Response: This comment will be taken under consideration for incorporation in the 1991 ASERs. The text in the EMP provides information concerning the types of sampling locations.

3. Page 17, Section 5.1 A short paragraph in the middle of the page states that before now, there was no formal plan (I suspect we had substantial parts, however). Consider the following substitution. Instead of keeping it a one-sentence paragraph, make it the lead in of the next paragraph that describes when the site monitoring program was initiated in 1981.

   Response: Text has been revised to state: "Although this EMP was prepared in 1991, the environmental monitoring program at SLAPS has been evolving for some time."

4. Page 20, Table 5 This table gives the initial, observed, exposure rates used to choose the gamma monitoring locations. It would be more useful to isopleth those values over the monitoring locations depicted in Figure 5-2.

   Response: We do not have enough information for isopleths.

5. Page 58, Section 8.0 The second sentence describes the three components of the site-specific evaluation for the site. However, a subsequent sentence is needed to tell where the reader can find discussions of these three components. The components do not relate to the organization of the chapter. Include a discussion of how the chapter is organized.

   Response: This section was rewritten.

6. Page 70, Section 10.5 A variety of terms are used to describe the documentation for the control of field sampling and monitoring activities (procedures, guides, detailed plan). Select a uniform description if there is only one form, or differentiate the documentation if there are no more than one form of documentation.

Response: The text has been modified to reflect the use of one term.

Comment Resolutions for Supplemental DOE-Headquarters' Generic Comments on Environmental Monitoring Plans Based on the Draft (9/27/91) Colonie Plan

General

1. Chapter 2 on liquid effluent monitoring should have better consistency with the rest of the report. Expand the discussion to address the following issues:

    - The holding and testing of liquids at CISS for batch release to the Albany Company treatment plant to satisfy the requirements of Order 5400.1.

    - The matter of stormwater discharge, which is addressed elsewhere in the report (e.g., page 37).

    Response : Section 2.0 on liquid effluent monitoring has been revised to address the issue of all liquids generated within the building and disposal to the Albany County Sewer District through a commercial water hauler.

    The discussion of stormwater discharge has been revised in Subsection 5.5.2, Sampling Location Rationale on page 40.

2. The anticipated airborne effluents described in Chapter 3 are not tied to the pathway exposure assessments in the rest of the plan. Include a description of how the effluent data will be used and reported (e.g., comparative standards, dose assessments) apart from the realtime, onsite use. Apply the same concepts to liquid effluents described in Chapter 2.

    Response: Section 3.0 has been revised to reflect sampling to be conducted during remedial actions planned for the site in the coming year.

3. The components of the sections in Chapter 7 should be consistent in all monitoring plans as well as with higher-level plans for FUSRAP such as those for environmental protection implementation and for quality assurance. Some examples of components are "completeness", "method blank", and Table 7-1, in Sections 7.1 and 7.2, which was not included for SLAPS.

    Response: Section 7.0 has been revised to achieve consistency throughout all EMPs. Section 7.2 contains site-specific information, based on the sampling regime described in Section 5.0.

Specific

1. Page 61, Subsection 8.2.3 This discussion in the CISS plan discusses the use of AIRDOS to estimate doses to airborne particulates at the site. However, the previous page states that under normal conditions "atmospheric particulates do not constitute a viable pathway." Furthermore on page 27 in Section 5.3, it is stated that monitoring will be performed for airborne particulates because wind erosion is "unlikely". But in Section 5.1 (page 17), surface soils are identified as an applicable ("potential") source at CISS, although the text is silent with regard to the air pathway. The plan should account for any apparent conflicts.

   Response: Subsection 8.2.3 has been revised to reflect consistency with Subsections 5.1 and 5.3.

2. Page 63, Subsection 8.3.3 In the discussion of groundwater, state the basis and value for the estimated dilution factor, D.

   Response: Subsection 8.3.3 has been deleted.

3. Page 68, Section 9.2 Bulletize topics for TSCA and NESHAPs discussions to be consistent with other EMPs. With respect to NESHAPs, use subbullets for each of the following:

   - Subpart H
   - Subpart M
   - Subpart Q

   Response: Text in Section 9.2 has been expanded to include additional discussion of TSCA and NESHAPs (although NESHAPs topics were not bulletized).

4. Page 28, Subsection 5.4.2 In the last paragraph the "current understanding of the groundwater flow conditions" is discussed. Provide the reference where a detailed analysis and description may be found.

   Response: This information is based on the CISS remedial investigation report and previous ASERs.

5. Page 37, Subsection 5.5.2 At the top of the page, change "fiscal year" information to "calendar year" information.

   Response: The term "fiscal year" was left in place because site planning is conducted on a fiscal cycle.

6. Page 37, Subsection 5.5.2 In the discussion of stormwater discharge (bottom of page) state the results of the evaluation, such as what monitoring might be conducted.

   Response: The text has been revised to state that analytical parameters and sampling methods will be in accordance with EPA guidelines and DOE Order 5400.1.

Readability

1. Page 20, Section 5.1 The last sentence of this section states that the following section will establish the plan for monitoring "these" pathways. Describe what the grouping "these" represents and list the components of the grouping in the order that they appear in the following sections.

   Response: Because the text preceding the last paragraph expands on the pathways, the sentence was revised to state: "The following sections establish the plan for monitoring the aforementioned pathways."

DOE/OR/21949-310

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

ENVIRONMENTAL MONITORING PLAN FOR THE MAYWOOD INTERIM STORAGE SITE

Maywood, New Jersey

November 1991

Bechtel National, Inc.

4.83 8814.3

DOE/OR/21949-310

ENVIRONMENTAL MONITORING PLAN
FOR THE MAYWOOD INTERIM STORAGE SITE
MAYWOOD, NEW JERSEY

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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FIGURES

TABLES

ACRONYMS

AEC	Atomic Energy Commission
ASER	annual site environmental report
ASTM	American Society for Testing and Materials
BNI	Bechtel National, Inc.
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chain of custody
CWA	Clean Water Act
DCG	derived concentration guideline
DI	deionized
DOE	Department of Energy
DQO	data quality objective
EIS	environmental impact statement
EML	Environmental Measurements Laboratory
EMP	environmental monitoring plan
EPA	Environmental Protection Agency
FR	Federal Register
FUSRAP	Formerly Utilized Sites Remedial Action Program
ICPAES	inductively coupled plasma atomic emission spectrophotometry
ID	identification
MAP	mitigation action plan
MCW	Maywood Chemical Works
MEI	maximally exposed individual

ACRONYMS
(continued)

MISS	Maywood Interim Storage Site
NCR	nonconformance report
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NJDEP	New Jersey Department of Environmental Protection
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NS&W	New York, Susquehanna, and Western
PCB	polychlorinated biphenyl
PMC	project management contractor
PQAS	project quality assurance supervisor
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RPD	relative percent difference
SRM	standard reference material
TETLD	tissue-equivalent thermoluminescent dosimeter
TMA/E	Thermo Analytical/Eberline
TOC	total organic carbon

ACRONYMS
(continued)

TOX	total organic halides
TPH	total petroleum hydrocarbons

UNITS OF MEASURE

cm	centimeter
ft	foot
g	gram
gal	gallon
h	hour
ha	hectare
km	kilometer
L	liter
m	meter
mi	mile
mg	milligram
ml	milliliter
μg	microgram
μmhos	micromhos
μR	microroentgen
mR	milliroentgen
mrem	millirem
pCi	picocurie
ppb	parts per billion
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 Maywood Interim Storage Site (MISS), effective January 1, 1992. MISS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a Department of Energy (DOE) 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 to ensure that the public and 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 unplanned releases and 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 DOE Orders 5400.1 and 5400.5), 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 MISS. These three elements of the program implement the

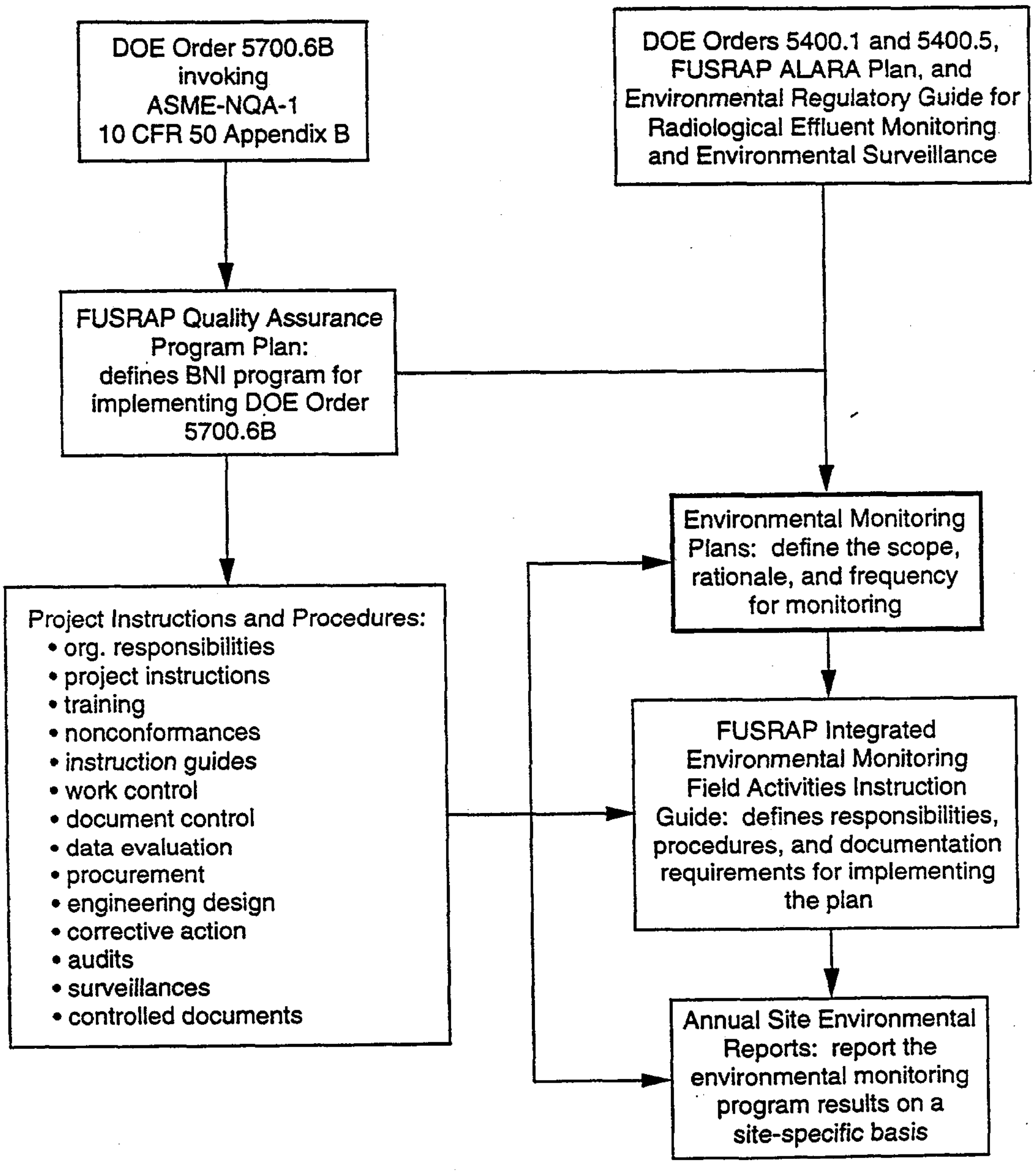


Figure 1-1
Relationship Among Environmental Monitoring Program Elements

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 1990a). 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:

- Ensure compliance with applicable environmental regulations
- Adequately represent the MISS 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 MISS and the surrounding area since 1984. A remedial investigation (RI) of the site was completed in February 1991. An RI report is scheduled for publication in 1992. 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 MISS 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 MISS and the information known about the contaminants onsite. Sections 2.0 through 5.0 discuss features of the environmental monitoring program at MISS. 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 MISS.

1.2 SITE LOCATION AND DESCRIPTION

MISS is a 4.73-ha (11.7-acre) fenced lot that was once part of a 12.1-ha (30-acre) property formerly owned by Maywood Chemical Works (MCW). MISS is located in northern-central New Jersey in the Borough of Maywood and the Township of Rochelle Park (Bergen County) (Figure 1-2). The site contains an interim waste storage pile, two buildings (Building 76 and a pumphouse), a reservoir (tank), and two railroad spurs (Figure 1-3). It is bounded on the west by Highway 17, on the north by a New York, Susquehanna, and Western (NS&W) Railroad line, and on the south and east by commercial and industrial properties (Figure 1-4). The nearest residential properties are located northeast of the site and within approximately 50 m (150 ft) of the boundary. The total population of the area within an 80-km (50-mi) radius of MISS is over 10 million.

The topography is generally flat, ranging in elevation from approximately 15.2 to 20.4 m (51 to 67 ft) above mean sea level. The highest elevations are in the northeastern portion of the property. Small mounds and ditches are present; these are the result of process waste stored by MCW. At least two partially buried structures remain from these processing operations.

The interim storage pile at MISS occupies approximately 0.81 ha (2 acres) and contains approximately 27,000 m^3 (35,000 yd^3) of

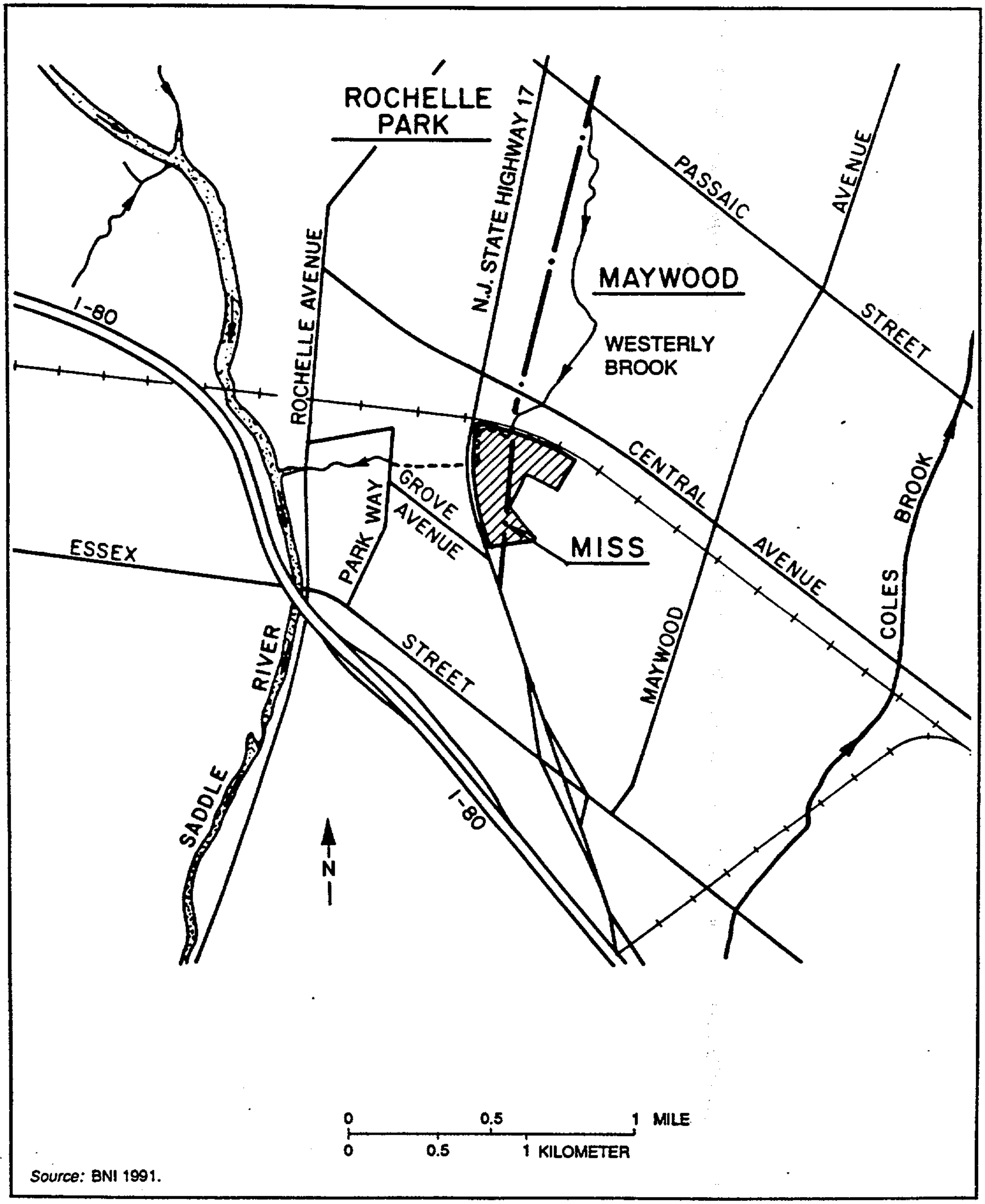
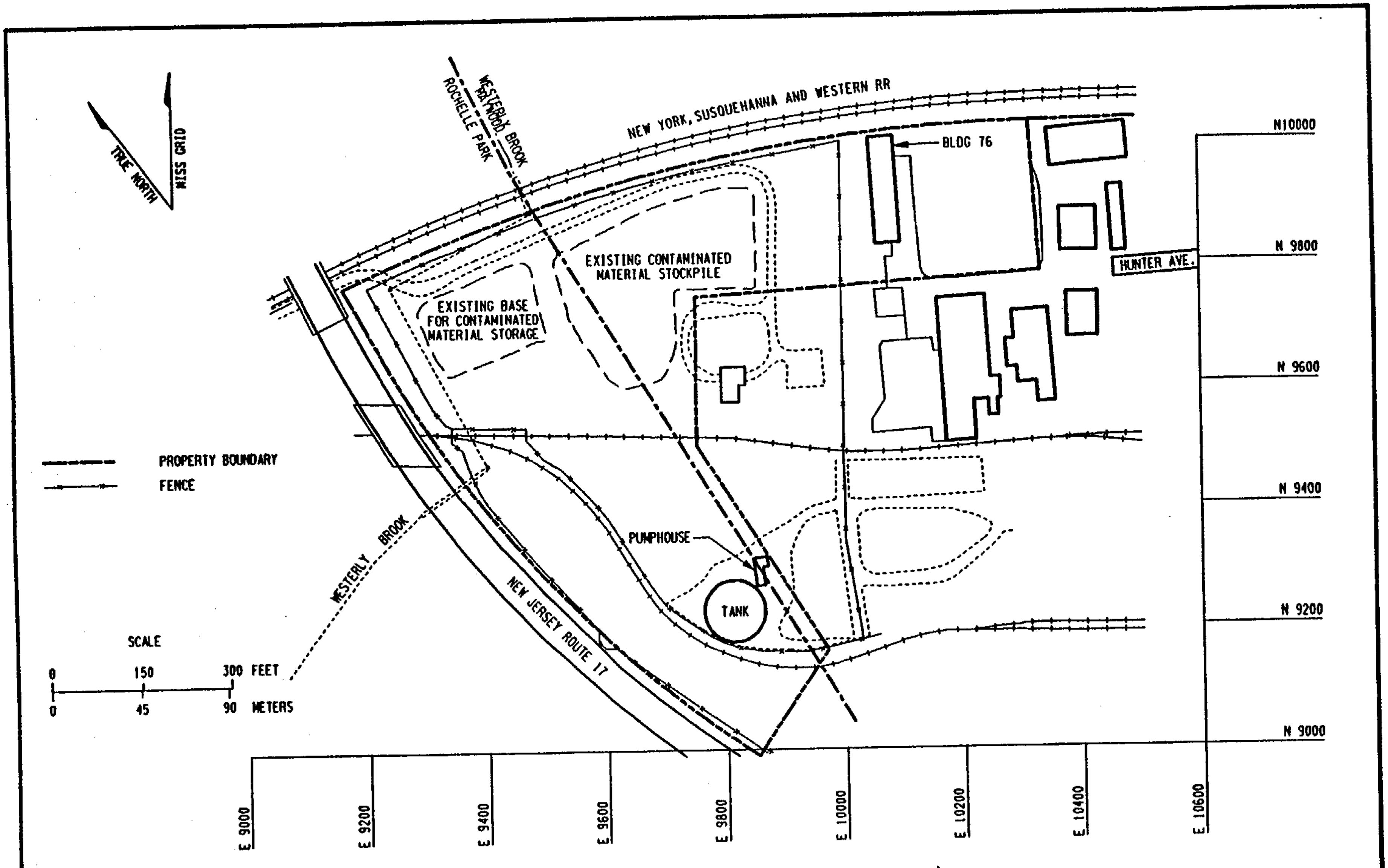


Figure 1-2
Location of MISS



Source: Adapted from BNI 1991.

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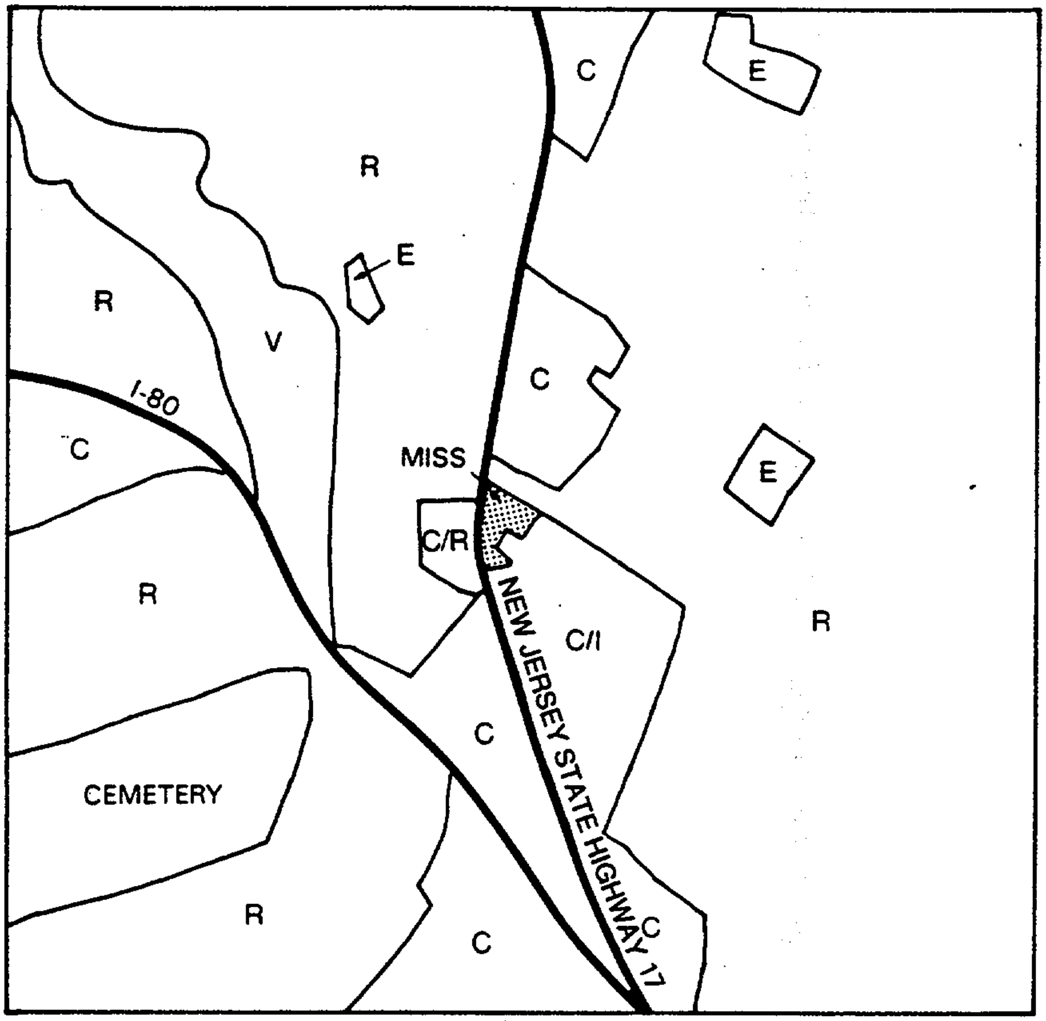
Figure 1-3
Plan View of MISS



BASED ON AERIAL PHOTOGRAPHS, SITE VISITS AND USGS TOPOGRAPHIC MAP 1:24000 SCALE, HACKENSACK, NJ QUADRANGLE (PHOTO REVISED 1981)

R RESIDENTIAL
C COMMERCIAL
C/I MIXED COMMERCIAL/INDUSTRIAL
E EDUCATIONAL
V VACANT
C/R MIXED COMMERCIAL/RESIDENTIAL

0 0.5 MILE
0 0.5 KILOMETER

N

Source: BNI 1991.

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

contaminated soils and materials from removal actions conducted on vicinity properties near the site (BNI 1991a).

Westerly Brook, which flows under the northern edge of MISS via a concrete pipe, empties into the Saddle River, a tributary of the Passaic River; these sources are not used for drinking water. Almost all of the Borough of Maywood and the Township of Rochelle Park are served by a municipal water system supplied by bedrock aquifer wells (BNI 1991a).

1.3 SITE HISTORY

MCW was constructed in 1895. In 1916, the plant began extracting thorium and rare earths from monazite sand for manufacturing industrial products such as mantles for gas lanterns. The process included production of mantle-grade thorium nitrate and various compounds such as lithium hydroxide and lithium chloride (NRC 1981). Although thorium extraction had ceased in 1956, thorium processing continued until 1959, using stockpiled monazite sands and various lithium compounds.

MCW also produced rare earths, detergents, alkaloids, essential oils, and lithiated compounds. Lithium wastes are believed to have been disposed of in diked areas on the MCW site. Various other inorganic and organic chemicals have been identified in soils and groundwater at the present MISS.

During thorium-processing operations, MCW pumped the process waste into two areas surrounded by earthen dikes on property west of the plant (ORAU 1981). In 1932, the disposal areas were separated from the plant; Highway 17 was constructed over part of the areas. Some of the process wastes were removed and used as mulch and fill on nearby properties, thereby contaminating those properties with radioactive thorium (Bionetics 1984). Although the fill consisted primarily of tea and coca leaves from other MCW processes, it apparently included some of the thorium processing wastes.

Additional waste apparently migrated off the property via natural drainage associated with the former course of Lodi Brook. Historical photographs and maps indicate that the former course of the brook, which originated on the MCW property, generally coincides with the distribution of contaminated properties in the Borough of Lodi. Most of the open stream channel in Lodi has been replaced by a subsurface storm drain system.

In 1954, the Atomic Energy Commission (AEC) issued a license to MCW that allowed the plant to continue to possess, process, and distribute radioactive materials under authority of the Atomic Energy Act of 1954. MCW stopped extracting thorium in 1956, after approximately 40 years of production. The property was sold to the Stepan Company in 1959.

In 1961, the Stepan Company was issued an AEC license for handling radioactive materials. Although Stepan never processed radioactive materials at the property, the company agreed to take corrective actions on property on the western side of Route 17 (now known as the Ballod property). In 1963, residues and tailings on the Ballod property were partially stabilized; in 1966, 6,391 m^3 (8,400 yd^3) of contaminated material was removed and buried on the Stepan property at Burial Site No. 1 (Figure 1-5), a grass-covered area. In 1967, an additional 1,570 m^3 (2,053 yd^3) of material was removed and buried on Stepan property at Burial Site No. 2, which is now a parking lot (Figure 1-5). In 1968, an additional 6,575 m^3 (8,600 yd^3) of waste from the Ballod property was buried at Burial Site No. 3 (Figure 1-5), where a warehouse was later constructed. At this time, AEC certified the Ballod property usable without radiological restrictions, apparently unaware that contaminated waste materials still remained in the northeastern corner of the property. In 1968, Stepan sold this portion to a private citizen, who later sold it to Ballod Associates (ORAU 1981).

In 1980, the radioactive waste in the northeastern corner of the Ballod property was discovered during a survey of the area (Highway 17, Ballod property, and Stepan property) conducted by the New Jersey Department of Environmental Protection (NJDEP). The survey identified the contaminants as thorium-232 and radium-226.

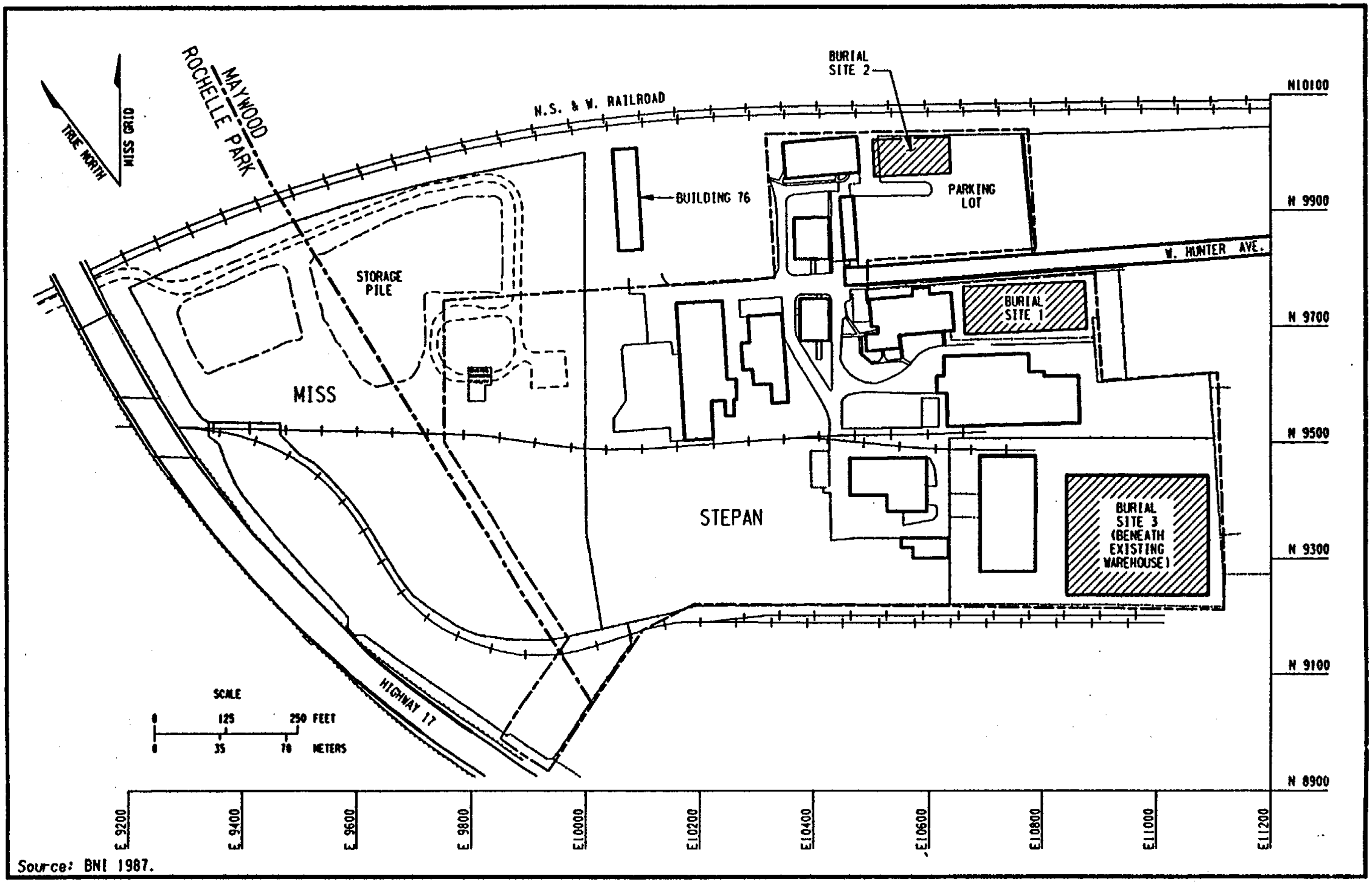


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Figure 1-5
Burial Sites on the Stepan Company Property

The Nuclear Regulatory Commission (NRC) was notified, performed its own surveys, and confirmed the findings (NRC 1981). A number of subsequent surveys confirmed the findings of both NJDEP and NRC regarding contamination on the Ballod property, Stepan, and a number of properties in the vicinity. These surveys resulted in designation of the Ballod property for remedial action under FUSRAP (DOE 1983).

By enacting the Energy and Water Development Appropriations Act of 1984, Congress authorized DOE to undertake a decontamination research and development project at the Maywood site. Accordingly, the site was assigned to FUSRAP, and DOE negotiated access to a 4.7-ha (11.7-acre) portion of the Stepan property for use as an interim storage facility for contaminated materials that were to be removed from vicinity properties. This area is now known as MISS.

In late 1983, DOE instructed Oak Ridge National Laboratory and Bechtel National, Inc. (BNI) to begin surveying properties in the vicinity of the former MCW plant. In 1984 and 1985, DOE conducted removal actions at 26 properties and placed the resulting waste in temporary storage at MISS. In September 1985, ownership of MISS was transferred to DOE.

1.4 CONTAMINANTS OF CONCERN

In the early 1980s, several radiological surveys were conducted to determine the nature and extent of the contamination resulting from operations at the site (ORAU 1981, NRC 1981, Nuclear Safety Associates 1982). These surveys identified radioactive contamination, primarily thorium-232 and its associated daughter products, with lesser amounts of radium-226 and uranium-238.

Because the concentration of thorium-232 (half-life of 1.41×10^9 yrs) is greater than that of either uranium-238 (half-life of 4.51×10^9 yrs) or radium-226 (half-life of 1,602 yrs), thorium-232 is considered the primary contaminant of concern. 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 natural equilibrium with the uranium-238. The radioactive contaminants of concern at MISS are listed in Table 1-1.

Because radium-226 is present at the site, radon-222 [radon (half-life of 3.823 days)] is also a contaminant of concern. Radon-220 [thoron (half-life of 55.61 seconds)], which results from the radioactive decay of thorium-232, is also present.

The RI identified some chemical contamination as well. Based on a comparison of radiological and chemical data for some locations, lithium and several rare earth elements are often present in association with radioactive contamination. The coexistence of rare earth metals, lithium, and radioactive constituents is supported by historical research of the thorium processing operations conducted at the site. Results of the volatile organic analyses indicate the presence of benzene and toluene at some locations. Analysis for semivolatiles shows a cluster of contamination where radioactive contamination was also identified. Analytical results for priority pollutant metals indicate a number of hazardous constituents present at above-background concentrations.

Analytical results for pesticides and polychlorinated biphenyls (PCBs) show no detectable levels of these constituents. There are above-background levels of metals, namely arsenic and antimony, that are below the maximum concentrations specified in 40 CFR 261.24. No samples exhibited hazardous waste characteristics as defined by the Resource Conservation and Recovery Act (RCRA). The toxicity characteristic leaching procedure for metals, volatile organic compounds, pesticides, and herbicides yielded no results that exceed the regulatory limits. The chemical contaminants of concern are also presented in Table 1-1.

Table 1-1

Contaminants of Concern Identified at MISS

Page 1 of 2

Contaminant	Concentration[a] Average	Maximum
Radionuclides[b]		
Thorium-232	83	1,699
Radium-226	19	447
Uranium-238	39	304
Radon-222[c]	0.5[d]	2.8[d]
Radon-220	–[e]	–[e]
Metals (ppm)		
Arsenic	10.8	1,060
Antimony	15.3	110
Barium	45.7	3,000
Cadmium	4.1	20
Chromium	352.7	3,920
Copper	24.7	224
Magnesium	[d]	6,500
Mercury	5.1	93
Lead	137.9	1,080
Selenium	0.6	3
Thallium	112.7	744
Zinc	89.8	304
Semivolatiles (ppb)		
Chrysene	443	1,400
Fluoranthrene	802	3,300
Phenanthrene	528	2,400
Pyrene	596	2,600
Volatiles (ppb)		
Toluene	704	3,000

Table 1-1
(Continued)

Contaminant	Concentration[a] Average	Maximum
Total Petroleum Hydrocarbons (ppb)	659	6,100

[a]Background values have not been subtracted.

[b]Radionuclide concentrations are given in units of pCi/g. Radon-222 and radon-220 concentrations, monitored in the air, are expressed in pCi/L.

[c]Adapted from BNI 1987.

[d]Concentrations were measured by the monitoring stations on the site boundary and the two onsite locations.

[e]Radon-220 concentrations are not available.

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, which is addressed in Subsection 5.5 of this plan. Because MISS is not an operating facility, the only effluents from the site are the rinseates resulting from decontamination of sampling equipment. The decontamination rinseates will be collected and stored in a 5000-gal tank. When the tank is filled to capacity, the liquid will be sampled and, if contaminated, will be disposed of by a commercial disposal service.

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, discharge of airborne effluents are not anticipated. However, radionuclides could be released as particulates by wind erosion or as radon or thoron. These potential forms of release are addressed in Subsection 5.3.

4.0 METEOROLOGICAL MONITORING

Because MISS 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 MISS 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 New York City.

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 <u>Screening Techniques for Determining Compliance with Environmental Standards</u> (NCRP 1986). QA/QC procedures will be followed in accordance with the requirements outlined in Section 10.0.

5.0 ENVIRONMENTAL SURVEILLANCE

Requirements for environmental monitoring of radioactive materials are found in DOE Orders 5400.5 and 5400.1. 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 (DCGs), and dose limits for radioactive releases from DOE facilities. Special studies at MISS are not covered in this EMP; they are reported in the ASER.

5.1 EVALUATION OF NEED

The environmental monitoring program at MISS was initiated in 1984 to study the movement of radioactive contaminants from the site via surface water and sediments. Monitoring for radon and external gamma radiation was also conducted. In 1985, quarterly monitoring of groundwater for radionuclides and chemical indicator parameters [pH, specific conductance, total organic carbon (TOC), and total organic halides (TOX)] began at MISS. Analyses for New Jersey priority pollutants were performed once yearly.

As knowledge of the site increased based on characterization and environmental monitoring data, the program was expanded to include more sampling locations and monitoring for the contaminants of concern. This EMP has been developed to optimize the efficiency of the program. Appendix B is a table comparing the program as it existed in 1991 to 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.

Environmental surveillance activities are necessary at MISS to ensure that the onsite waste is not posing a threat to human health or the environment. The overall goal of the environmental monitoring program at MISS is to determine whether contaminants are released and, if so, to determine the impact of site contaminants 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 applicable criteria outlined in the regulatory guide.

The goal will be achieved by implementing:

- Routine surveillance of 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 illustrates the potential sources of contamination at MISS and identifies the means by which those contaminants could migrate to the general public. As shown, contaminants are present in surface and subsurface soils on the MISS property and in an onsite interim storage pile.

Based on Figure 5-1, all of the transport pathways indicate a potential for exposure to the contaminants at the site. However, not all of the exposure routes are valid for MISS. The invalid exposure routes are ingestion of contaminated livestock or foodstuffs, direct contact by ingestion of contaminated fish, and overland migration of contaminants from the site to soils on adjacent properties. 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 for individuals near the site

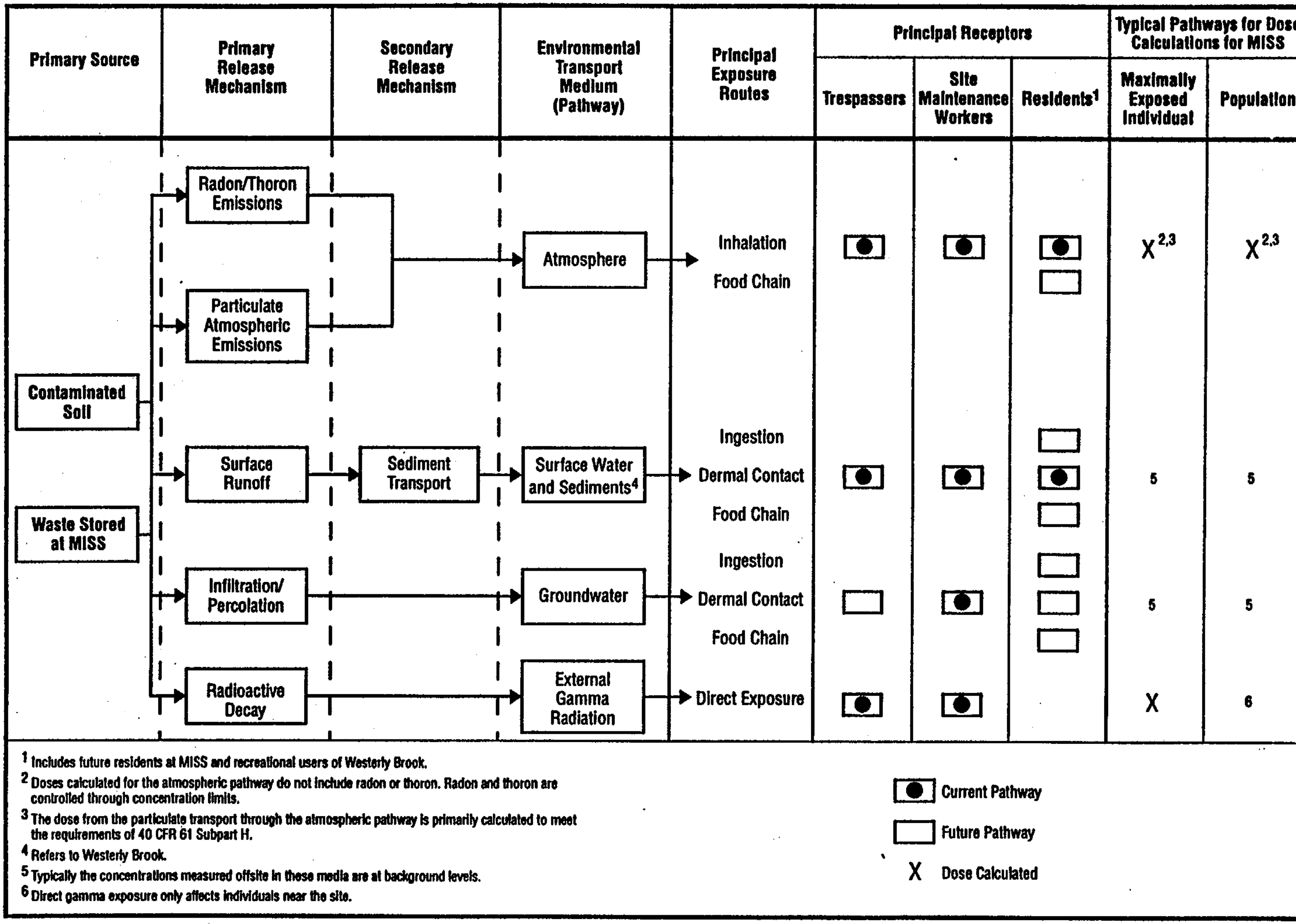

Figure 5-1
Exposure Pathway Analysis

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Contamination in surface and subsurface soils could migrate to groundwater through the infiltration of surface water into contaminated zones, with subsequent leaching of the contaminants from soil into groundwater. Groundwater could then migrate from the site and could be used by the public for various purposes, leading to potential exposure of the public via ingestion or dermal contact.

Contamination in surface soils could also be transported from the site via overland surface runoff onto adjacent properties or into the MISS stormwater drainage system. The surface water could carry contaminated sediments from the site or could dissolve contaminants. Surface water and sediments leave the site and flow primarily into Westerly Brook and then into the Saddle River. Water from Westerly Brook and the Saddle River is available to members of the public, who could therefore sustain exposure via ingestion or dermal contact.

Radium-226 exists at MISS in natural equilibrium with the uranium in the ores processed there by MCW. When radium-226 radioactively decays, it generates radon, an inert gas. This gas can migrate from the soil, become airborne, disperse, and be transported offsite. The general public could inhale the diffused radon. Thoron, a daughter product in the thorium-232 decay chain, behaves similarly to radon.

Another exposure route would be direct contact with the contaminated surface soils at MISS. Direct contact includes exposure to external radiation emitted from the contamination in the soil. Direct ingestion of soil is an unrealistic pathway, considering the low specific activity of uranium and the measured low-level concentrations in the soil.

Plant and biota samples are not collected because there are no foodstuffs (i.e., gardens), livestock, or endangered species near the site.

Based on this exposure pathway analysis, contamination could leave the site in either groundwater, surface water, or sediments carried by surface water. Additionally, the general public could receive exposure from the radioactively contaminated surface soils.

Surface water and groundwater modeling are not conducted because the environmental monitoring program includes groundwater and surface water sampling.

The MISS environmental monitoring program is designed to monitor these potential pathways to the public and current contaminant levels and to detect trends in the pathways that could indicate a developing problem. This information is 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.

The following sections establish the plan for monitoring the aforementioned pathways.

5.2 BASIS AND CRITERIA FOR EXTERNAL GAMMA RADIATION SURVEILLANCE

Virtually all of the surface soil at MISS is radioactively contaminated with low concentrations of depleted uranium (primarily uranium-238) and thorium-232. These radionuclides emit primarily alpha particles, which can travel only a few centimeters in air and cannot penetrate the dead skin layer on humans. Alpha emissions, therefore, do not pose a radiological hazard and will not be monitored.

Beta emissions from depleted uranium and thorium-232 daughter products are present at MISS. However, beta particles can travel only a few yards in air, and they do not typically penetrate human skin. For this reason, monitoring for beta exposures at MISS is not warranted.

Thorium-232 daughter products do emit gamma radiation. Because this form of radiation travels several yards in air and penetrates the skin to deliver a radiological dose to internal organs, the MISS environmental monitoring program will include monitoring for external gamma radiation.

These contaminants are located primarily in a covered storage pile, beneath building foundations, or beneath vegetative cover.

MISS is not an operating facility; therefore, contaminant locations and concentrations are stable and not expected to change. Because MISS is used as an interim storage site for low-level waste and for equipment storage, is completely fenced, and is accessible only to employees and authorized visitors, no releases of radiation are expected to occur. Previous monitoring data (BNI 1991a) support this conclusion; external gamma radiation exposure levels have been relatively constant since 1986, and no "unexpected releases" have occurred (BNI 1991a).

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

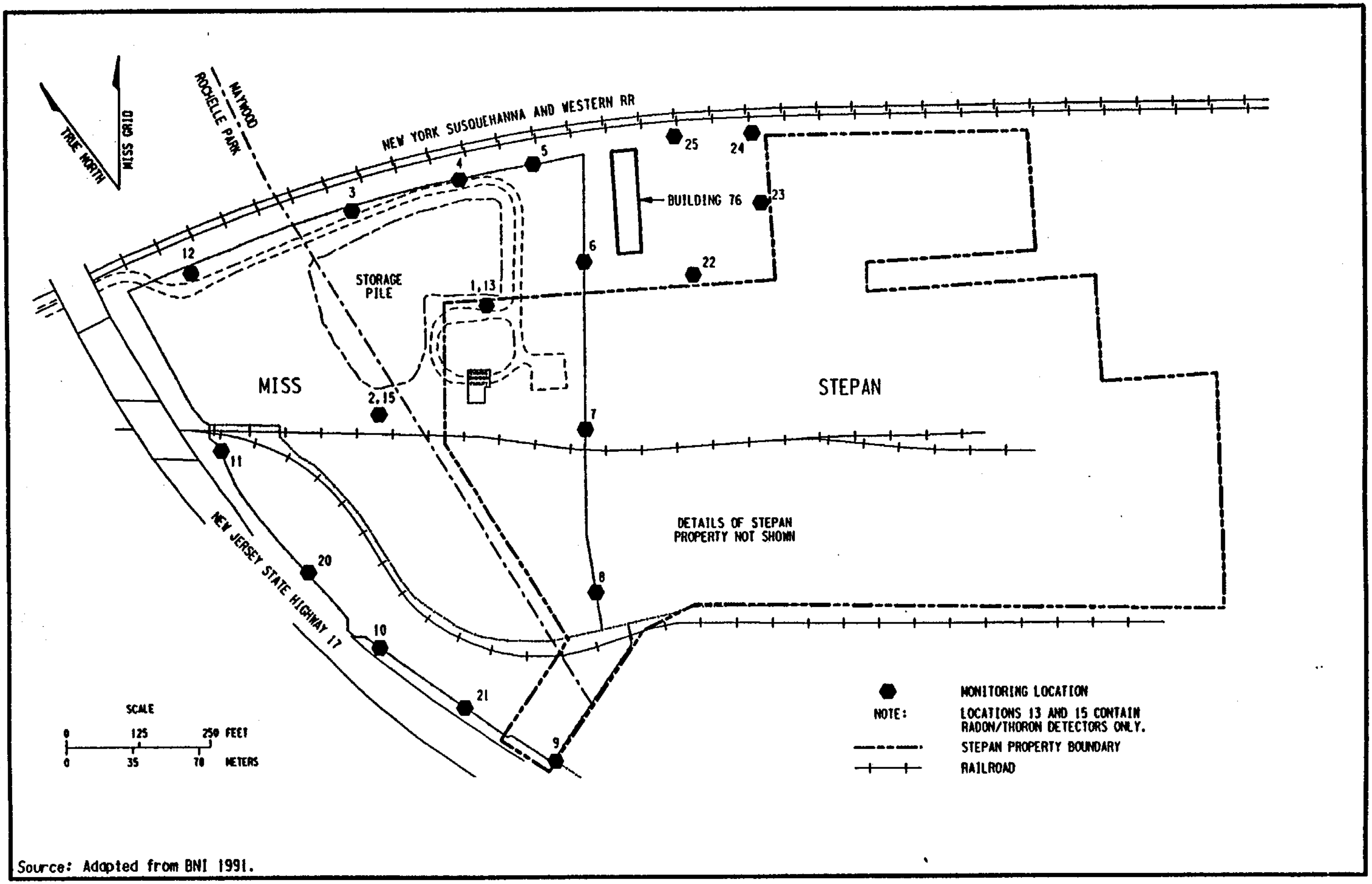
The requirements for the external gamma radiation surveillance program are that timely information be received on exposures to the public from both stable site conditions and unexpected releases. The information obtained from this program should be adequate to estimate the potential doses to the hypothetical maximally exposed individual and to workers and the public in case of an accidental release.

5.2.2 Dosimeter Location Rationale

Tissue-equivalent thermoluminescent dosimeters (TETLDs) will be positioned approximately 1 m (3 ft) above the ground surface (approximately at gonad level) to represent the exposure to the critical organ nearest the contamination. TETLDs will be placed at 21 stations (2 onsite, 16 fenceline, and 3 offsite) to monitor external gamma radiation levels (Figures 5-2 and 5-3). The onsite dosimeters are positioned to detect the maximum exposure levels to personnel working at MISS. Fenceline dosimeters are positioned to supply data used to calculate potential exposures at the site boundary, representing locations closest to contaminated areas that are accessible to the public. Additional dosimeters are placed near areas that contain large quantities of contaminated soils and/or high concentrations of contaminants. Offsite (background) dosimeters are currently located at the Department of Health, Paterson, approximately 8.8 km (5.5 mi) west of MISS; at the Rochelle Park Fire Station, approximately 0.8 km (0.5 mi) northwest of MISS; and at the Rochelle Park Post Office, approximately 0.8 km (0.5 mi) northwest of MISS.

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



Source: Adapted from BNI 1991.

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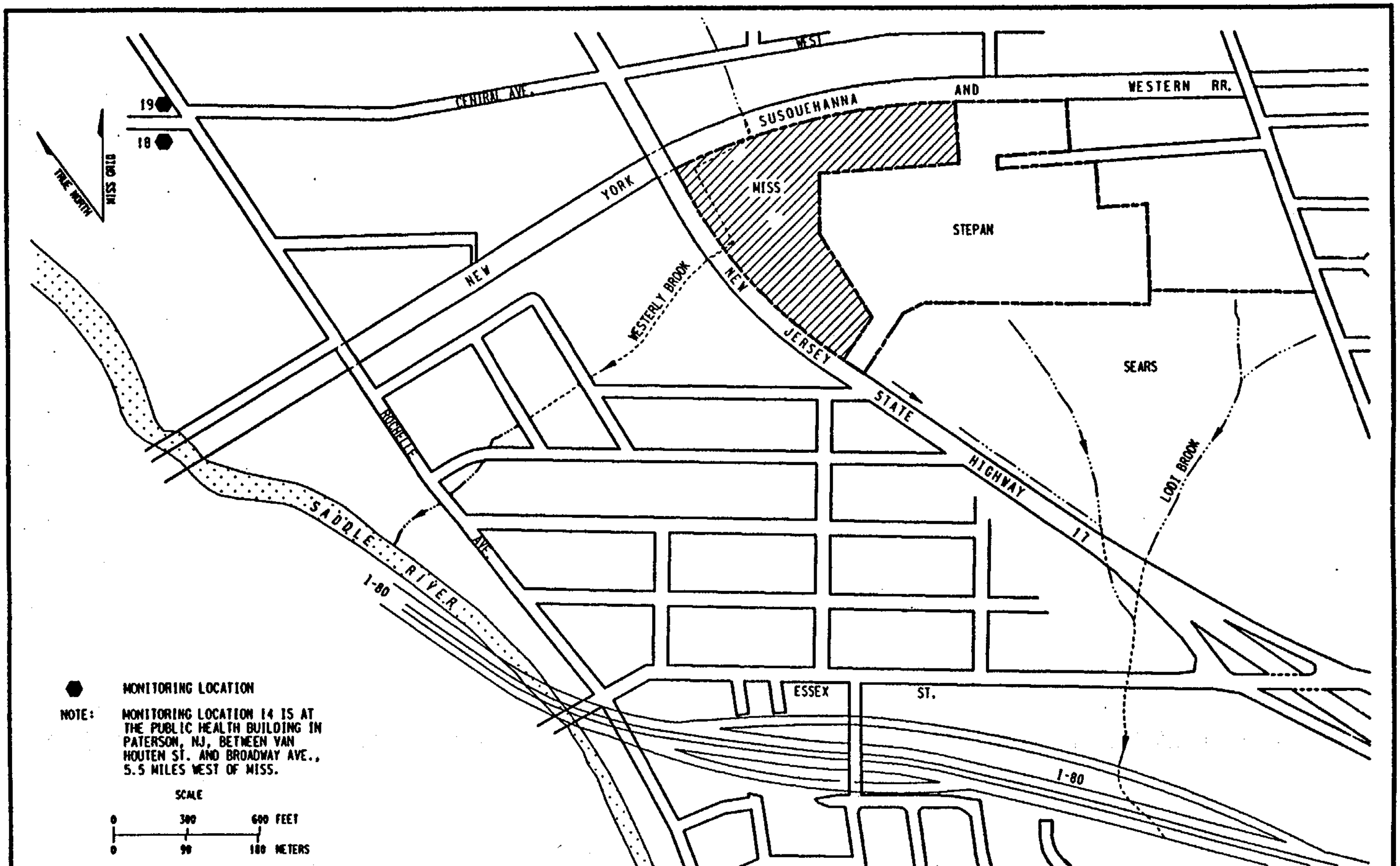
Figure 5-2
Onsite Radon, Thoron, and External Gamma Radiation Monitoring Locations



Source: Adapted from BNI 1991.

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

5.2.3 Sampling Frequency

Waste has been stored at the site for many years, and past monitoring has not indicated substantial changes in levels of gamma radiation. Therefore, dosimeters that provide real-time measurements are not considered necessary. The TETLD, an integrating dosimeter, will be appropriate for the monitoring program.

Four dosimeters will be placed at each station in January. Two of these 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 remaining two will be retrieved and analyzed 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. This semiannual sampling frequency will also be applicable for any new sampling stations that might be established.

5.2.4 Sampling Methods and Dosimeters

Each TETLD station will consist of a vertical support and a polyvinyl chloride (PVC) holder assembly. The individual TETLD will consist of a polyethylene sphere containing five individual lithium fluoride chips that will be selected on the basis of having a reproducibility of ±4 percent across a series of laboratory exposures; this reproducibility will be traceable to National Institute of Standards and Technology (NIST) criteria. Values are reported with a 95 percent confidence level. Attached to the TETLD will be 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; this corrected value is the radiation dose, expressed in mR/yr.

5.2.5 Field Activities Quality Assurance

The specific QA requirements to be met as part of the external gamma radiation monitoring program will be as follows:

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

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

- Fresh dosimeters are installed as soon as practical 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 are verified by instrument surveys every six months, and a record of the surveys is maintained in the site files.

- After removal, dosimeters are shipped immediately for analysis.

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

- By design, duplicate QC measurements are made at each sampling location, which protects against data losses due to faulty, damaged, or lost dosimeters.

- Dosimeter sampling locations are inspected monthly for dosimeter loss, damage, proper housing height, signs of vandalism, theft, etc.

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

5.2.6 Emergency Provisions

Because of the nature of the material stored at the site and the fact that MISS is usually not occupied (see Subsection 5.1), unexpected releases are highly unlikely. In the event of an unanticipated release, trained site operations personnel and the site safety officer will notify appropriate personnel of BNI (the PMC for FUSRAP) and DOE 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 can be removed and analyzed. If conditions warrant, a health physics technician will evaluate site conditions with appropriate instrumentation.

5.3 BASIS AND CRITERIA FOR ATMOSPHERIC PATHWAY SURVEILLANCE

There are two exposure routes for the atmospheric pathway: particulate transport due to wind erosion, and gaseous emissions of radon and thoron. Airborne particulate transport will not be monitored under the environmental surveillance program for the following reasons:

- Because the site is covered with pavement, vegetation, and buildings, wind erosion is not considered a potential release mechanism.

- No outdoor work that would disturb surface soil conditions is planned for the site in the near future. Release of particulates to the atmosphere via mechanical disturbances is not considered a credible scenario.

One of the primary pathways for radiation exposure from the uranium-238 and thorium-232 decay series is inhalation of short-lived radon and thoron and their daughter products. Radon and thoron are alpha-emitting gases that are very mobile in air. Radon poses the greater potential hazard to the public because of its longer half-life (3.82 days, as compared with 55.0 seconds for thoron). Potential receptors of radon and thoron releases include members of the public living in areas adjacent to the site. The residence nearest to the site is approximately 50 m (150 ft) away (see Subsection 1.2). Therefore, radon and thoron are the contaminants of concern for the atmospheric pathway.

DOE will also collect radon and thoron flux monitoring data from the onsite storage pile to provide data to EPA to verify compliance with 40 CFR Part 61, Subpart Q. Radon and thoron flux monitoring will be conducted as agreed upon with EPA Region II. Major modifications to the pile will require a timely monitoring event to ensure compliance with the standard.

5.3.1 Surveillance Requirements

The radon/thoron monitoring program at MISS is designed to:

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

5.3.2 Detector Location Rationale

The rationale for selection of detector locations was based primarily on the fact that the waste at the site is relatively stable and instantaneous releases are not expected to occur. Data collected since 1986 support the rationale that site contaminants are stable, radon and thoron concentrations are low, and there is little potential for a major release of radon or thoron (BNI 1991a).

The detector system can be expected to detect continuous releases of radon and thoron. The wind direction varies enough that several detectors along the boundary would pick up a continuous release. The detectors will be at 4 onsite locations, 16 fenceline locations (Figure 5-2), and 3 offsite (background) locations (Figure 5-3) identical to the external gamma radiation dosimeter stations. Onsite detectors are positioned to detect the maximum potential exposure levels to personnel working on the site. Detectors along the site fence are spaced to provide monitoring capability under most atmospheric conditions and to supply data used to calculate potential exposures at the site boundary.

All detectors will be placed 1.5 to 1.7 m (5.0 to 5.5 ft) above the ground surface to detect radon and thoron concentrations in the breathing zone for the average person. Stations may be added to or deleted from the monitoring program as needed.

5.3.3 Sampling Frequency

There are no areas of the site where elevated levels of radon or thoron are known to be released; therefore, a continuous monitoring system is not required. Instead, use of an integrating detector is more appropriate so that average concentrations can be obtained over a relatively extended period. The alpha track etch detector is considered to be a suitable type of integrating detector. Sampling frequency will be quarterly. The detectors will remain at the sampling locations for the entire quarter to determine integrated average radon and thoron concentrations over the quarter. The quarterly sampling frequency for radon and thoron will ensure that if an unexpected release occurs, corrective actions can be accomplished in a prompt manner.

5.3.4 Sampling Methods and Detectors

Radon and thoron concentrations will be measured using an integrating alpha track etch detector that contains a piece of alpha-sensitive film enclosed in a small two-piece cup. The radioactive gases diffuse through a membrane of the cup until the concentrations inside the cup are in equilibrium with atmospheric concentrations. Different types of membranes are used to distinguish between radon and thoron; one permits both radon and thoron to diffuse into the cup, and one permits only radon to diffuse. Alpha particles from the radioactive decay of radon and thoron and their 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 and thoron concentrations in air. For thoron measurements, both types of detectors are installed at the sampling location. The thoron level is then determined by subtracting the level measured by the radon detector from the level measured by the radon/thoron detector.

5.3.5 Field Activities Quality Assurance

Various QA controls will be part of the radon and thoron 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 exposure
- Detector COC will be maintained and documented; COC seals will be placed on shipping containers

- Stations will be inspected monthly for detector loss, damage, housing height, and signs of vandalism

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

5.3.6 Emergency Provisions

Unexpected releases of radon or thoron from the site can be expected to occur only when the site configuration is 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, as specified in FUSRAP project instructions.

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 groundwater monitoring program at MISS is designed to:

- Provide data for use in determining basic groundwater quality

- Demonstrate compliance with applicable regulations and DOE orders
- Provide data for the early detection of groundwater contamination

5.4.2 Well Location Rationale

Groundwater monitoring at MISS 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.

Since the inception of the sampling program at MISS, wells have been added to or removed from the program based on increased understanding of migration pathways and knowledge of the contaminants present. The groundwater monitoring program at MISS follows EPA recommendations for groundwater monitoring at hazardous waste sites and meets DOE requirements for environmental protection. The program will use background well data to determine whether contamination is being added to groundwater by onsite sources and will focus on areas with elevated concentrations of contaminants.

Based on current understanding of groundwater flow conditions, the two water-bearing systems (upper and lower) identified as primary potential pathways at MISS are suspected to be hydraulically connected. Monitoring of the upper and lower systems will provide the data necessary to detect offsite migration. Well locations and general flow direction at the site are presented in Figures 5-4 (upper system) and 5-5 (lower system). They also show upgradient, offsite areas that possibly contain buried contamination. These were identified during a characterization of the Stepan property, which includes three known burial sites as well. Figure 5-6 shows the locations of the former waste retention ponds known to be associated with earlier activities at MISS.

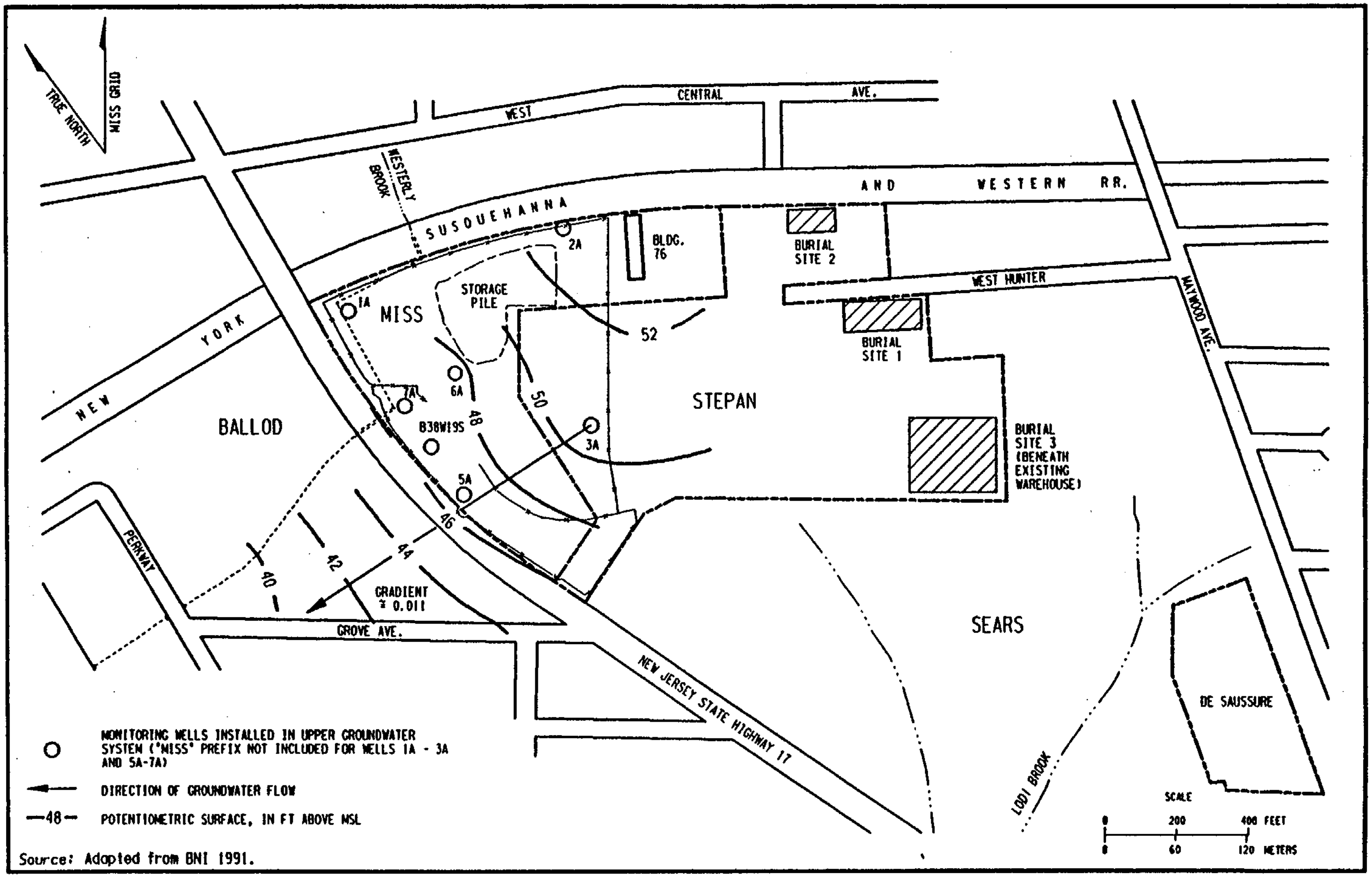

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Figure 5-4
Upper Groundwater System Wells Used for Radiological and Chemical Sampling

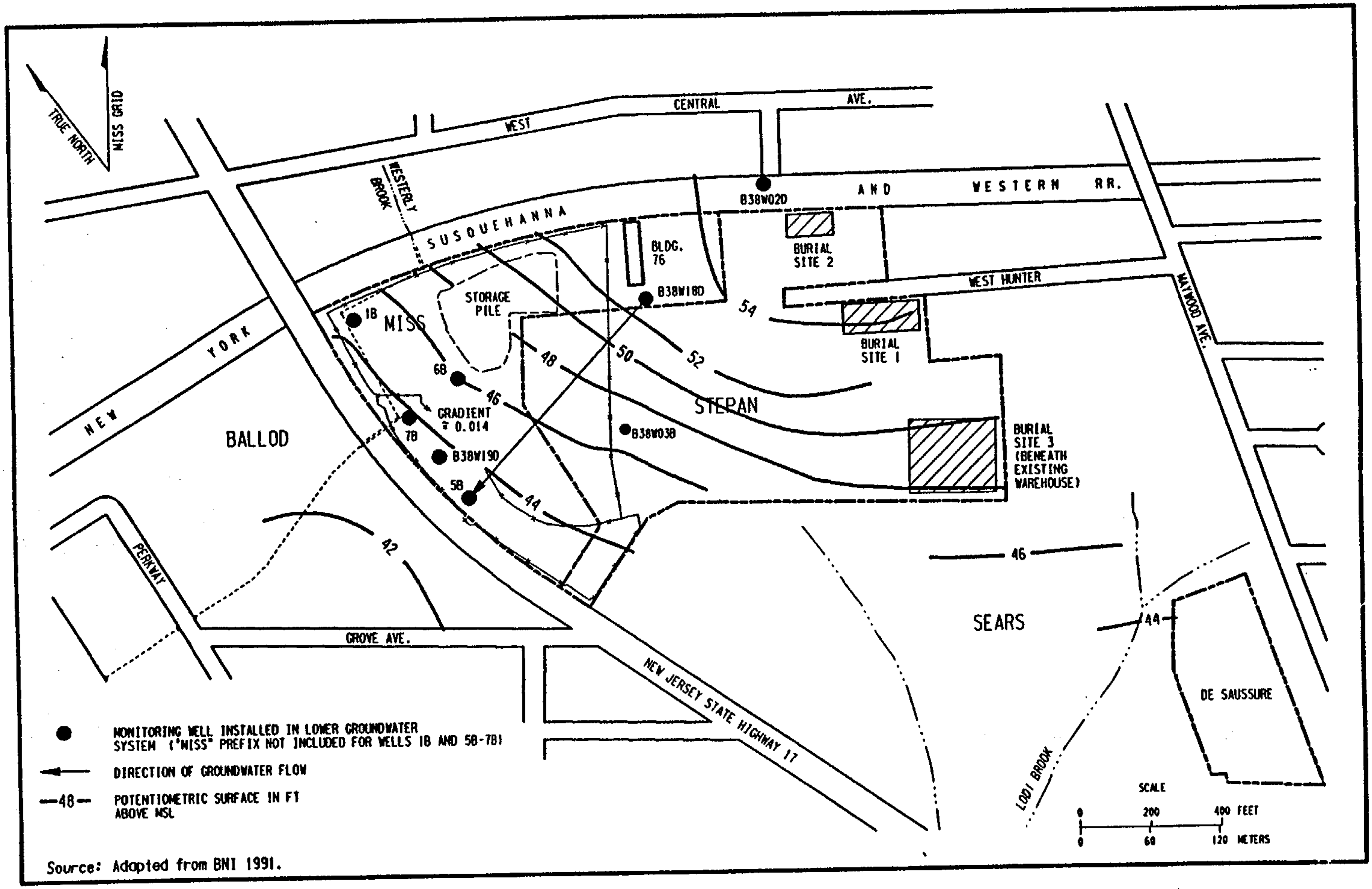

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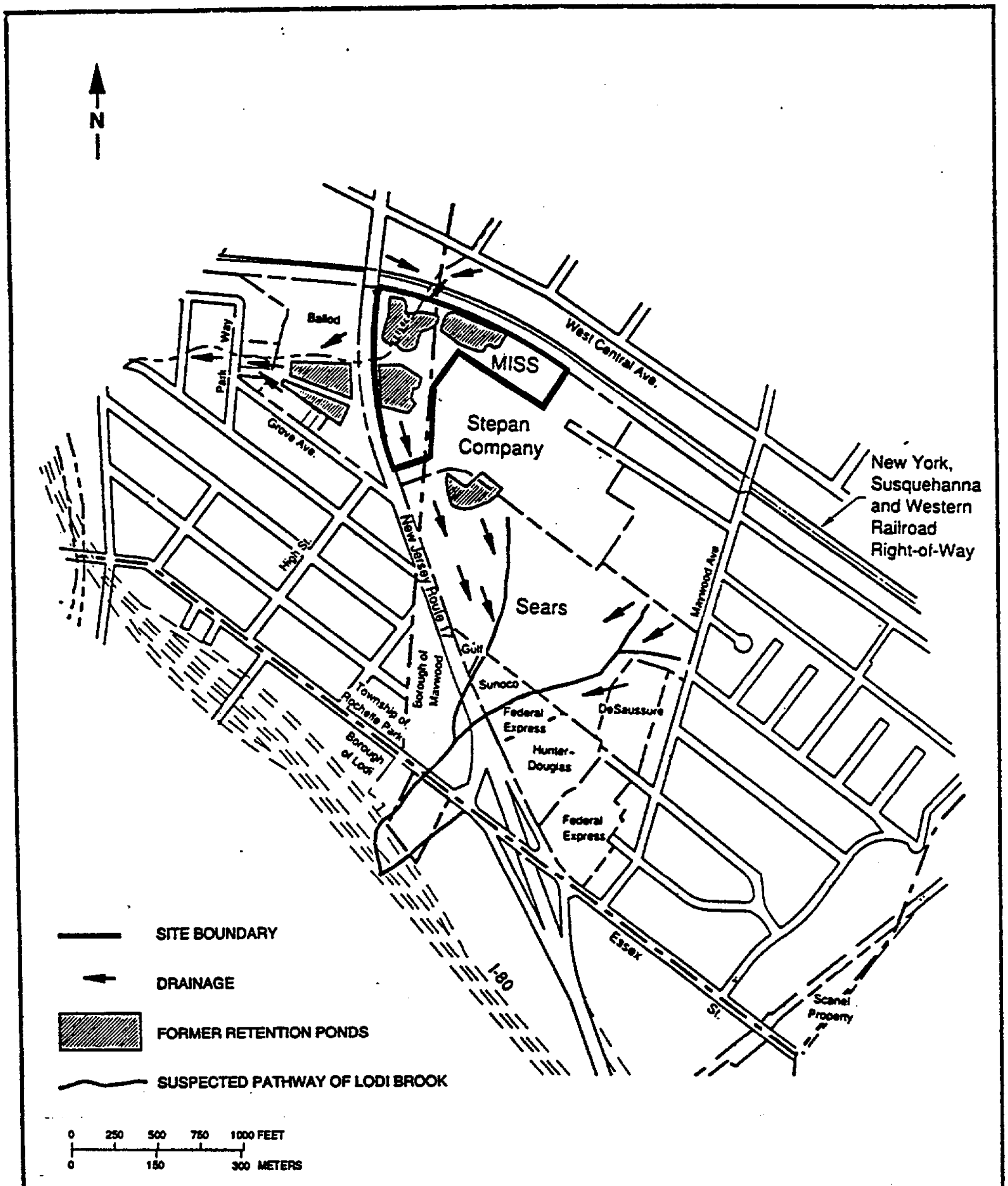
Figure 5-5
Lower Groundwater System Wells Used for Radiological and Chemical Sampling



Source: Adapted from ANL/BNI 1990.

Figure 5-6
Waste Retention Ponds and Drainage Pathways

Sampling locations and frequency were chosen assuming that 1) the subsurface is homogeneous in all directions, 2) the highest calculated average linear flow velocity is representative of flow rates in the subsurface, 3) contaminants are not bound to soils by any mechanism, and 4) mechanisms that enhance contaminant transport (e.g., complexing and chelating) are not occurring.

Upper groundwater system

The flow direction of the upper groundwater system generally follows the slope of surface topography, toward the west. Onsite and perimeter monitoring will be provided by wells MISS-1A, MISS-3A, MISS-5A, MISS-6A, MISS-7A, and B38W19S (Figure 5-4).

Lower groundwater system

The lower groundwater system monitoring wells are completed in bedrock. Water level measurements define the potentiometric surface, which slopes generally along the same gradient as the top of bedrock, toward the west. The potentiometric surface is locally distorted by groundwater flow along fracture openings.

Onsite and perimeter monitoring data will be provided by wells MISS-1B, MISS-5B, MISS-6B, MISS-7B, B38W03B, B38W18D and B38W19D (Figure 5-5).

Background locations

In the upper groundwater system, well MISS-2A will be used for background analysis. Well B38W02D will be used for background analysis in the lower groundwater system.

Water level measurements

Monitoring of groundwater levels at MISS 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 13 wells in the upper system and 19 wells in the lower system (Figure 5-7). Automatic well recorders will measure water levels daily in three upper and three lower system wells.

5.4.3 Sampling Frequency

Radiological sampling at MISS will be conducted on a semiannual basis for all shallow wells and annually for all deep wells. Chemical sampling will take place annually when the potentiometric surface is at an intermediate level, between the highest and lowest seasonal groundwater levels of the year.

Sampling frequency is based on groundwater flow conditions. The groundwater monitoring program at MISS will continue to be evaluated based on flow conditions and contaminant concentrations; recommendations for changes in well locations and water sampling frequency will be made as appropriate. The frequency of water level measurement and sampling is shown in Table 5-1.

5.4.4 Analytical Parameters and Sampling Methods

The primary contaminants of concern at MISS are thorium-232, radium-226, radium-228, and uranium-238. Chemical contaminants may also be present at the site. All groundwater samples will be collected as grab samples.

To ensure the detection of contaminants in groundwater, samples will be collected and analyzed for:

- Total uranium
- Radium-226
- Radium-228
- Thorium-232
- Indicator parameters: specific conductance, pH, TOC, total petroleum hydrocarbons (TPH), and TOX
- Inductively coupled plasma atomic emission spectrophotometry (ICPAES) metals and lithium

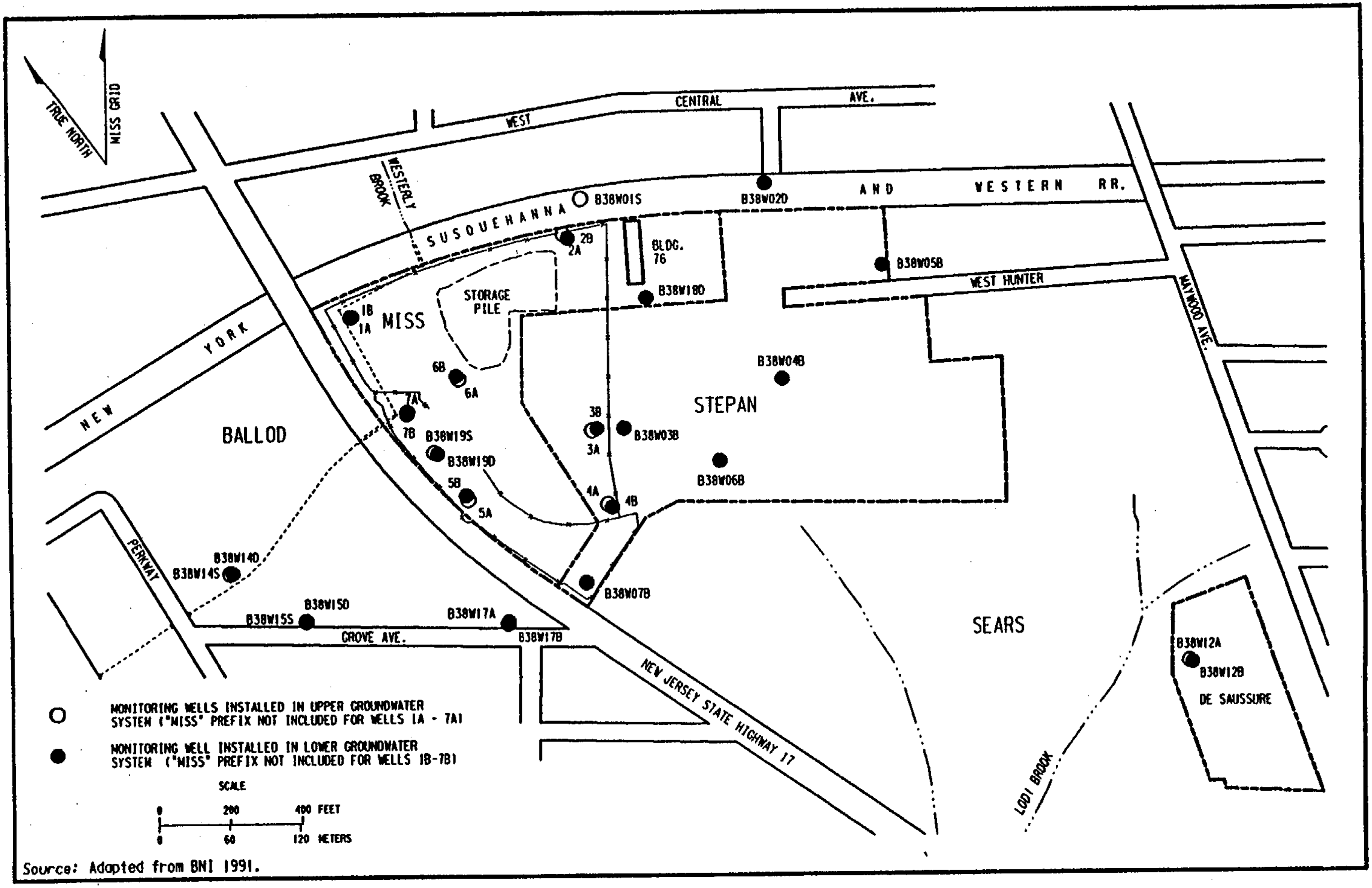


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Figure 5-7
Wells Used for Water Level Measurements

Table 5-1

Frequency of Sampling and Water Level Measurement in Wells at MISS

Well No.[a]	Sampling	Water Level Measurement
Upper Groundwater System		
MISS 1A	Semiannually	Quarterly
MISS-2A	Semiannually	Quarterly
MISS-3A	Semiannually	Quarterly
MISS-4A	-[b]	Quarterly
MISS-5A	Semiannually	Quarterly
MISS-6A	Semiannually	Quarterly
MISS-7A	Semiannually	Quarterly
B38W01S	-	Quarterly
B38W12A	-	Quarterly
B38W14S	-	Quarterly
B38W15S	-	Quarterly
B38W17A	-	Quarterly
B38W19S	Semiannually	Quarterly
Lower Groundwater System		
MISS-1B	Annually	Quarterly
MISS-2B	Annually	Quarterly
MISS-3B	-	Quarterly
MISS-4B	-	Quarterly
MISS-5B	Annually	Quarterly
MISS-6B	Annually	Quarterly
MISS-7B	Annually	Quarterly
B38W02D	-	Quarterly
B38W03B	Annually	Quarterly
B38W04B	-	Quarterly
B38W05B	-	Quarterly
B38W06B	-	Quarterly
B38W07B	-	Quarterly
B38W12B	-	Quarterly
B38W14D	-	Quarterly
B38W15D	-	Quarterly
B38W17B	-	Quarterly
B38W18D	Annually	Quarterly
B38W19D	Annually	Quarterly

[a]Well locations are shown in Figures 5-4, 5-5, and 5-7.

[b](-) = Well not sampled.

- Volatile and semivolatile organics, pesticides, and PCBs

Indicator parameter analyses are performed to determine whether additional chemical contamination is present. Abnormally high values will prompt more detailed analyses to verify the exact nature of the contaminants.

Data from samples collected from PVC wells will be reviewed to determine whether the PVC well casing has had any effect on the volatile organic results. This review is necessary because the PVC casing can absorb and release organics in an aqueous solution. If any of the data are questionable, the ASER that reports them will contain a statement about their usability.

Monitoring well procedures (including sampling equipment, techniques, and decontamination methods) required to achieve this objective are described in detail in an instruction guide that governs sampling activities at MISS. This guide is based on Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846) (EPA 1990) and A Compendium of Superfund Field Operations Methods (EPA 1987a). In accordance with best management practices, upgradient wells will be sampled before downgradient wells.

5.4.5 Field Activities Quality Assurance

Sampling techniques, type of equipment, and decontamination procedures to be used for groundwater monitoring are based 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 an unexpected 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 additional sampling that is 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 primary objective of surface water and sediment sampling at MISS (initiated in 1984) is to assess the potential radiation dose from the site to members of the public.

The objective of surface water and sediment sampling at MISS 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

Analytical results for past sampling events document that contaminant fluxes exiting the site via surface water and sediment have been very low (BNI 1991a).

The most likely occurrence of contaminant movement from MISS via the surface water/sediment pathway is during storm events, especially if site soil is disturbed as a result of construction or remedial action. No construction or remedial action is scheduled for the site in the near future; therefore, there is little potential for exposure to the public via this pathway. With the possible exception of discharges during and following heavy rainfall, emissions from radioactive materials are too small to be detectable by state-of-the-art continuous monitoring devices.

5.5.2 Sampling Location Rationale

The overall pattern of surface water/stormwater flow for MISS and current surface water and sediment sampling locations are shown in Figure 5-8. Surface water leaves MISS by two routes: Westerly Brook, which runs through the northwestern corner of the site, and a tributary of Lodi Brook, to the south of the site. Grab sampling locations will be both upstream (location 3) to establish background conditions, and downstream (locations 1, 2, and 4) to determine the effect of runoff from the site on surface waters in the vicinity.

Additional surface water and sediment sampling may be required at MISS to comply with 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 stormwater discharge will be prepared and submitted to NJDEP. A permit will likely require stormwater discharge monitoring on a regular basis; any monitoring will be conducted in compliance with those permit requirements. If a stormwater discharge permit is required, analytical parameters and sampling methods will be in accordance with EPA guidelines and DOE Order 5400.1.

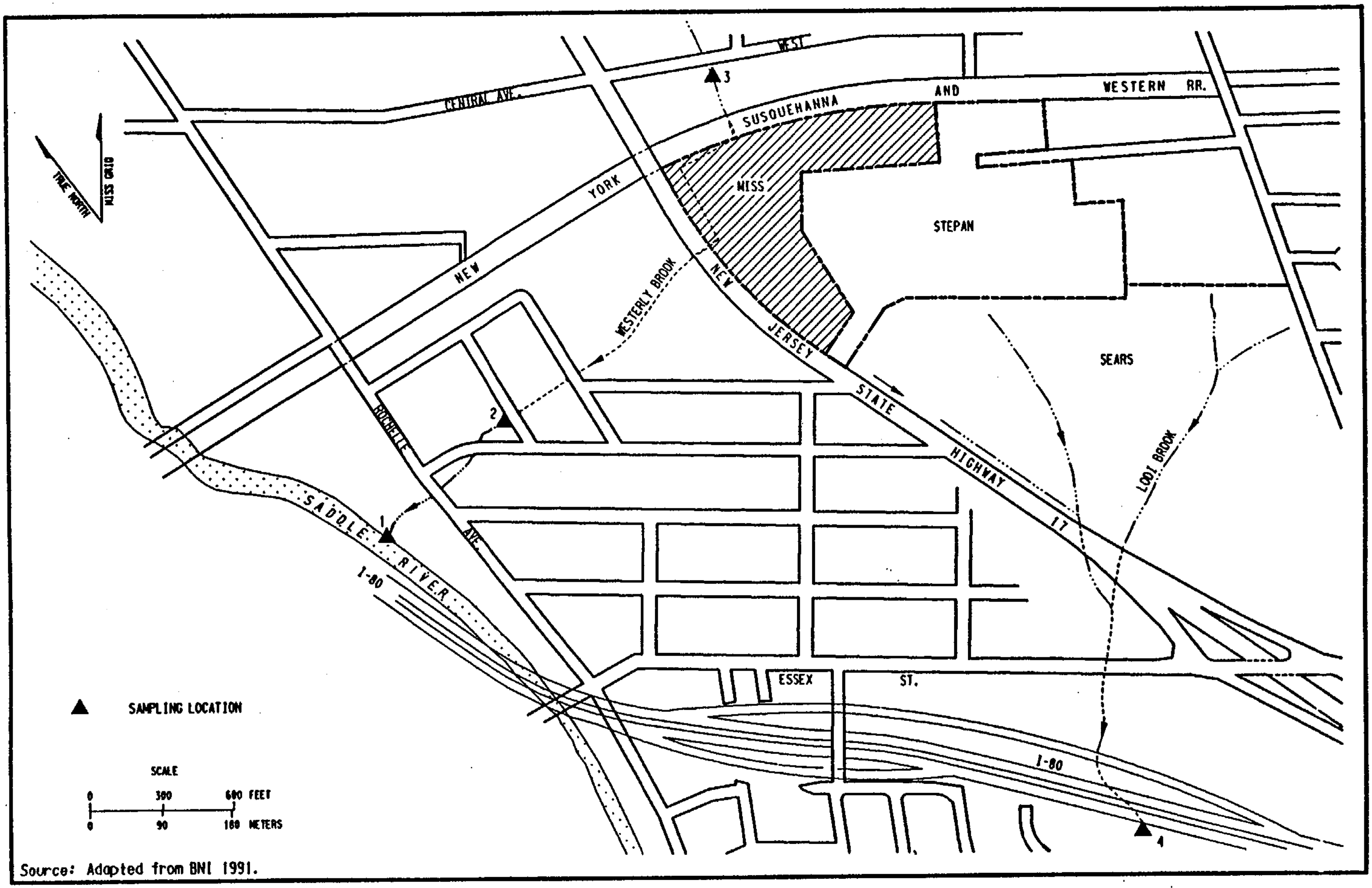

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Figure 5-8
Surface Water and Sediment Sampling Locations in the Vicinity of MISS

5.5.3 Sampling Frequency

Downstream (locations 1, 2, and 4) concentrations of radioactive contaminants in surface water and sediment have differed little from background (location 3) concentrations since 1986. Based on environmental monitoring conducted to date (BNI 1991a), there is no indication that the site is contributing significant levels of contaminants to the environment via the surface water/sediment pathway. Because the site has remained stable since 1986 with no contaminant releases to the environment and there are no plans for construction or remedial action during the near future that could disturb the soil surface, sampling will be conducted semiannually for radiological parameters. Radiological samples will be collected during the second and fourth quarters when the potential for contaminant transport offsite via surface water would be high because of high rainfall during these periods. Chemical samples will be collected during the second quarter. Location 1 will be sampled only if sampling results from location 2 indicate that contaminants of concern are migrating from MISS.

5.5.4 Analytical Parameters and Sampling Methods

Based on site history, characterization data (BNI 1987), and previous monitoring results (BNI 1991a), the radionuclides of concern in surface water and sediment samples are total uranium, radium-226, radium-228, and thorium-232. Analytical parameters for chemicals in surface water will be ICPAES metals, lithium, TOX, TPH, and TOC. Analytical parameters for chemical in sediments are ICPAES metals, lithium, and TPH. Surface water and sediment will be collected as grab samples.

Surface water and sediment sampling procedures (including equipment, techniques, and decontamination methods) will be based on protocols recommended in <u>Test Methods for Evaluating Solid Waste, Physical/Chemical Methods</u> (SW-846) (EPA 1990) and <u>A</u>

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 for surface water and sediment monitoring 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 analyses of 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). Specifications of laboratory methods, analytical requirements, and reporting formats for analyses performed by these laboratories are given in the BNI subcontracts for chemical and radiological analytical services. 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 subsection is to identify acceptable analytical methods and laboratory protocols required for the environmental monitoring program at MISS. These methods were selected for their ability to detect the maximum number of analytes. This section also addresses 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 used to label all samples taken for the program is provided in an instruction guide. This sample ID convention will also be used in the environmental monitoring database to track all pertinent information generated in the program.

Subcontracted laboratories may use their own unique identifiers for in-house tracking of samples, but they will use the same sample ID format as described above to report the analytical results. All environmental monitoring data will be retrievable by sample ID number.

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 collection locations to the laboratory.

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 methods of chemical and radiological analyses used in this program and the detection limits required for each method 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, radium-226, and thorium-232. Total uranium in water will be measured using the fluorometric method, which has proven to be a very sensitive and

Table 6-1
Analyses Performed on Samples from MISS

Parameter	Analytical Technique	EPA Method No.	Detection Limit
Water			
Total uranium	Fluorometric	U-01[a,b]	5.0 µg/L
Isotopic Uranium	Alpha spectroscopy	U-04[a,b]	0.5 pCi/L
Radium-228	Beta scintillation	EPA 600/4-80-32	1.0 pCi/L
Radium-226	Radon emanation	Ra-03[a]	0.1 pCi/L
Thorium-232	Alpha spectroscopy	Th-01[a,b]	0.1 pCi/L
Isotopic thorium	Alpha spectroscopy	Th-03[a]	0.5 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[c]	ICPAES[d]	200.7	Varies with analyte
Arsenic	Atomic absorption	206.2	0.010 mg/L
Lead	Atomic absorption	239.2	0.003 mg/L
Selenium	Atomic absorption	270.2	0.005 mg/L
Thallium	Atomic absorption	279.2	0.010 mg/L
Sulfate	Turbidimetric	375.4	5.0 mg/L
Phosphate	Colorimetric	365.2	0.01 mg/L
Nitrate	Colorimetric	353.1	0.01 mg/L
Chloride	Titrimetric	325.2	1.0 mg/L
Rare earths[e]	ICPAES[d]	200.7	Varies with analyte
Volatile organic compounds	Gas chromatography/ mass spectrometry	8240	Varies with analyte
Semivolatile organic compounds	Gas chromatography/ mass spectrometry	8270	Varies with analyte
Pesticides/PCBs	Gas chromatography/ mass spectrometry	8080	Varies with analyte

Table 6-1
(continued)

Parameter	Analytical Technique	EPA Method No.	Detection Limit
Sediment			
Total uranium	Fluorometric	U-01[a,b]	5.0 μg/L
Radium-226	Gamma spectroscopy	C-02[a]	0.5 pCi/g
Radium-228	Beta scintillation	EPA 600/4-80-32	1.0 pCi/g
Isotopic thorium	Alpha spectroscopy	Th-03[a]	0.5 pCi/g
Metals[c]	ICPAES[d]	200.7	Varies with analyte
Arsenic	Atomic absorption	7060	2.0 mg/L
Lead	Atomic absorption	7421	1.0 mg/L
Selenium	Atomic absorption	7740	5.0 mg/L
Thallium	Atomic absorption	7841	2.0 mg/L
Sulfate	Turbidimetric	375.4	25.0 mg/L
Phosphate	Colorimetric	365.2	5.0 mg/L
Nitrate	Colorimetric	353.1[f]	1.0 mg/L
Chloride	Titrimetric	325.2[f]	50 mg/L
Rare earths[e]	ICPAES[d]	6010	Varies with analyte

Source: BNI 1991a.

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

[b]Modified EML procedure to accommodate the matrix.

[c]Includes aluminum, antimony, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lithium, magnesium, manganese, molybdenum, nickel, potassium, silver, sodium, vanadium, zinc, and lanthanides.

[d]Inductively coupled plasma atomic emission spectrophotometry.

[e]Includes cerium, praseodymium, neodymium, tellurium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, lutetium, and lanthanum.

[f]Approximately 20 g of soil is tumble-extracted in 100 ml laboratory water for a 30-minute period. The sample is filtered and the resulting leachate is then analyzed using the method indicated.

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 will be determined by radon emanation. This method for detecting radon consists of precipitating radium-226 as sulfate and transferring the treated sulfate to a radon bubbler, where the radon is allowed to come into 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.

Thorium-232 is collected from surface water samples by precipitation with ammonium hydroxide. Separation from other ions in the water is accomplished by adsorption of thorium on a cation exchanger from dilute hydrochloric acid, washing with water, and elution with dilute sulfuric acid. Final collection is accomplished by coprecipitation of lanthanum and thorium as hydroxides. The thorium is then electroplated on a stainless steel disk and counted by alpha spectroscopy.

Sediment samples will be analyzed for total uranium, radium-226, and thorium-232. Thorium-232 will be analyzed by gamma spectroscopy. Total uranium concentrations will be measured by using the fluorometric method. Samples to be analyzed for radium-226 will be sealed to allow the radon and its daughters (including bismuth-214) to come into secular equilibrium with the radium-226. Then the sample will be analyzed using gamma spectroscopy, which will detect the radiation from the bismuth-214.

Because the radon daughters (including bismuth-214) are in equilibrium with the radium-226, the radium-226 concentration can be inferred.

In general, chemical analysis methods are based on standard methods given in the EPA SW-846 manual (EPA 1990). Analyses requested for MISS are based on previous site characterization studies and the history of chemical processes conducted there. Detailed laboratory requirements and the specification of chemical methods performed are documented in the chemical analytical services subcontract.

TETLDs containing lithium fluoride chips are used to measure external gamma radiation.

6.1.3 Procedures to Prevent Cross-Contamination

The BNI subcontractor laboratories will each 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 integrity from the time of collection to that of analysis and to help meet the "holding time" guidelines. Concentrated nitric acid will be used as the preservative for radiological groundwater samples to lower 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. This requirement sets forth the levels of decontamination for glassware and equipment. To reduce the possibility for introduction of contaminants during sample preparation, reagents used in preparing standards and samples must meet levels of purity appropriate to the analyses performed. Sample preparation, handling, and analyses will be performed according to applicable EPA methods to minimize cross-contamination. Method blanks and duplicates are used to monitor for contamination that may have occurred during the analytical process.

Volatile samples will be stored in segregated areas at the laboratory to minimize cross-contamination of samples. Method blanks will be analyzed to detect possible cross-contamination of laboratory reagents, solvents, or glassware. Corrective action will be initiated when cross-contamination is identified.

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

6.1.4 Calibration

Generally, laboratory equipment will be calibrated using the calibration frequency recommended by the manufacturers. The internal QA program for each subcontracted 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 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 an internal QA program that will be audited annually by BNI to ensure that the analytical results for samples collected at MISS 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 performance of each laboratory.

Independent verification of compliance with the requirements of this section is accomplished through BNI QA audits of each subcontractor's 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. This scope will ensure that laboratory activities comply with calibration procedures set forth in the subcontract agreements, maintain sample integrity, and minimize possible cross-contamination in the laboratory 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

FUSRAP has established acceptable data analysis and statistical treatment practices by using EPA guidance on data quality objectives (DQOs) to ensure that analytical results comply with DOE Orders 5400.1 and 5400.5. EPA has identified five levels of data quality.

For both radiological and chemical analyses, the DQOs at MISS 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 NRC guidance (NRC 1979).

Data QC level 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 MISS 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 QC reports 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 from the mean.

Recovery limits for each chemical parameter are within the guidelines set forth by the method selected from those available and documented by EPA. Ten percent recovery is 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 and organics, 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 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 for rejected data.

Analytical results will be reported in the ASER after the data review is completed. All analytical results 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, 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.

Annual averages will be determined for all locations from the individual data points. Standard deviations of annual results for samples collected at MISS 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 are those values included within ±2 standard deviations using historic data from the past five years.

Current annual average 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 data evaluation 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 Subsection 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 data reported (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 for both radiological and nonradiological environmental programs will be included in the MISS ASER to satisfy the requirements specified in DOE Order 5400.1.

QC samples will be analyzed to determine whether the QA program objectives are being met. QC sample requirements are listed in Table 7-1. The ten types of QC samples used in the environmental monitoring program are described below. If a QC sample is contaminated, all the 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.

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 is 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	Trip blank	1 per shipment per matrix (volatiles)
		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 or NIST. 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** 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 water that has been demonstrated to be analyte-free and has been poured into and/or over decontaminated sampling equipment. It serves 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.

Matrix spikes and matrix spike duplicates (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 provides 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 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 re-collection of the sample using the same procedures as for the collection of the first sample. For groundwater samples, however, it will not be necessary to purge the well a second time because the duplicate will be collected immediately after the first sample.

A duplicate sample will be taken for every matrix sampled and analyzed for all the same analytes. Duplicates will be taken at a frequency of at least 5 percent (1 for every 20 samples taken). 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 MISS; 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 MISS, 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 MISS are radioactive particulate transport via the atmospheric pathway, 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 MISS because the site is covered with vegetation and the soil is not disturbed. However, modeling will be conducted for this pathway to show compliance with 40 CFR 61 Subpart H.

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 will be considered a potential exposure pathway. Westerly Brook traverses MISS beneath the northeastern corner of the site, while the southwestern part is drained by runoff to Lodi Brook. Both empty into the Saddle River, but none of these sources are used to supply drinking water. Both surface water and sediment from these sources will be monitored for radioactive and chemical contamination at upstream (background) and downstream locations as described in Subsection 5.5. If surface water monitoring data do not indicate above-background concentrations of radioactive contaminants, dose calculations will not be performed.

The groundwater system at MISS will also be considered a potential exposure pathway. Concentrations of radioactive contaminants in groundwater have been well below the DCGs for thorium-232, uranium-238, and radium-226. Groundwater sampling will be conducted as part of the monitoring program, and if above-background concentrations of radioactive or chemical contaminants are detected, estimates will be made of exposure. Onsite groundwater sources are not considered viable exposure pathways because the site is fenced and wells outside the fence are capped and locked.

The foodchain is not considered a primary pathway because the site is not located in an area where significant amounts of livestock are raised or foodstuffs (i.e., gardens) are grown.

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 at a location near the site. Exposure data for this individual will be collected through the TETLD program, which provides an average fenceline exposure rate at 1 m (3 ft) above the ground surface. An exposure will then be calculated at a distance of 50 m (150 ft) from the fenceline assuming the individual works at this location for an entire year, using the following equation (Cember 1983):

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

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

h_2 = Distance to the MEI [50 m (150 ft)]

L = Half the length of the site

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 to allow for 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 MISS.

8.3.2 Pathway for Airborne Particulates

To estimate a maximum dose to a hypothetical MEI from airborne particulates from the site, it will be assumed that the individual lives and works within 50 m (150 ft) of the site. Environmental monitoring data will be incorporated into the EPA AIRDOS model (current version) (ORNL 1989) to calculate the effective dose equivalent.

To determine the collective dose to the general population via the atmospheric pathway, the EPA AIRDOS model is applied at differing distances from the site to a maximum of 8 km (5 mi). Using the effective dose rate equivalents and the population density, a collective dose for the general population within 80 km (50 mi) is calculated.

Atmospheric particulate release rates, used in the AIRDOS model, are determined by using an unlimited wind erosion model (EPA 1985) for the site and soil concentration values obtained during 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 (standard calculations by which others may be compared) will be used to verify any computer modeling code.

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 MISS. 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 MISS, 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; maintenance and retention of 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 duplicate records are 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 when such events are 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 MISS are contained in numerous regulations. Applicable requirements found under CERCLA, Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), Clean Air Act (CAA), and National Environmental Policy Act (NEPA) are explained below.

- **CERCLA:** CERCLA is the primary statutory authority for response actions conducted at MISS 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 40 CFR Part 300, 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. The administrative record contains documents that form the basis for selecting response actions at a particular site.

In general, any permits required by federal or state law must be kept onsite. However, CERCLA Section 121 provides an exception to the administrative requirements 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 the requirements for inclusion of specific documents may be resolved by 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 MISS 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:** No permit applications are required.

- **NEPA:** Many NEPA documents will be placed in the onsite administrative record pursuant to CERCLA. For example, the remedial investigation/feasibility study (RI/FS) will be part of the administrative record, and FUSRAP prepares integrated CERCLA/NEPA documents such as the RI/FS-environmental impact statement (EIS). Therefore, certain NEPA documents will be kept onsite. 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.

Neither hazardous waste nor radioactive mixed waste is present at MISS; therefore, the site is not subject to regulation under RCRA. In addition, there are no PCBs or asbestos onsite, and MISS is, therefore, not subject to the PCB or asbestos regulations in the Toxic Substances Control Act.

Some record-keeping and reporting requirements applicable to MISS are found under 40 CFR Part 61; Subpart H of NESHAPs regulates atmospheric radionuclide emissions from DOE facilities. Compliance status is determined using an EPA-approved computer model such as COMPLY or AIRDOS (and direct measurements, if necessary). The information is then used to support submittal of annual reports to EPA (due at the end of June).

Current site information indicates that MISS is not subject to Subpart Q of NESHAPs, which regulates atmospheric radon emissions. Calculations to estimate the potential radon flux rate indicate that radium is not present at MISS in sufficient quantities to generate radon-222 flux rates in excess of the Subpart Q standards. Documentation of these calculations is provided to EPA upon request.

Recent developments in the regulation of water discharges require stormwater discharge permits for sites where industrial activities were once conducted. DOE is considered the operator of

MISS and plans to permit discharges at the site. Documentation of the permitting process will be subject to record-keeping requirements.

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

10.0 QUALITY ASSURANCE

10.1 IMPLEMENTATION

The comprehensive QA program is based on the MISS quality assurance project plan (BNI 1990b) and 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 performed in support of MISS. QA requirements will also be incorporated into contracts, work orders, and purchase orders issued for work and services at MISS 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 surveillance and auditing 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 MISS. Sampling and sample analysis will be performed primarily by two subcontractors, TMA/E and Weston. Other subcontractors will perform labor, supply material, and assist in the various aspects of FUSRAP activities at MISS.

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. Any subcontractor not having its own QA program will work under the requirements of FUSRAP's 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 NRC.

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 MISS 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, the instruction guide for the sampling program 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
- Calibration of analytical equipment
- Data verification
- Data reporting
- Data and record retention
- Sample retention

10.6 RADIATION AND CHEMICAL MEASURING EQUIPMENT

Equipment used to quantify radiological and chemical contaminants 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.

REFERENCES

Argonne National Laboratory (ANL) and Bechtel National, Inc. (BNI), 1990. Work Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Site, Maywood, New Jersey (Draft), DOE/OR/20722-193.1, Oak Ridge, Tenn. (July).

The American Society of Mechanical Engineers (ASME), 1989. Quality Assurance Program Requirements for Nuclear Facilities, ASME-NQA-1 (September 15).

BNI, 1987. Characterization Report for the Maywood Interim Storage Site, DOE/OR/20722-139, Oak Ridge, Tenn. (June).

BNI, 1990a. Quality Assurance Program Plan for U.S. DOE FUSRAP, Oak Ridge, Tenn. (December 11).

BNI, 1990b. Quality Assurance Project Plan for the Remedial Investigation/Feasibility Study-Environmental Impact Statement for the Maywood Site (Draft), DOE/OR/20722,193.5, Oak Ridge, Tenn. (June).

BNI, 1991a. Maywood Interim Storage Site Annual Environmental Report - Calendar Year 1990, DOE/OR/21949-288, Oak Ridge, Tenn. (September).

BNI, 1991b. Formerly Utilized Sites Remedial Action Program ALARA Plan, Oak Ridge, Tenn. (August).

Bionetics Corporation, 1984. Site Analysis, Maywood Chemical Sites, Maywood and Rochelle Park, New Jersey, prepared for the Environmental Protection Agency, Environmental Monitoring Systems Laboratory, TS-PIC-84023, Wattenton, Va. (May).

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

Department of Energy (DOE), 1983. Letter from F. E. Coffman (Director, Office of Terminal Waste Disposal and Remedial Action, Office of Nuclear Energy, DOE Headquarters) to J. La Grone (Manager, DOE Oak Ridge Operations Office) Subject: R & D Decontamination Projects under the Formerly Utilized Sites Remedial Action Program (FUSRAP) (August 3).

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

DOE, 1988b. Order 5820.2A, "Radioactive Waste Management" (September 26).

DOE, 1989. Order 5700.6B, "Quality Assurance" (November 22).

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

DOE, 1990b. EML Procedures Manual, Environmental Measurements Laboratory, HASL-300-Ed. 27.

DOE, 1991. Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, DOE/EH-0173T, Washington, D.C. (January).

Environmental Protection Agency (EPA), 1985. Rapid Assessment Exposure to Particulate Emissions from Surface Contamination Sites, EPA/600/8-85/002 (February).

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

EPA, 1987b. Data Quality Objectives for Remedial Response Activities, Office of Emergency and Remedial Response and Office of Waste Programs Enforcement, EPA 540/G-87/003, Washington, D.C. (March).

EPA, 1990. Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods, "Revision of Chapter 11 of SW-846, Ground-water Monitoring Design, Installation, and Operating Practices" (Draft) (November).

National Council on Radiation Protection and Measurements (NCRP), 1986. Screening Techniques for Determining Compliance with Environmental Standards (Commentary 3).

Nuclear Regulatory Commission (NRC), 1979. "Quality Assurance for Radiological Monitoring Programs - Effluent Streams and the Environment," Guide 415, Rev. 1 (February).

NRC, 1981. Stepan Company Inspection, Office of Inspection and Enforcement, Region I, No. 40-8610/80-01 (February 18).

Nuclear Safety Associates, Inc., 1982. Natural Thorium in Maywood, New Jersey, Potomac, Md. (September 29).

Oak Ridge Associated Universities (ORAU), 1981. Radiological Assessment of Ballod Associates Property (Stepan Chemical Company), Maywood, New Jersey, , Oak Ridge, Tenn. (July).

Oak Ridge National Laboratory (ORNL), 1989. AIRDOS-EPA: A Computerized Methodology for Estimating Environmental Concentrations and Dose to Man from Airborne Releases of Radionuclides, ORNL-5532, Oak Ridge, Tenn. (December).

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

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

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

D. No radioiodides are present.

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

MISS 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	5.5.6

	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

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

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 3.0

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	A
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

MISS 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

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, ¶ 3
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, ¶ 3

	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, ¶ 14
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
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	5.3.6, ¶ 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

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, ¶ 3
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
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, ¶ 4
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, ¶ 2 and 3
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 5.3.2, ¶ 2 5.4.2, ¶ 2 and 8 5.5.2, ¶ 1

MISS EMP Summary Matrix

	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, ¶ 14 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, ¶ 12
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, ¶ 14

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
w. The analytical procedure to be used **should*** be considered when choosing a method for preserving milk samples.	5.8.2.1	H 5.1, ¶ 12
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
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 Table 6-1
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, ¶ 5
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 and 2

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, ¶ 4
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 section
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, ¶ 4
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, ¶ 6, 8, 9, 11, and 12 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, ¶ 13
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 section
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		
	10.0	10.1
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.		
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

MISS EMP Summary Matrix

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 MISS (1991 Versus 1992)

APPENDIX B

MAYWOOD 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		31	652		7/8	108	
Ra-226	Quarterly			Semiann/Annual			5.4.2
Ra-228	Quarterly			Semiann/Annual			
Th-232	Quarterly			Semiann/Annual			
Total uranium	Quarterly			Semiann/Annual			
CHEMICAL PARAMETERS		31	2436		15	208	
ICPAES	Quarterly			Annually			5.4.3
VOA	Annually			Annually			
BNAE	Annually			Annually			
Pest/PCBs	-			Annually			
TOC	Quarterly			Annually			
TOX	Quarterly			Annually			
Sulfate	Quarterly			-			
Nitrate	Quarterly			-			
Chloride	Quarterly			-			
Ortho-Phos.	Quarterly			-			
As-AA	Quarterly			-			
Pb-AA	Quarterly			-			
Se-AA	Quarterly			-			
Tl-AA	Quarterly			-			
Hg-AA	Quarterly			-			
Li-AA	Quarterly			Annually			
Rare Earths	Quarterly			-			
TPH	-			Annually			
SURFACE WATER SAMPLING							
RADIOLOGICAL PARAMETERS		4	80		3	32	
Ra-226	Quarterly			Semiannually			5.5.2
Ra-228	Quarterly			Semiannually			
Th-232	Quarterly			Semiannually			
Iso Uranium	Quarterly			Semiannually			
CHEMICAL PARAMETERS		4	406		3	30	
ICPAES	Quarterly			Annually			5.5.2
VOA	Annually			-			
BNAE	Annually			-			
Pest/PCBs	-			-			
TOC	Quarterly			Annually			
TOX	Quarterly			Annually			
Sulfate	Quarterly			-			

	1991 FREQUENCY	1991 LOCATIONS	1991 ANALYSES/YR* or MEASUREMENTS/YR	1992 FREQUENCY	1992 LOCATIONS	1992 ANALYSES/YR* or MEASUREMENTS/YR	RATIONALE (EMP SECTION)
CHEMICAL PARAMETERS (continued)							
Nitrate	Quarterly			-			
Chloride	Quarterly			-			
Ortho-Phos.	Quarterly			-			
As-AA	Quarterly			-			
Pb-AA	Quarterly			-			
Se-AA	Quarterly			-			
Tl-AA	Quarterly			-			
Hg-AA	Quarterly			-			
Li-AA	Quarterly			Annually			
Rare Earths	Quarterly			-			
TPH	-			Annually			
GEOLOGICAL PARAMETERS		33	858		32	128	5.4.2
Water Level Measurements	Biweekly			Quarterly	(Plus 3 automatic well recorders)		
SEDIMENT SAMPLING							
RADIOLOGICAL PARAMETERS		4	80		3	32	
Ra-226	Quarterly			Semiannually			5.5.2
Ra-228	Quarterly			Semiannually			
Th-232	Quarterly			Semiannually			
Iso Uranium	Quarterly			Semiannually			
CHEMICAL PARAMETERS		4	336		3	18	
ICPAES	Quarterly			Annually			5.5.2
Sulfate	Quarterly			-			
Nitrate	Quarterly			-			
Chloride	Quarterly			-			
Ortho-Phos.	Quarterly			-			
As-AA	Quarterly			-			
Pb-AA	Quarterly			-			
Se-AA	Quarterly			-			
Tl-AA	Quarterly			-			
Hg-AA	Quarterly			-			
Li-AA	Quarterly			Annually			
Rare Earths	Quarterly			-			
TPH	-			Annually			
FIELD MONITORING							
PARAMETERS		19	76		19 (2 each)	76	
Gamma radiation	Quarterly			Semiannually			5.2.3

APPENDIX B

(continued)

	1991 FREQUENCY	1991 LOCATIONS	1991 ANALYSES/YR* or MEASUREMENTS/YR	1992 FREQUENCY	1992 LOCATIONS	1992 ANALYSES/YR* or MEASUREMENTS/YR	RATIONALE (EMP SECTION)
RADON MONITORING							
PARAMETERS		19 (2 types)	152		19 (2 types)	152	
Radon + daughters	Quarterly			Quarterly			5.3.2

*QC samples included.