DOE/OR/20722-81
REVISION 1

M-110

Formerly Utilized Sites Remedial Action Program (FUSRAP)
Contract No. DE-AC05-81OR20722

CHARACTERIZATION PLAN FOR SEARS AND ADJACENT PROPERTIES

Maywood, New Jersey

July 1986

Bechtel National, Inc.
Advanced Technology

038672

Bechtel National, Inc.
Engineers — Constructors

Jackson Plaza Tower
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37830

Mail Address: P.O. Box 350, Oak Ridge, TN 37831-0350
Telex: 3785873

JUL 28 1986

U.S. Department of Energy
Oak Ridge Operations
Post Office Box E
Oak Ridge, Tennessee 37831

Attention: J. F. Wing
Technical Services Division

Subject: Bechtel Job No. 14501, FUSRAP Project
DOE Contract No. DE-AC05-81OR20722
Published Version of Characterization Plan for
Sears and Adjacent Properties
File 148, 138-K

Reference: Letter, S.W. Ahrends to J.F. Nemec, "Prepublication Review of Characterization Plan for Sears and Adjacent Properties," July 17, 1986

Dear Mr. Wing:

Enclosed are 10 copies of the subject document, as requested in the referenced letter. It was agreed in a telephone discussion between Chris Leichtweis and Bob Atkin on July 25 that no change would be made to the document in response to the comment transmitted in the above letter.

Very truly yours,

James R. Kannard
Project Manager - FUSRAP

CONCURRENCE

JMH	CPS	JRK		

JMH/jmh

Enclosures: As Stated

cc: S.W. Ahrends
R.G. Atkin
B.A. Hughlett
J.F. Nemec

0668x

Received by
JUL 28 1986
FUSRAP PDCC

038672

DOE/OR/20722-81
Revision 1

CHARACTERIZATION PLAN FOR
SEARS AND ADJACENT PROPERTIES
MAYWOOD, NEW JERSEY

JULY 1986

Prepared for

UNITED STATES DEPARTMENT OF ENERGY

OAK RIDGE OPERATIONS OFFICE

Under Contract No. DE-AC05-81OR20722

By

Bechtel National, Inc.

Advanced Technology

Oak Ridge, Tennessee

Bechtel Job No. 14501

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

Characterization of Sears and adjacent properties is necessary to determine the magnitude and nature of the radioactive contamination present. Limited chemical characterization of radiologic waste will be performed at two of the adjacent properties. This report is intended to document the scope of the characterization effort and the procedures to be used.

1.1 HISTORICAL OVERVIEW

Areas near the Stepan Company plant known as the Sears Distribution Center, Gulf Station, Sunoco Station, Federal Express, Hunter Douglas, and DeSaussure (Figure 1-1) were shown to be radioactively contaminated by the NUS Corporation during a radiological survey conducted in July 1983 (Ref. 1). This contamination originated from the processing of thorium ores between 1916 and 1956 (Ref. 2) by the Maywood Chemical Works (later purchased by the Stepan Company) and is known to consist primarily of thorium-232 and its daughters with some elevated concentrations of uranium-238 and its daughters.

The 1984 Energy and Water Appropriations Act directed the U.S. Department of Energy (DOE) to conduct a decontamination research and development project at four sites throughout the nation, including the site of the former Maywood Chemical Works and its vicinity properties in the Borough of Maywood, Township of Rochelle Park, and Borough of Lodi, New Jersey. Remedial action at these properties was performed under the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE effort to identify, decontaminate, or otherwise control sites where low-level radioactive contamination (exceeding current guidelines) remains from either the early years of the nation's atomic energy program or commercial operations causing conditions that Congress has mandated DOE to remedy. Bechtel

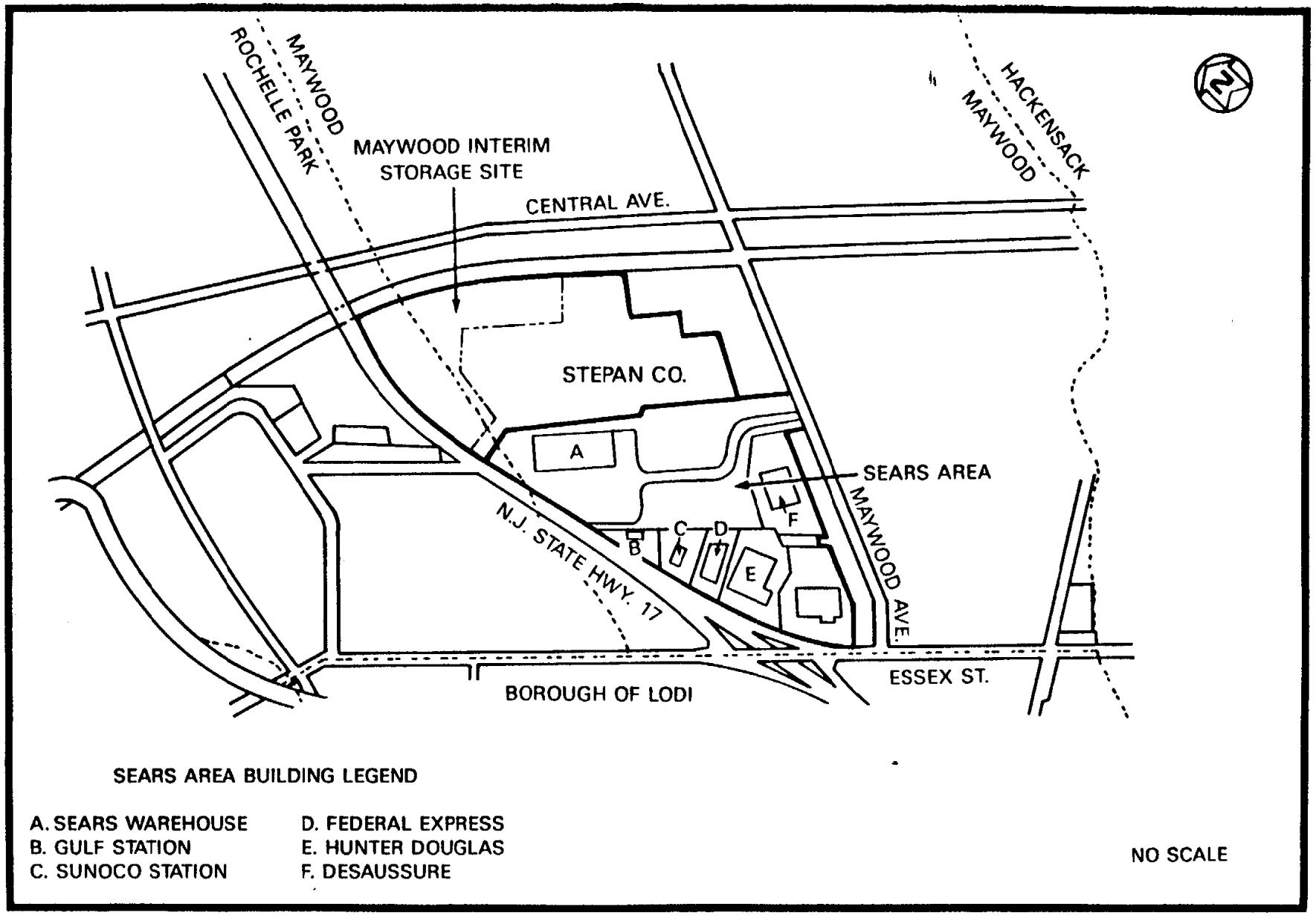

FIGURE 1-1 LOCATION OF SEARS AND ADJACENT PROPERTIES

National, Inc. (BNI), was selected as Project Management Contractor for FUSRAP. The guidelines governing the remedial action at Maywood are presented in Table 1-1.

1.2 REVIEW OF EXISTING INFORMATION

Before field activities for the characterization commence, available information on the site will be reviewed. These reviews will include, but will not be limited to, all known previous characterization reports by various organizations, topographic surveys, aerial photographs, and eyewitness accounts.

As a result of this effort, a reasonable knowledge of expected site conditions and suspect areas will be obtained. This information will be used to help direct biased sampling activities and will result in a more accurate projection of site conditions while minimizing costs. Review of this information will be completed in time for findings to be made available to the field characterization team for use in performing the survey.

1.3 SCHEDULE

The Sears and adjacent properties characterization will follow the MISS characterization. It will start in June 1986, with completion scheduled for July 1986.

1.4 SUPPORT SERVICES

Accomplishment of this characterization will necessitate the following support subcontracts:

- Surveying services will be required to establish a 50-ft grid system at the six properties to be characterized and to survey all the boreholes installed during this investigation. The former will be required before the start of characterization activities.
- A subcontract will be required for borehole drilling.

TABLE 1-1
SUMMARY OF RESIDUAL CONTAMINATION GUIDELINES FOR MAYWOOD

SOIL (LAND) GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

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

STRUCTURE GUIDELINES (MAXIMUM LIMITS FOR UNRESTRICTED USE)

Airborne Radon Decay Products

Generic guidelines for concentrations of airborne radon decay products shall apply to existing occupied or habitable structures on private property that are intended for unrestricted use; structures that will be demolished or buried are excluded. The applicable generic guideline (40 CFR 192) is: In any occupied or habitable building, the objective of remedial action shall be, and reasonable effort shall be made to achieve, an annual average (or equivalent) radon decay product concentration (including background) not to exceed 0.02 WL.[d] In any case, the radon decay product concentration (including background) shall not exceed 0.03 WL. Remedial actions are not required in order to comply with this guideline when there is reasonable assurance that residual radioactive materials are not the cause.

External Gamma Radiation

The average level of gamma radiation inside a building or habitable structure on a site to be released for unrestricted use shall not exceed the background level by more than 20 μR/h.

Indoor/Outdoor Structure Surface Contamination

Radionuclide[f]	Allowable Surface Residual Contamination[e] (dpm/100 cm^2) Average[g,h]	Maximum[h,i]	Removable[h,j]
Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224 U-232, I-126, I-131, I-133	1,000	3,000	220
U-Natural, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000 β-γ	15,000 β-γ	1,000 β-γ

TABLE 1-1

(continued)

[a]In the event of occurrence of mixture of radionuclides, the fraction contributed by each radionuclide to its limit shall be determined, and the sum of these fractions shall not exceed 1.

[b]These guidelines represent unrestricted-use residual concentrations above background averaged across any 15-cm-thick layer to any depth and over any contiguous 100-m^2 surface area.

[c]Localized concentrations in excess of these limits are allowable provided that the average over a 100-m^2 area is not exceeded.

[d]A working level (WL) is any combination of short-lived radon decay products in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha energy.

[e]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[f]Where surface contamination by both alpha- and beta-gamma-emitting radionuclides exists, the limits established for alpha- and beta-gamma-emitting radionuclides should apply independently.

[g]Measurements of average contamination should not be averaged over more than 1 m^2. For objects of less surface area, the average shall be derived for each such object.

[h]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/h and 1.0 mrad/h, respectively, at 1 cm.

[i]The maximum contamination level applies to an area of not more than 100 cm^2.

[j]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and measuring the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. The numbers in this column are maximum amounts.

2.0 RADIOLOGICAL CHARACTERIZATION

2.1 SCOPE/PURPOSE

Radiological characterization of Sears and adjacent properties will be conducted to determine approximate horizontal and vertical limits of contamination, to determine ranges of radionuclide concentrations, and to estimate the volume of contaminated material present on each property. An important secondary objective is to identify and evaluate any pathways by which contamination might have migrated from these sites. Individual activities designed to cost-effectively accomplish these goals are delineated in a checklist presented in Appendix A. The following subsections provide more detail associated with the checklist. The planned level of effort for Thermo Analytical/Eberline (TMA/E), the BNI radiological support contractor, is documented in Appendix B.

2.2 CHARACTERIZATION ACTIVITIES

2.2.1 Site Grid System

A civil surveyor will establish a 50-ft grid over the entire Sears Distribution Center and six adjacent properties by staking the intersections of a series of mutually perpendicular lines (Figure 2-1). Each stake will be marked with grid coordinates. A 2-in.-square wooden hub stake will also be installed at each alternate stake (every 100 ft) along each grid line. The grid will be an extension of the grid established on the Maywood Interim Storage Site and will be tied to the New Jersey state grid system with sufficient detail to allow reestablishment of the grid at some future date. All property lines will be located and set. A drawing showing the property lines, buildings, fences, roads, gravel, asphalt, surface obstructions, landmarks, grid intersections, and other features will be provided by the surveyor. This drawing will help identify surface obstructions and ground elevations, as well as problem areas that will significantly affect the cost of remedial action.

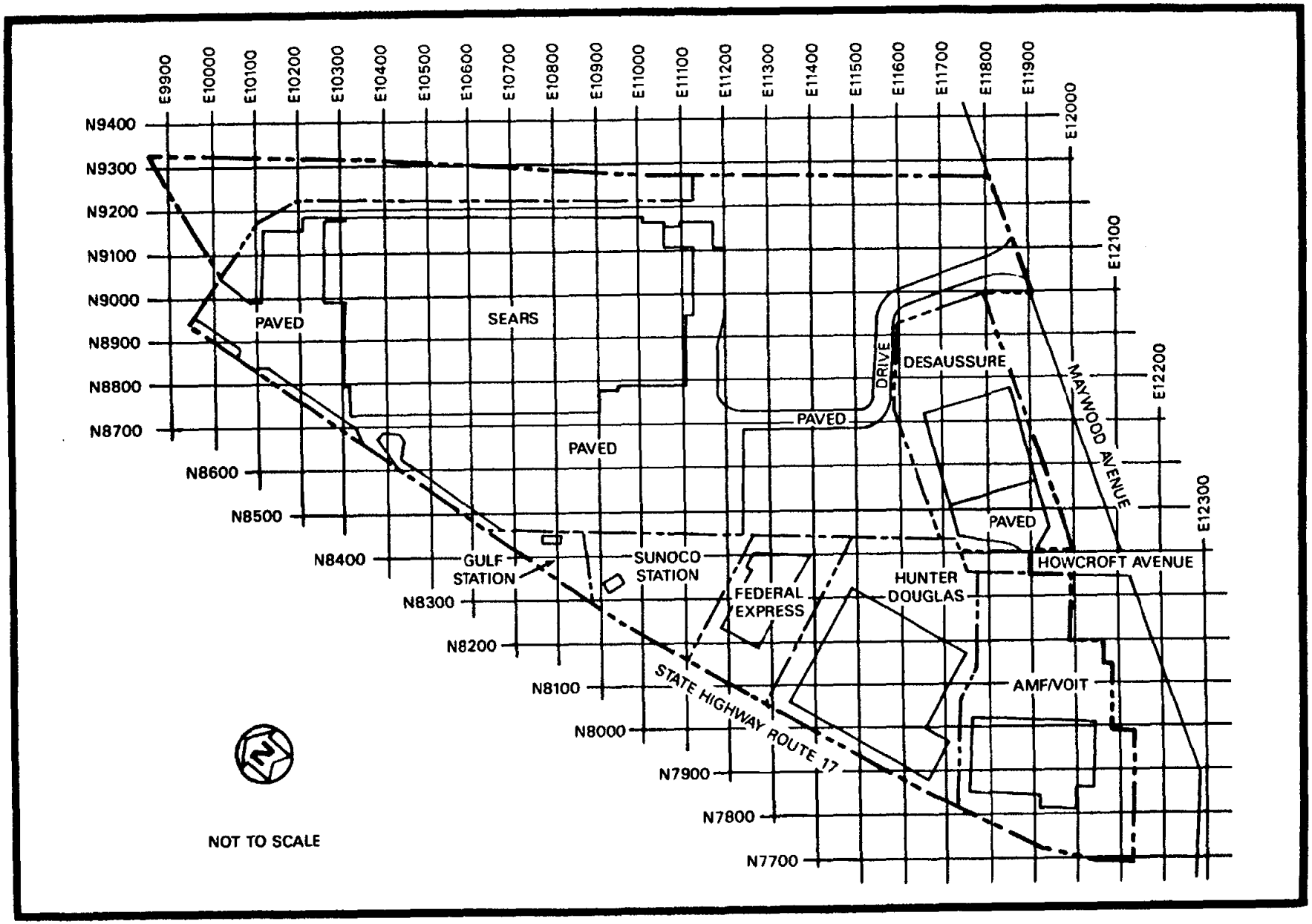

FIGURE 2-1 GRID FOR SEARS AND ADJACENT PROPERTIES

2.2.2 Surface Characterization

Surface characterization will precede subsurface investigations so that an understanding of contamination patterns is gained before biased borehole locations are selected. This will ensure that the depth of all surface contamination is known.

Surface characterization will consist of the activities listed below.

- Walkover surveys will be performed that consist of gamma radiation scans of individual 50-ft by 50-ft grid blocks. Areas in which readings exceed twice normal background levels will be marked on a site drawing. The walkover survey covers essentially 100 percent of the ground surface and ensures that hotspots between grid points are detected.

- Cone-shielded gamma scintillometer measurements will be made at no greater than 12.5-ft intervals in areas of contamination identified during the walkover survey. These measurements will minimize discrepancies in the size of a given area that might have been created by lateral gamma flux (shine) from other contaminated areas nearby. Data obtained from this survey will permit refinement of the boundaries of contaminated areas established on the basis of the walkover scans.

- Surface soil samples (0 to 6 in.) will be collected from selected locations on both systematic and biased spacing. Locations will be selected after review of the gamma scanning data. Samples will be analyzed for uranium-238, thorium-232, and radium-226. The samples will be selected to determine radionuclide concentrations in areas where the surface scan data are ambiguous.

- Sediment samples will be collected from all drainage pathways, including ditches, swales, berms, and culverts. These samples will be analyzed for uranium-238, thorium-232, and radium-226. The analyses will help quantify radionuclide concentrations in pathways leaving the properties.

2.2.3 Subsurface Investigation

Systematic subsurface investigation will be conducted by drilling 6-in.-diameter boreholes at most 100-ft grid intersections. Systematic subsurface investigation is necessary to 1) define vertical excavation limits, 2) estimate the volume of waste, and 3) provide assurance to the Independent Verification Contractor that

major subsurface deposits have been identified. Biased locations will also be chosen to gain information from areas of suspected contamination and to reduce some uncertainties in the waste volume estimates. At least one borehole will be drilled in each area where elevated concentrations of surface radioactive contamination are found so that the depth of the contamination can be determined. Boreholes will be advanced until the field geologist indicates that undisturbed soil has been reached. This will ensure that all layers of contamination have been penetrated and detected.

Subsurface investigation will be performed primarily by gamma logging of drilled boreholes since this method is more cost effective than soil sampling and analysis. Once drilled, each characterization hole will be temporarily lined with a closed-end, 4-in.-diameter PVC casing while it is gamma logged. Gamma logging will be conducted by lowering a gamma scintillometer into the borehole. This detector will be calibrated to allow correlation from counts per minute to picocuries per gram (pCi/g). Gamma radiation measurements will be made typically at 1-ft vertical intervals; however, the interval may be smaller near the boundaries of contamination to more accurately determine the boundary between clean and contaminated soil. Subsurface soil samples will also be collected at selected locations by a split-spoon sampler driven in advance of the auger to help resolve gamma logging inconsistencies.

After each borehole is systematically logged, the depth of gamma-emitting radionuclide contamination in it will be compared with depths of contamination in other boreholes in the area. If a significant difference is noted, additional boreholes will be drilled at a closer spacing to better define the areas of contamination. These boreholes will be logged and sampled in the manner described above. When high levels of contamination are suspected in and around habitable structures, interior drilling will be conducted. With the exception of drilling through existing concrete floors, the drilling methodology will be similar to that discussed above. Once sampled, all boreholes will be sealed using bentonite and/or cement/bentonite grout.

Although current information does not indicate the presence of contamination on the AMF/Voit property, results from surface scans and analyses on subsurface samples from the adjacent DeSaussure and Hunter Douglas properties will be examined to determine whether boreholes should be drilled on the AMF/Voit property.

Samples from boreholes in which suspicious materials are encountered will be chemically analyzed to determine whether or not hazardous materials are present that might necessitate special precautions during excavation or storage of the radioactively contaminated materials. Suspicious materials may include sludges, liquids, discolored or colored soils, or airborne contaminants detectable by industrial hygiene instrumentation. It is anticipated that samples from no more than 12 boreholes will be analyzed for selected chemical contaminants.

2.2.4 Data Review

Meetings of the field characterization team will be held after each successive stage of the characterization to review and discuss findings to date. At these meetings, problem areas and inconsistencies with current and historical data will be identified, and a strategy for continued investigation will be developed. The meetings will serve to structure the characterization sequentially so that information collected in each phase is built upon and clarified throughout the course of the survey.

Field data will be submitted to the BNI Oak Ridge office on a daily basis for interpretation by the BNI health physics staff. This will allow monitoring of progress and real-time resolution of problems. Changes in methodology can be implemented to refine the characterization and gain better information in a cost-effective manner.

2.3 DOCUMENTATION

All data collected during the survey will be transmitted to the BNI Oak Ridge office via the TMA/E Oak Ridge office in an approved format (graphically whenever possible). Before the start of field activities, the field team will be provided with blank grid drawings on which to plot field measurements. The field team will assign a scale to the grid blocks, which will permit later interpretation of the drawings. These drawings will show:

- Surface walkover scan findings in the form of grid blocks showing radiation levels greater than twice background
- All cone-shield readings in counts per minute
- Locations of all surface soil and sediment samples, identified in such a way that the results of laboratory analyses for each location can be clearly associated with the corresponding point on the drawing
- Locations of all boreholes with identification numbers corresponding to gamma logs and soil samples
- Sketches of buildings, surface obstructions, irregularities, drainage pathways, culverts, fences, roads, landmarks, (to rough scale)

2.4 REPORTING

A formal radiological characterization report will be prepared to present the data collected and an interpretation of the results. The main objectives of the report will be to present the current radiological conditions at Sears and adjacent properties and to provide an evaluation of these conditions.

3.0 PERSONNEL HEALTH AND SAFETY

The health and safety of site personnel performing characterization activities will be protected through the implementation of the FUSRAP Occupational Health/Industrial Hygiene Plan (PI 26.0) (Ref. 3). This plan is based on prudent practices that are designed to minimize the hazards posed by substances that may be present on-site.

A brief description of the FUSRAP Occupational Health/Industrial Hygiene Plan follows.

- General Policy, Organization, and Responsibility: Delineates the responsibilities of key FUSRAP personnel for implementing the plan, including coordinator and management review of the overall health protection system.
- Medical Screening: Establishes scope of and criteria for pre-work, periodic, and follow-up medical assessment to ensure the evaluation of site personnel health status during performance of project work.
- Personnel Protective Apparel and Equipment: Discusses specific health protection systems, including personnel protective apparel and equipment requirements; environmental hygiene monitoring equipment; equipment/personnel decontamination procedures; radiological health protection systems; availability of first-aid, safety, and fire protection equipment on an emergency basis; and rationale for identification of certain on-site conditions as health hazards.
- Conduct of On-site Workers and Visitors: Itemizes general health and safety procedures as well as prohibited practices for performing work on-site.
- Field Personnel Health and Safety Training: Sets forth training objectives and proposed instructional outline to ensure comprehensive health and safety training of site personnel; reviews the personnel protection program in detail; and delineates emergency procedures, prohibited procedures, and general safety requirements for conducting site work.
- Special Conditions for Specific Operations: Details the potential health hazards present during drilling and excavation operations (i.e., gases, volatile organics, and hydrogen sulfide).

REFERENCES

1. NUS Corporation. Radiological Study of Maywood Chemical, Maywood, New Jersey, November 7, 1983.

2. Morton, Henry W. Natural Thorium in Maywood, New Jersey, Nuclear Safety Associates, Inc., Potomac, MD, September 29, 1982.

3. Bechtel National, Inc. Generic Occupational Health/Industrial Hygiene Plan for FUSRAP/SFMP Sites, FUSRAP Project Instruction 26.0, Oak Ridge, TN, January 1985.

APPENDIX A
RADIOLOGICAL CHARACTERIZATION CHECKLIST
FOR SEARS AND ADJACENT PROPERTIES

APPENDIX A

RADIOLOGICAL CHARACTERIZATION CHECKLIST FOR SEARS AND ADJACENT PROPERTIES

Action	Completed	
	Initials	Date
1. Review of Historical Information		
a. previous radiation surveys	_____	_____
b. operations descriptions	_____	_____
c. photos	_____	_____
d. interviews		
1) operations personnel (hire as consultants?)	_____	_____
2) neighbors	_____	_____
3) others	_____	_____
e. Aero Space Research resources	_____	_____
f. others	_____	_____
2. Property Surveys		
a. obtain blank grid drawings	_____	_____
b. obtain old and new topographical drawings	_____	_____
c. confirm that the property is staked at 50-ft intervals	_____	_____
3. Walkover Tour of Properties (note on drawings)		
a. rubble	_____	_____
b. surface obstructions	_____	_____
c. buried utility lines	_____	_____
d. utility poles	_____	_____
e. culverts	_____	_____
f. stockpiles	_____	_____
g. grates, drains	_____	_____
h. others (wells, etc.)	_____	_____

4. Characterization Team Review of Preliminary Information
   a. compare old and new topographic maps for changes _____ _____
   b. develop sketches of properties from historical information _____ _____

5. Surface Gamma Surveys
   a. walkover with unshielded gamma scintillometer _____ _____
   b. cone-shielded gamma survey to define boundaries of contaminated areas _____ _____

6. Team Meeting to Review Gamma Scans
   a. map areas exceeding preselected limits with unshielded scan _____ _____
   b. map areas exceeding preselected limits with cone-shield results _____ _____
   c. check consistency of surface scans with historical information _____ _____
   d. plan locations for systematic and biased surface soil samples _____ _____
   e. plan locations for systematic boreholes _____ _____
   f. plan locations for sampling around Item 3 problem areas _____ _____
   g. plan sediment sampling locations
      1) culverts _____ _____
      2) drainage ways _____ _____
      3) inside storm sewers _____ _____
      4) outfalls _____ _____
      5) others _____ _____

7. Surface Soil Sampling (as planned in 6d) _____ _____

8. Sediment Sampling (as planned in 6g) _____ _____

9. Subsurface Investigations (as planned in 6e)
   a. drill systematic boreholes to depth of undisturbed soil _____ _____

b. drill systematic boreholes inside habitable structures if warranted _____ _____

c. obtain surface elevation of boreholes _____ _____

d. gamma log boreholes _____ _____

e. sample as required from boreholes _____ _____

f. review gamma logs for uniformity of contamination layers _____ _____

g. plan biased borehole locations to resolve inconsistencies between systematic holes _____ _____

h. repeat steps a. through d. for biased boreholes _____ _____

10. Team Meeting to Review Sampling

a. were all planned samples collected? _____ _____

b. were sufficient samples collected to

1) establish background? _____ _____

2) calibrate cone shield? _____ _____

3) calibrate unshielded gamma walkover survey? _____ _____

4) calibrate borehole gamma logs? _____ _____

c. were problem areas from Item 3 characterized?

1) sides? _____ _____

2) bottoms? _____ _____

3) tops? _____ _____

d. was a borehole drilled in each area of surface contamination? _____ _____

e. identify all areas that are unmeasurable _____ _____

f. graphically review data to ensure that all areas have been characterized _____ _____

11. Review of Data for Consistency with Historical Information _____ _____

12. Field Sample Collection Forms
    a. do coordinates on samples match those on forms? _____ _____
    b. are all samples on collection forms? _____ _____
    c. were all logged samples shipped? _____ _____
    d. was copy of field sample collection sent to TMA/E Oak Ridge office? _____ _____
    e. was copy of collection form sent with samples to laboratory? _____ _____

13. Transmit all Field Notes, Data, and Drawings to TMA/E Oak Ridge Office _____ _____

14. BNI/EH&S Interpretation of Characterization Data
    a. surface
        1) Develop surface contamination isopleths _____ _____
        2) Compare BNI and characterization team isopleths _____ _____
    b. subsurface
        1) correlate soil samples and borehole gamma logs to determine cpm/pCi/g _____ _____
        2) develop contamination isopleths at various depths _____ _____
            a) map all borehole logs that exceed criteria _____ _____
            b) map all borehole logs with increasing trends regardless of magnitude _____ _____

15. Comparison of Contamination Limits and Historical Information for Consistency _____ _____

16. Transmittal of Data for Review to BNI Engineering Department with Copies to Construction and the Characterization Team _____ _____

17. Site Tour to Review Characterization Findings with

    a. lead health physicist _____ _____

    b. lead engineer _____ _____

    c. lead construction representative _____ _____

    d. lead member of characterization team _____ _____

APPENDIX B
STAFFING/BUDGET FOR THERMO ANALYTICAL/EBERLINE FOR THE CHARACTERIZATION OF SEARS AND ADJACENT PROPERTIES

APPENDIX B
STAFFING/BUDGET FOR THERMO ANALYTICAL/EBERLINE FOR THE CHARACTERIZATION OF SEARS AND ADJACENT PROPERTIES

The following budgetary constraints are applicable to the Thermo Analytical/Eberline support for the characterization of Sears and adjacent properties:

- Manpower in the Oak Ridge office will be limited to no more than 160 hours for the technical director for characterizations and 20 hours for the project manager.
- The field characterization team will not expend more than 2000 man-hours.
- Budgetary support is currently limited to analysis of:
  - 100 soil samples (radiological)
  - 30 soil samples (chemical)
  - 15 urine samples
- The approximate number of boreholes should not exceed 150.

All samples shall be analyzed for thorium-232, radium-226, and uranium-238.