FINAL

HISTORICAL SITE ASSESSMENT
and
ADDENDUM TO ENVIRONMENTAL CONDITION OF PROPERTY REPORT

FORT MONMOUTH
EATONTOWN, NEW JERSEY

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ACRONYMS AND ABBREVIATIONS

ACADA	Automatic Chemical Agent Alarm
AEC	U.S. Atomic Energy Commission
AFSC	Army Field Support Command
AMC	U.S. Army Materiel Command
ANSI	American National Standards Institute
amsl	above Mean Sea Level
AR	Army Regulation
ARA	Army Radiation Authorization
ARL	Army Research Laboratory
BEC	BRAC Environmental Coordinator
BML	Byproduct Materials License
BRAC	Base Realignment and Closure
CECOM	U.S. Army Communications and Electronics Command
CELCMC	U.S. Army Communications-Electronics Lifecycle Management Command
CENAB	U.S. Army Corps of Engineers, Baltimore District
CERDEC	U.S. Army Communications, Engineering, Research, and Development Center
CD	Compact Disc
CFR	Code of Federal Regulations
CHISR	Center for Healthcare Information Systems Research
CHP	Certified Health Physicist
cm^2	square centimeter
CWA	Charles Wood Area
d	day
DCGL	Derived Concentration Guideline Level
DLA	Defense Logistics Agency
DOA	Department of the Army
DoD	Department of Defense
DOE	Department of Energy
dpm	disintegrations per minute
DPW	Directorate of Public Works
DQO	Data Quality Objective
ECD	Electron Capture Detectors
ECP	Environmental Condition of Property
EPA	U.S. Environmental Protection Agency
F	degrees Fahrenheit
FCS-NSI	Future Combat System – Network Systems Integration
FOIA	Freedom of Information Act
FY	fiscal year
g	gram
hr	hour
HSA	Historical Site Assessment
IL	Illinois
l	liter
MACOM	U.S. Army Major Command
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual

mCi	milliCurie
MD	Maryland
MEDDAC	Medical Department Activity
MP	Main Post
mph	miles per hour
mR	milliRoentgen
mrem	milliRem
mSv	milliSievert
NJDEP	New Jersey Department of Environmental Protection
NRC	U.S. Nuclear Regulatory Commission
NUREG	U.S. Nuclear Regulatory Commission Regulation
NW	Northwest
PA	Pennsylvania
PCB	Polychlorinated Biphenyl
pCi	picoCurie
PEOC3T	Program Executive Office for Command, Control, and Communications Tactical
PEOEIS	Program Executive Office for Enterprise Information Systems
PEOEIWS	Program Executive Office for Intelligence, Electronic Warfare, and Sensors
PMDCASS	Project Manager, Defense Communications and Army Switched Systems
POC	Point of Contact
POW	Prisoner of War
QC	Quality Control
R&D	research and development
RADIAC	Radiation Detection, Indication, and Computation
RAM	radioactive materials
RIC	Radioisotope Committee
RCC	Radiation Control Committee
RCOPC	Radiological Contaminants of Potential Concern
RSO	Radiation Safety Officer
RWP	Radiation Work Permit
SOP	Standard Operating Procedure
SW	Southwest
Team C4ISR	Team Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
TOC	Technical Operations Center
U.S.	United States
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine (formerly USAEHA)
USAEHA	U.S. Army Environmental Hygiene Agency (now USACHPPM)
USARC	U.S. Army Reserve Command
USGS	U.S. Geological Survey
VA	Virginia
WWI	World War I
WWII	World War II
yr	year

1.0 EXECUTIVE SUMMARY

The following is a radiological Historical Site Assessment (HSA) prepared by CABRERA Services, Inc. for the Fort Monmouth military installation. The Site is located 12 miles west of the Atlantic Ocean and 45 miles south of New York City, just north of Eatontown in Monmouth County, New Jersey. Military operations began at this installation in 1917.

Fort Monmouth has been identified as one of the military installations in Base Realignment and Closure (BRAC) 2005 (Public Law 101-510 as amended). The U.S. Army Environmental Center (USAEC), with support from the U.S. Army Corps of Engineers (USACE), is responsible for evaluating whether BRAC installations are suitable for release or reuse with respect to environmental conditions. An Environmental Condition of Property (ECP) assessment is being conducted concurrently for this installation by Shaw Environmental; this HSA will be appended to the Phase I ECP prepared for this installation.

This HSA is being conducted to specifically address facilities and areas that had operations involving radioactive materials that were U.S. Nuclear Regulatory Commission (NRC) licensed, or that fall under a Department of the Army Radiation Authorization (ARA). As such, the purpose of the HSA is to: (1) identify potential, likely, or known sources of potential radioactive contamination resulting from radioactive material use or storage; (2) identify areas as Impacted or Non-Impacted in accordance with assessment protocol as outlined in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (USEPA, 2000); (3) identify specific data gaps for Impacted areas; and (4) provide information useful for designing subsequent radiological characterization surveys of Impacted areas that will support unrestricted release.

A Certified Health Physicist (CHP) reviewed historical information to determine if there is sufficient data to declare buildings as "Impacted" or "Not Impacted" in accordance with MARSSIM methodology. Documents gathered from various sources were reviewed and evaluated to extract information on the possession and use of radioactive materials (RAM). These documents included licenses, permits, authorizations, inventory records, surveys, historical drawings, and floor plans. In addition, the HSA included a visual inspection of all buildings and areas where RAM was used or stored, and interviews with individuals knowledgeable of RAM handling, storage, and disposal.

The use of RAM at Fort Monmouth was historically, and is currently conducted in accordance with a number of U.S. Nuclear Regulatory Commission (NRC) licenses and Army Radiation Authorizations (ARAs). This information is summarized in Section 5.2.2.

The radiological contaminants of potential concern (RCOPC) at Fort Monmouth are those associated with the use and storage of radioactive commodities by the Garrison and current and former tenants. In addition, radioactive calibration sources and research and development commodities used by the U.S. Army Communications and Electronics Command (CECOM) may present additional sources of radioactive material at Fort Monmouth. The following radionuclides should be considered RCOPCs based on information regarding current and former use, storage, or handling of RAM at Fort Monmouth:

TABLE 1-1: PRIMARY RADIONUCLIDES USED/STORED AT FORT MONMOUTH (POTENTIAL RCOPCS)

Radionuclide	Name	Half Life	Notes
Am-241	Americium-241	432 y	Isotope referenced in RAD.inventory 1997 through 2000 files
Cf-252	Californium-252	2.64 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
C-14	carbon-14	5,730 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Cs-137	cesium-137	30.2 y	Isotope referenced in RAD.inventory 1997 through 2000 files; found in at least large irradiator.
Cl-36	Chlorine-36	301,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Co-57	Cobalt-57	270.9 d	Isotope referenced in Rad inventory 1994-1995 files. Likely totally decayed away if used in check source quantities.
Co-60	Cobalt-60	5.2 y	Isotope referenced in License 29-0102-07. Likely decayed away depending on the size of the original source.
Eu-154	europium-154	8.8 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
H-3	hydrogen-3 (tritium)	12.3 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Used in self-illuminated exit signs and watches.
I-125	iodine-125	60 d	Isotope referenced in a 1983 Radiation Protection Survey. Used in hospital for thyroid treatment.
Kr-85	krypton-85	10.7 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use and radioactive test samples
Ni-63	Nickel-63	100.1 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use, explosive detectors, and radioactive test samples
Pu-238	plutonium-238	87.75 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use and radioactive test samples. Instrument check source
Pu-239	plutonium-239	24,131 y	Isotope referenced in Rad inventory 1994-1995 files.
Pm-147	promethium-147	2.62 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Ra-226	radium-226	1,600 y	Isotope referenced in RAD.inventory 1997

Radionuclide	Name	Half Life	Notes
			through 2000 files. Used in check sources, luminescent dials and instruments in radios, compasses, night vision adapters, and other commodities
Rn-222	radon-222	3.8 d	Constituent of radon gas and progeny; despite short half-life, is continuously regenerated from Ra-226 parent.
Sr/Y-90	strontium-90/yttrium-90	28.6 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Tc-99	technetium-99	213,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Th-232	thorium-232	14,050,000,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
U-238	uranium-238	4,468,000,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.

Approximately 22 buildings, building complexes, and/or open areas have been identified as areas where RAM was used, stored, or potentially disposed, based on review of records and interviews as outlined herein, and 4 buildings have been classified as Impacted by RAM. The buildings or areas are identified as follows:

TABLE 1-2: FORT MONMOUTH BUILDINGS/AREAS WITH RAM USE/STORAGE HISTORY

Building Number	Building/Area Name & Use	Current Tenant and Conditions
116	Warehouse/Shipping & Receiving	Existing; used by Base Contractor for Garrison Supply, contains secure radiological storage areas.
173	Environmental Laboratory	Existing; Electron Capture Detectors are used for environmental sample analysis in designated room.
205	Wackenhut/Alutiiq Security Office	Existing; three explosives detectors are stored in Room 136.
275	Museum	Existing; several display items contain radioactive materials.
282	Main Post Fire Department	Existing; once used explosive detectors containing sources, have been removed.
283	Squier Building (Administrative)	Existing; housed Signal Laboratories before they were moved to 2700, renovated to administrative space.
292	Museum Storage	Existing; several items in storage contain radioactive materials.
451	Postal Facility	Existing; once used explosive detectors containing sources, have been removed.

Building Number	Building/Area Name & Use	Current Tenant and Conditions
602	High Security Fabrication & Testing	Existing; once used explosive detectors containing sources, have been removed.
1075	Patterson Health Clinic	Existing; used radioisotopes in thyroid treatment in late 1960's-early 1970's; may have used incinerator on the grounds that has since been demolished.
2535	Battery Test Facility	Existing; battery testing facility.
2502-2507	Fabrication and Integration	Existing; CERDEC fabrication and integration of materials into military vehicles.
2539	Communications and Electronics Command (CECOM) Safety Office	Existing; administrative area.
2540	Communications and Electronics Command (CECOM)Laboratory	Existing; research and development laboratory.
2560	Charles Wood Fire Department	Existing
2700	Myers Center (Administrative)	Existing; once used explosive detectors containing sources, have been removed.
2701	Charles Wood Entry Area	Existing; once used explosive detectors containing sources, have been removed.
2704	Environmental Test Facility	Existing; military environmental conditions testing facility.
2705	U.S. Army Communications, Engineering, Research, and Development Center (CERDEC) (formerly Army Research Laboratory (ARL))	Existing; formerly contained a Night Vision lab and had radioactive source use, currently administrative.

A radon study was performed throughout all Fort Monmouth buildings in 1989 in which 1,132 detectors were deployed for 90 days in the Main Post, Charles Wood, and Evans Areas. 1,077 were retrieved, accomplishing a 95% recovery rate. All were analyzed and none showed levels above the EPA recommended action level of 4 pCi/L (Ref. 033, Ref. 081, Ref. 082).

No comprehensive inventory of tritium exit signs within existing facilities has been completed at Fort Monmouth. However, a program was instituted in 2003 by the Fort Monmouth Directorate of Public Works (DPW) to identify and properly dispose of all exit signs that contained tritium (H-3) in buildings prior to demolition. As part of the Building Demolition Checklist utilized by Fort Monmouth demolition contractor, all tritium exit signs are identified, removed and given to CECOM Safety for proper disposal, prior to the building demolition.

Based on currently available information, the areas listed in the following table would be considered "Impacted" and additional surveys and/or samples are necessary for a complete characterization of Fort Monmouth. Data quality objectives and recommendations for specific radiological scoping activities to support unrestricted release of these Impacted areas will be developed and submitted in a separate document. Although the specifics of these additional surveys are yet to be developed, the following should be considered based on the state of the existing survey information.

TABLE 1-3: FORT MONMOUTH PROPOSED SURVEY AREAS

Building/ Survey Area	Description	Possible RCOPCs
275 (Museum)	Impacted, MARSSIM Class 3	Ra-226
283 (Squier Hall)	Impacted, MARSSIM Class 3 (in unrenovated areas)	Polonium
292 (Museum Storage)	Impacted, MARSSIM Class 3	Various
2540 (CECOM Laboratory)	Impacted, MARSSIM Class 1	Cs-137, Pu-238, Tc-99, Co-60, Ra-Be, Cf-252, Th-232, Ra-226, H-3

Potential contaminated media include Class 1, Class 2, or Class 3 building interiors and surfaces, including potentially contaminated work benches, storage cabinets, and disposal sinks.

2.0 INTRODUCTION AND OBJECTIVES

Cabrera Services, Inc. (CABRERA) has prepared the following Historical Site Assessment (has) for Fort Monmouth, located in the central-eastern portion of New Jersey in Monmouth County. This work was accomplished in accordance with the U.S. Army Corps of Engineers (USACE) Statement of Work entitled *Historical Site Assessment in Support of the Environmental Condition of Property Phase I for Selected Base Realignment and Closure Installations, March 2006*, under the terms and conditions of Contract No. W912DR-05-D-0024, Delivery Order 0002 between USACE Baltimore District (CENAB) and CABRERA. A Final Work Plan, dated June 2006, was prepared by CABRERA and is included as Appendix A to this report. The *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; NUREG-1575 Rev. 1/EPA 402-R-97-016 Rev. 1/DOE/EH-0624, Rev. 1) as well as the *Radiological Survey Policy for Base Realignment and Closure (BRAC) Sites Where Army Radioactive Commodities Were Present (AMC, 2004)* were the primary guidance documents for conducting this HSA (Ref 040, Ref 071).

2.1 Program Objectives

Fort Monmouth has been identified as one of the military installations slated for closure as part of Base Realignment and Closure (BRAC) 2005 (Public Law 101-510 as amended). BRAC is the process by which the nation reshapes its military installations to become more efficient and effective in supporting its forces. As part of this process an Environmental Condition of Property assessment (ECP) must be completed for all BRAC installations. Shaw Environmental, Inc. has been tasked by U.S. Army Environmental Center (USAEC), under contract to CENAB, to complete the Phase I ECP for Fort Monmouth. This HSA is being conducted to specifically address facilities and areas that had operations involving radioactive materials that were U.S. Nuclear Regulatory Commission (NRC) licensed, or that fall under a Department of the Army Radiation Authorization (ARA). This HSA will be appended to the Phase I ECP prepared for this installation.

2.2 Specific Objectives of this HSA

This HSA is being conducted as part of an overall effort to ensure that Fort Monmouth can be turned over for redevelopment or reuse as part of the BRAC process. Specifically, this HSA is the first step in the process of releasing all facilities and areas at Fort Monmouth for unrestricted use. Such release will be sought from NRC as appropriate for all radioactive materials (RAM) license(s). In accordance with the MARSSIM (USEPA, 2000), this HSA should accomplish the following:

- Identify current potential sources of radiological contamination
- Determine which parts of the facility are impacted (and non-impacted) by previous operations
- Classify areas as Impacted or Non-Impacted as defined in MARSSIM
- Identify any data gaps in Impacted Areas
- Provide input into decisions to perform radiological scoping and characterization surveys

Recommendations for specific radiological scoping or characterization survey design to address all areas characterized as Impacted will be provided in a separate document for evaluation by the Army stakeholders**.**

2.3 Data Quality Objectives

Data Quality Objectives (DQOs) are qualitative and quantitative statements that clarify the study objective, define the most appropriate type of data to collect, determine the most appropriate conditions for collecting data, and specify limits on decision errors (USEPA, 2000). DQOs define the performance criteria that limit the probabilities of making decision errors by considering the purpose of collecting the data, defining the appropriate type of data needed, and specifying tolerable probabilities of making decision errors. Project-specific DQOs are developed using the seven-step DQO Process. The DQOs for this HSA are:

Step 1 – State the Problem

Does sufficient information exist to define the nature and extent of radioactive materials at the Fort Monmouth Site and support the decision that areas have or have not been impacted by radiological activities at the Site? The decision makers for this HSA are Department of the Army (DOA), specifically USAEC, CENAB, and the Installation. Other stakeholders include the NRC and local communities surrounding Fort Monmouth.

Step 2 – Identify the Decision

The principal study question is: Have areas at the Fort Monmouth Site been impacted by radiological activities at the Site? Potential actions include: additional investigation of radiologically impacted areas *(i.e.*, additional review of existing data, collection of additional environmental data, or additional remediation) or release of non-impacted areas from radiological controls. Impacted areas have a possibility of containing residual radioactivity in excess of natural background (USEPA, 2000). Non-impacted areas have no reasonable possibility of residual radioactivity. All areas are either impacted or non-impacted.

Step 3 – Identify Inputs to the Decision

Inputs to the decision are archival documents provided by the Fort Monmouth Safety Office and others. Pertinent information includes radioactive material use authorizations and inventories for various Fort Monmouth facilities permitted to receive, store, and use radiological materials.

Step 4 – Define the Boundaries of the Study

Temporal boundaries for the study are defined by the period of use of radiological materials at Fort Monmouth. Spatial boundaries are defined by the locations of historical radiological materials storage and use.

Step 5 – Develop a Decision Rule

If there is reasonable probability or conclusive evidence that an area was impacted (*i.e.*, contaminated) by site activities (*i.e.*, storage, use, disposal) at the Fort Monmouth Site, then the area will be considered radiologically impacted and additional investigations will be performed in that area. All other areas will be considered non-impacted (*i.e.*, non-disturbed); however, additional investigations may be performed in these areas.

Step 6 – Specify Tolerable Limits on Decision Errors

Decision errors occur when an incorrect action based on the decision rules is recommended. Decision errors occur primarily as a result of uncertainty in the data. Most HSA data collected are qualitative or require professional judgment to be interpreted meaningfully, which makes it difficult to assign a quantitative value for decision error rates. All available information, including historical decision errors used to define impacted and non-impacted areas of the Site, have been considered to limit decision errors in the HSA.

Step 7 – Optimize the Design for Collecting Data

The CECOM Safety Office at Fort Monmouth provided access to their archival records maintained in accordance with their NRC licenses and facility requirements. These records, as well as additional documents provided by the Directorate of Public Works (DPW) and CDs provided by U.S. Army Environmental Hygiene Agency / U.S. Army Center for Health Promotion and Preventative Medicine (USAEHA/USACHPPM) containing historic records from the 1950s through the 1990s were reviewed and evaluated. This review helped to decide if radiological activities have or have not impacted any Site areas. Information on impacted areas was also evaluated for completeness to identify data gaps and support development of additional investigations.

2.4 Report Organization

The Fort Monmouth HSA is organized into the follow Sections:

- Section 3.0 of the HSA provides a description of the Site's location and environmental setting, including geology, hydrogeology, surface water, meteorology, seismicity, and cultural resoes.
- Section 4.0 summarizes the HSA methodology, including document review, personnel interviews, historical and current photo documentation, and site walkdowns.
- Section 5.0 summarizes the Fort Monmouth Site history from its initial construction to the present day condition, and includes a description of activities in specific Site areas that could have affected its radiological status.
- Section 6.0 discusses the findings of this HSA, discussing impacted or potentially impacted areas, non-impacted areas, and regulatory issues.
- Section 7.0 provides a summary of conclusions reached during the HSA.
- Section 8.0 presents the list of references consulted while preparing the HSA.

3.0 PROPERTY IDENTIFICATION

The following is a brief physical description of the subject property location and setting. This information was derived largely from Historical Records Review prepared by Malcolm Pirnie in 2006 (Ref 025).

3.1 Physical Characteristics

3.1.1 Location

Fort Monmouth is located in the central-eastern portion of New Jersey, in Monmouth County, approximately 45 miles south of New York City, 70 miles northeast of Philadelphia, and 40 miles north of Trenton. The Atlantic Ocean is approximately 3 miles to the east. Fort Monmouth falls within the boroughs of Eatontown, Oceanport, and Tinton Falls. The areas surrounding Fort Monmouth are characterized by a mixture of residential, commercial, and light industrial uses.

The Main Post encompasses approximately 630 acres and contains a total of 397 buildings and structures. The Main Post is bounded by State Highway 35 to the west, Parkers Creek to the north, the New Jersey Transit Railroad to the east, and Main Street and State Highway 71 to the south, as shown in the aerial view photograph (Figure 3-1). The Charles Wood Area, located approximately one mile southwest of the Main Post, is composed of approximately 511 acres and contains a total of 241 buildings and structures (Figure 3-1). This area is bounded by the Garden State Parkway to the west, Tinton Avenue to the north, Maxwell Place and the New Jersey Transit Railroad to the east, and Pine Brook Road to the south.

Prior to 1996, Fort Monmouth included a third operational area – the Evans Area – located approximately 12 miles south of the Main Post. The Evans Area is excluded from this HSA since it is being managed under an earlier BRAC program, which was implemented in fiscal year (FY) 1993 (Ref. 025, Ref. 068). Separate Historical Site Assessment efforts were made for the Evans Area.[1]

[1] Copies of the Evans Area HSA documents were acquired through the Evans Area BRAC Environmental Coordinator (BEC); however, no information was found to be applicable to the current HSA effort.

FIGURE 3-1: AERIAL VIEW OF FORT MONMOUTH

3.1.2 Topography

Topography at both the Main Post and Charles Wood areas is characterized generally by low relief. Elevations above mean sea level range from 5-34 feet and 26-60 feet, respectively, with regional slope generally towards the Atlantic Ocean (i.e., towards the east). Figure 3-2 provides the U.S. Geological Survey (USGS) topographic map for Fort Monmouth and the surrounding areas. Over the past 80 years, the natural topography of Fort Monmouth has been altered by excavation and filling activities by the military. The dominant topographic feature affecting contaminant transport and fate is the network of tributaries throughout Fort Monmouth that drain to the Shrewsbury River. The drainage network is discussed in detail in Section 3.2.3. (Ref. 068)

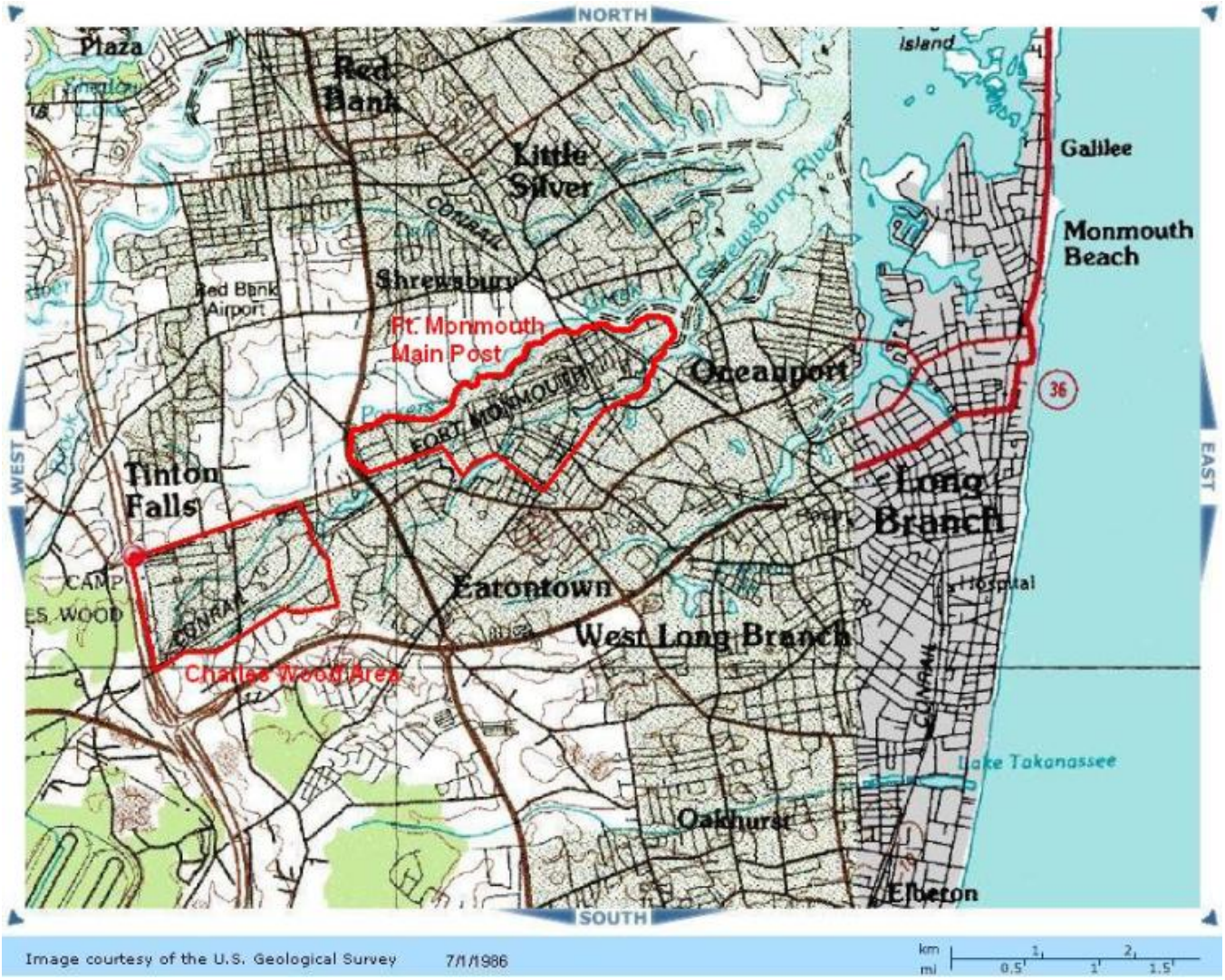


FIGURE 3-2: TOPOGRAPHIC DETAIL OF FORT MONMOUTH AND SURROUNDING AREA

3.2 Environmental Setting

3.2.1 Geology

Fort Monmouth lies within the Outer Coastal Plain subprovince of the New Jersey section of the Atlantic Coastal Plain physiographic province, which generally consists of a seaward-dipping wedge of unconsolidated sediments including interbedded clay, silt, sand, and gravel. To the northwest is the boundary between the Outer and Inner Coastal Plains, marked by a line of hills extending southwest, from the Atlantic Highlands overlooking Sandy Hook Bay, to a point southeast of Freehold, New Jersey, and then across the state to the Delaware Bay. These formations of clay, silt, sand, and gravel formations were deposited on Precambrian and lower Paleozoic rocks and typically strike northeast-southwest, with a dip that ranges from 10 – 60 feet per mile. Coastal Plain sediments date from the Cretaceous through the Quaternary Periods and are predominantly derived from deltaic, shallow marine, and continental shelf environments.

The formations record several major transgressive/regressive cycles. Regressive upward-coarsening deposits, such as Englishtown and Kirkwood Formations and the Cohansey Sand are usually aquifers, while transgressive deposits, such as the Merchantville, Marshalltown, and Navesink Formations, act as confining units. The thicknesses of these units vary greatly, ranging from several feet to several hundred feet, and thicken to the southeast.

The eastern half of the Main Post is underlain by the Red Bank Formation, ranging in thickness from 20-30 feet, while the western half is underlain by the Homerstown Formation, ranging in thickness from 20-30 feet. The predominant formation underlying the Charles Wood Area is also the Homerstown, with small areas of Vincentown Formation intruding in the southwest corner. Sand and gravel deposited in recent geologic times lie above these formations. Interbedded sequences of clay serve as semi-confining units for groundwater.

Udorthents-Urban land is the primary classification of soils on Fort Monmouth, which have been modified by excavating or filling. Soils at the Main Post include Freehold sandy loam, Downer sandy loam, and Kresson loam. Freehold and Downer are somewhat well drained, while Kresson is a poorly drained soil. The Charles Wood Area has sandy loams of the Freehold, Shrewsbury, and Holmdel types. Shrewsbury is a hydric soil; Kresson and Holmdel are hydric due to inclusions of Shrewsbury. Downer is not generally hydric, but can be (Ref. 025, Ref. 068).

3.2.2 Hydrogeology

Fort Monmouth lies in the Atlantic and Eastern Gulf Coastal Plain groundwater region and is underlain by undeformed, unconsolidated to semi-consolidated sedimentary deposits. The chemistry of the water near the surface is variable with generally low dissolved solids and high iron concentrations. In areas underlain by glauconitic sediments, the water chemistry is dominated by calcium, magnesium, and iron (*e.g.* Red Bank and Tinton sands). The sediments in the vicinity of Fort Monmouth were deposited in fluvial-deltaic to nearshore environments.

The water table is generally shallow at the Installation, and fluctuates with the tidal action in Parkers and Oceanport creeks at the Main Post. The depth to groundwater at Fort Monmouth is between 5-12 feet. The water table aquifer in the Main Post area is identified as part of the "composite confining units," or minor aquifers. The Hornerstown Formation acts as an upper boundary of the Red Bank aquifer, but it might yield enough water within its outcrop to supply individual household needs. The Red Bank outcrops along the northern edges of the Installation, and contains two members, an upper sand member and a lower clayey sand member. The upper sand member functions as the aquifer and is probably present on some of the surface of the Main Post and at a shallow depth below the Charles Wood Area. The Red Bank supplied many domestic wells with water at one time. The Hornerstown and Red Bank formations overlay the larger Wenonah-Mount Laurel aquifer.

Groundwater is not currently used as a potable water source/water supply at Fort Monmouth (Ref. 025, Ref. 068).

3.2.3 Hydrology

The Main Post is drained via several surface waterways that generally flow from west to east. Mill Brook enters Fort Monmouth along the southwest boundary and flows east and then north to Lafetra Creek. Lafetra Creek, originating off-post to the west, flows east along the northern

boundary of the Main Post. Parkers Creek originates at the convergence of Lafetra Creek and Mill Brook and flows along the northern boundary of the Main Post until it discharges to the Shrewsbury River, directly to the east of the Main Post. Parkers Creek is considered environmentally sensitive because it provides habitat for various species of indigenous wildlife. The northern half of the Main Post is located within the Parkers Creek sub-watershed.

Husky Brook, a fresh water stream originating off-post, drains the southern half of the Main Post lying within the Husky Brook sub-watershed. A portion of the brook has been dredged, widened, and dammed to form Husky Brook Lake, which is used for recreational purposes by Fort Monmouth personnel. Downstream from the lake, Husky Brook is piped for approximately 1,100 feet before it surfaces and flows east into Oceanport Creek. Oceanport Creek, to the east of the Oceanport Avenue Bridge, is a tidal stream that flows along a portion of the southern boundary of the Main Post before discharging into the Shrewsbury River. It is also periodically dredged by a contractor, permitted by New Jersey Department of Environmental Protection (NJDEP), in order to maintain a marina for Fort Monmouth personnel. The Shrewsbury River is a tidal estuary that empties into Sandy Hook Bay and is separated from the Atlantic Ocean by a narrow barrier beach ending at Sandy Hook.

The Charles Wood Area is located approximately one mile southwest of the Main Post. It is separated from the Main Post by a portion of the borough of Eatontown. The southern portion of the Charles Wood Area is drained by two streams that unit at a point near the eastern boundary. Its southernmost branch originates south of the Area; the other stream originates within a lowland wooded area in the vicinity of the old sewage treatment plant. These two streams become the main stem of the Wampum Brook, which flows through Eatontown and forms a small fresh water pond called Wampum Lake, which in turn gives rise to Mill Brook, eventually flowing into the Main Post.

Another stream, a northern tributary to Wampum Brook, originates near Charles Wood's western boundary and flows through the area, into the golf course. This tributary unites with Wampum Brook at a point east of the Charles Wood Area boundary.

An extensive stormwater drainage system was constructed at Fort Monmouth approximately 55 years ago. The system was designed to supplement the natural drainage and prevent localized flooding. The system discharges at various points into Wampum Brook, Husky Brook, Husky Brook Lake, Lafetra Creek, Mill Brook, Parkers Creek, and Oceanport Creek. The storm drainage system in the 600-area of the Main Post adequately carries stormwater drainage and is not subject to flooding. Some of the stormwater drainage system outfalls on the Main Post are below the elevation of the mean high tide, particularly along Oceanport Creek and Parkers Creek. Thus, during high tides, water backs up into the system. The extreme southeastern portion of the Main Post is subject to flooding during high tides combined with heavy rains. However, the 100-year base flood elevation for Wampum Creek at the eastern boundary of the Charles Wood Area is 26 feet, while ground surface elevations in this area range from 27-60 feet amsl (Ref. 025, Ref. 068).

3.2.4 Climate and Meteorology

Meteorological data for Newark is considered a suitable surrogate for the Fort Monmouth Site. The following table consists of meteorological data for Newark, New Jersey.

TABLE 3-1: AVERAGE METEOROLOGICAL DATA FOR NEWARK, NEW JERSEY AREA

	January	February	March	April	May	June	July	August	September	October	November	December
High Temp (°F)	39	41	50	61	72	81	86	84	77	66	55	43
Low Temp (°F)	24	26	33	43	53	63	68	67	59	48	39	29
Precipitation (inches)	4	3	4	4	4	3	4	4	3	3	4	4
Snow (inches)	8	9	5	1	-	-	-	-	-	-	1	5
Wind Speed (mph)	14	15	16	16	10	9	9	8	8	9	9	14
Wind Direction	NW	NW	NW	NW	SW	SW	SW	SW	SW	SW	SW	NW

(Source: Ref. 042)

Fort Monmouth is located in the temperate zone of the Middle Atlantic region. The mean annual temperature is 53 degrees Fahrenheit (^{o}F). Summers are generally warm, with an average temperature of 72 ^{o}F, and winters are moderate, with an average temperature of 33 ^{o}F. The average annual precipitation at Fort Monmouth is 45.18 inches. Thunderstorms generally occur in the summer and may combine high winds with heavy rainfall, though destructive storms are infrequent in Monmouth County. Heavy rains have occurred in connection with hurricanes, which sometimes move northward along the mid-Atlantic coast. The average seasonal snowfall is 25 inches, with the greatest amounts falling in December, January, and February.

Humidity is high in the area due to proximity to the Atlantic Ocean, and as a result, summers are relatively cooler and winters milder than elsewhere at the same latitude. Weather conditions are affected by northwest and southwest winds (Ref. 025, Ref. 068).

3.2.5 Seismicity

The history of this area shows a moderate to low probability of an earthquake of sufficient magnitude to cause damage to structures. The United States Geological Survey reports that the most severe earthquake ever observed in New Jersey occurred on June 1, 1927, in the Asbury Park area, not far from Fort Monmouth. Three shocks were felt along the coast from Sandy Hook to Toms River. Maximum intensities of VII on the Modified Mercalli Scale were observed at Asbury Park and Long Branch. Several chimneys fell, plaster cracked, and articles were thrown from shelves. The felt area extended over approximately 7,800 square miles. Earthquake events have occurred sporadically through New Jersey's history, but other than the one already mentioned, most are at intensity of V or VI or below, V being the lowest intensity in which some damage may occur (Ref. 044).

4.0 HISTORICAL SITE ASSESSMENT METHODOLOGY

This section summarizes the methodology and decision criteria for the Fort Monmouth HSA as detailed in the HSA Work Plan (Appendix A; Cabrera, 2006c).

4.1 Approach and Rationale

This HSA is being conducted as part of an overall effort to modify the Fort Monmouth NRC radioactive material licenses and safely release the facility and grounds for future use. The purpose of the radiological HSA is to collect and organize information describing radiological activities at Fort Monmouth from the onset of the first radioactive material license until cessation of operations. This HSA reviews historical information to determine if there is sufficient data to declare buildings as "Impacted" or "Not Impacted" in accordance with MARSSIM methodology (Table 4-1; USEPA, 2000).

Facilities, buildings, and rooms that contain or once contained equipment that produce X-Rays via AC or DC sources of energy are not sources of radioactive contamination and do not cause or result in HSA impacted areas. This equipment, which includes medical and dental diagnostic X-Ray machines, X-Ray security inspection machines, X-Ray diffraction, electron microscopes, X-Ray based XRF equipment, and some high voltage electron tubes, only produce ionizing radiation when energized. Operation of this equipment will result in ionizing radiation fields being produced in and around the equipment. Since posting of radiation areas is required during operation of such equipment, signs with the words "Caution Radiation Area" are visible on walls and entryways, but do not imply the presence of radiation when the equipment is not energized.

The operation of X-Ray generating equipment of the type utilized at Fort Monmouth does not produce radioactive materials or result in any residual radioactive contamination. Decision methodologies and radiological risk categories (Figure 4-1 and Table 4-1, respectively) specifically examine only areas where the potential for radioactive contamination occurs. Therefore, areas where X-Ray producing equipment exists or existed are not impacted areas, require no further review, and have been excluded from further field investigations.

The HSA also evaluates potential migration of contamination in the environment and makes recommendations for future surveys. To achieve this goal, a systematic approach was developed for screening the Fort Monmouth facilities, as outlined in Figure 4-1.

TABLE 4-1: HSA RADIOLOGICAL RISK CATEGORIES

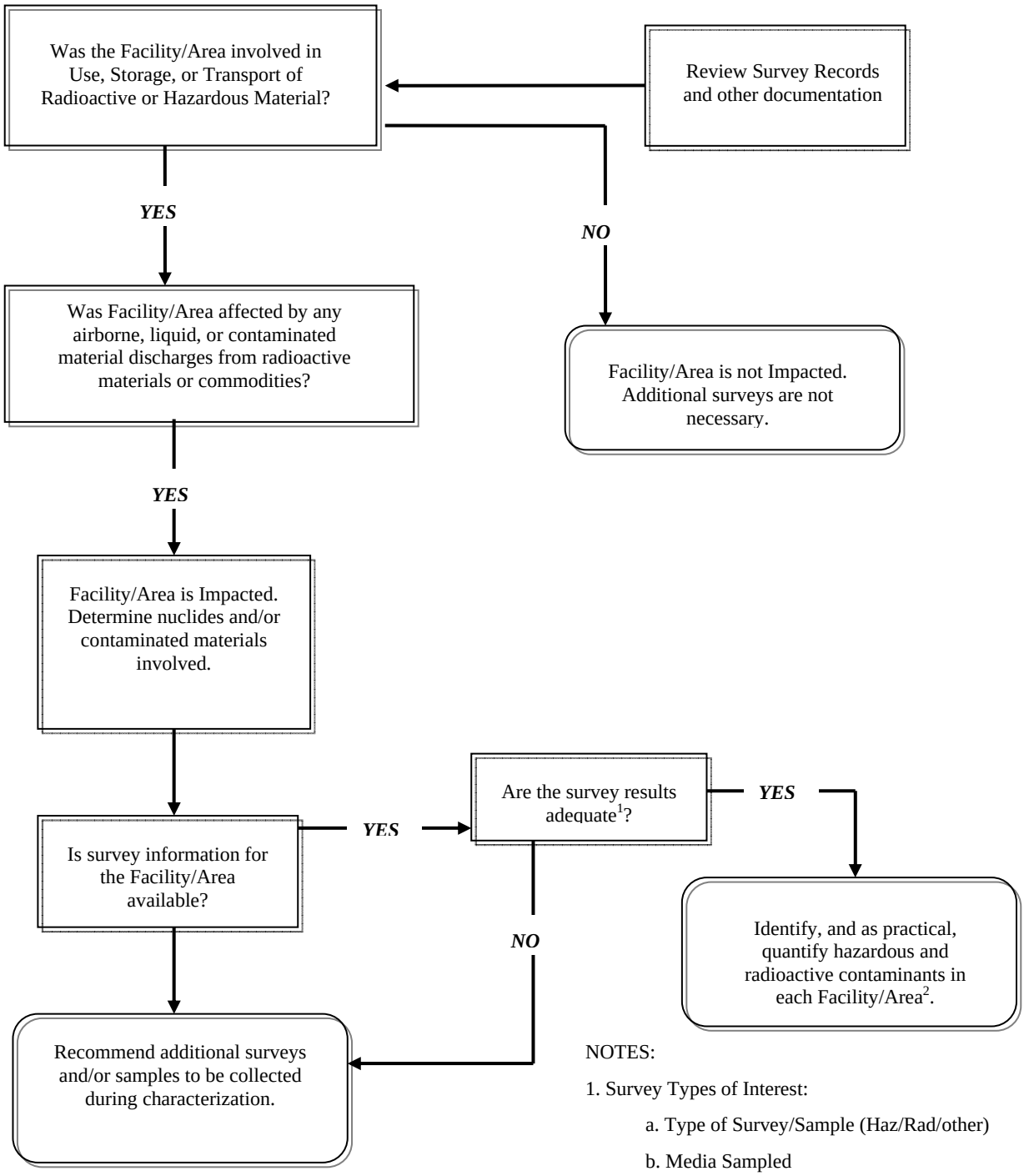
Impacted[1] **(MARSSIM Class 1 and 2)[2]**	Areas with moderate to high probabilities of potential contamination. Typical areas include: areas where commodity repair, maintenance, cannibalization, demilitarization, demolition of previously contaminated structures, disposal, or other operations potentially compromising non-dispersible commodity design occurred.
Impacted **(MARSSIM Class 3)**	Areas with very low potential for contamination but with insufficient information to justify a non-impacted classification. Typical areas include areas where commodities were received, stored , and/or shipped, but without loss of sealed source integrity, such as can potentially happen in commodity repair or maintenance.
Non-Impacted **(No Survey Needed)**	Areas with no potential for residual contamination. HSA records do not indicate presence of any radioactive materials more than smoke detectors or exit signs with sealed sources, or those areas that had radioactive materials, but have survey records documenting decontamination and/or free release of the area.

[1]In addition to "Impacted" or "Non-Impacted" from a radiological perspective, the survey areas are identified using the methodology presented in the flow chart (Figures 4-1).

[2]Class 1 areas are potentially contaminated above the Derived Concentration Guidance Level (DCGL) while Class 2 areas are potentially contaminated but are not expected to exceed the DCGL.

In order to answer the questions in the referenced decision tree, the following information was reviewed:

- Fort Monmouth operating history, including radioactive materials licenses, permits, and use authorizations and protocols;
- Minutes of the Fort Monmouth Radiation Control Committee (RCC) for reference to any spills, releases of radioactive material to the environment surrounding the Site during facility operations, and onsite disposals of radioactive or hazardous materials;
- Surveys for radioactive materials (RAM) present at Fort Monmouth;
- Physical tours of the Fort Monmouth facilities expected to be impacted due to both current and former RAM usage;
- Off-installation document repositories including the U.S. Nuclear Regulatory Commission (NRC) Public Document Room, U.S. Army Center for Health Promotion and Preventative Medicine (USACHPPM), and U.S. Army Field Support Command (AFSC); and
- Interviews with:
    - Staff responsible for ongoing Fort Monmouth site control and surveys, and
    - Previous Fort Monmouth personnel, including operators and training personnel, and personnel who performed previous radiological surveys, if available.



NOTES:

1. Survey Types of Interest:
   a. Type of Survey/Sample (Haz/Rad/other)
   b. Media Sampled
   c. Depth and extent/number
   d. Post-Survey Contamination Potential
2. If a Facility/Area has been demolished or removed, consider a survey of the site of the former building, as appropriate.

FIGURE 4-1: FLOWCHART OF HSA RADIOLOGICAL DECISION METHODOLOGY

4.2 Documents Reviewed

4.2.1 Government Supplied Information

The majority of the records available were stored at the CECOM Safety Office in Building 2539, administered by Mr. Craig Goldberg and assisted by Mr. Barry Silber (see Appendix C). Mr. Silber provided a CD containing file reports and information pertinent to the site visit and investigation, with most records post-dating 1996.

This HSA indicates that historical users of radioactive materials included both Fort Monmouth Garrison and various installation tenants. In a few cases, NRC licenses and ARAs were issued for activities.

Audits performed by USACHPPM dated from the 1950s to the 1990s reference the use of specific instruments (*e.g.* Radiac meters) and isotopes (*e.g.* I-125 at Patterson Health Clinic), some disposal methods (*e.g.* Acid Neutralization Pit at Building 2700) and the completion of regular radiological surveys *(e.g.* wipe tests performed in Building 283).

A detailed history, including isotopes potentially used in each building, is identified in the Building Fact Sheets, provided in Appendix B of this HSA, and summarized in Table 6-3.

4.2.2 Internet Review

Internet searches were conducted to determine if there was any pertinent information not available through other sources. General information was available describing the Fort Monmouth history and facilities, but no additional information pertinent to this HSA was identified.

4.2.3 NRC Document Repositories

No records pertaining to Fort Monmouth's licenses or inspection reports were directly obtained from the NRC during the preparation of this HSA. The NRC required submission of a Freedom of Information Act (FOIA) request to the agency in order to request any Fort Monmouth-specific NRC documents. Due to the volume of documents requested, the request is still currently in the process of being fulfilled; however, based on documentation received to-date, no pertinent new information is expected. Once records are received in-full and evaluated, this report can be revised or amended as necessary.

4.2.4 Other Document Repositories

Inquiries were also made at the following facilities concerning availability of radiological or hazardous material use and storage records at Fort Monmouth:

- U.S. Army Field Support Command (AFSC), Rock Island, IL
- Humphreys Engineering Center, Fort Belvoir, VA
- Defense Logistics Agency (DLA), New Cumberland Depot, PA
- Army Research Laboratory (ARL), Adelphi, MD

4.3 Property Inspections

Review of the RAM authorizations and protocols provided by the Fort Monmouth CECOM Safety Office, as well as other background information resulted in a list of buildings that have used/stored or are currently using or storing RAM. Each of these buildings was toured, if accessible, to gain building-specific information relevant to assigning risk categories and planning of future MARSSIM-related activities. Photographs were taken in areas approved by Installation personnel and are included in Appendices B and D. Table 6-3 contains a summary of findings and Appendix B includes a building by building summary of pertinent information, as well as photographs and drawings of current conditions.

4.4 Personnel Interviews

CABRERA personnel worked closely with installation personnel, including Wanda Green, Lou Benevides, and Guy Joseph, during a site visit conducted on July 10 - 13, 2006.

Interviews were also conducted with site personnel listed below. Appendix C contains all completed interview forms.

TABLE 4-2: FORT MONMOUTH SITE INTERVIEWS

Interviewee	Position at Fort Monmouth
Dee Baker	Administrative Assistant, DPW
Mike Borisky	Radiation Safety Officer (RSO), ARL (Adelphi)
Dave Campbell	Garrison Supply Receiving Department Manager
Tex Charkowick	Equipment Manager, CERDEC
Alex Chia	Environmental Testing Facility Operator
Patricia Corea	Senior Program Analyst, Laboratory
Jim Dempsey	Chief of Business Office for Project Manager, Defense Communications and Army Switched Systems (PMDCASS)
Tom Dillie	Chief of Fabrication and Integration
Chief John Erichsen	Fire Chief
Joe Fallon	Team Leader, Environmental Branch, DPW
Terry Flynn	Garrison Supply Excess Department Manager
Capt. Dale Freeman	Security, Wackenhut/Alutiiq
Pat Gervolin	Mechanical Engineer Technician
Shirley Glory	Radiological Technologist/Chief of X-Ray Clinic
Scott Gould	Works at Fire Training Facility, Charles Wood Area
Ed Haw	Garrison Supply Facility Manager
Charlie Johnson	Mechanical Engineer Technician

Interviewee	Position at Fort Monmouth
Otto Kirse	Foreman, Fabrication and Integration
Greg Kucharewski	Postal Worker
Karl Lasala	Environmental Testing Facility Operator
Ed Lynch	Postal Worker
Fred Mangino	Garrison RSO, Health and Safety Officer
Elaine Marcus	Program Analyst for the BRAC team for Center for Healthcare Information Systems Research (CHISR)
Robert Melascaglia	Master Planner, DPW
Bruce Pelka	Supervisory Industrial Hygienist
Tony Pellegrino	Facility Manager, Battery Test Facility
Lou Poirer	Chief, Physical Security Division
Kyle Reber	Machinist Manager, Fabrication and Integration
Mindy Rosewitz	Museum Curator
Chief Roszkowski	Assistant Fire Chief
Barry Silber	CECOM RSO, Point of Contact (POC) for radiological commodities
Dan Wright	Environmental Laboratory Supervisor/Director
Bob Zatorski	DPW Building Manager

5.0 FORT MONMOUTH HISTORY AND CURRENT USAGE

5.1 Installation History

Fort Monmouth is located 3 miles west of the Atlantic Ocean and 45 miles south of New York City, just north of Eatontown in Monmouth County, New Jersey. Fort Monmouth falls within the boroughs of Eatontown, Oceanport, and Tinton Falls. Fort Monmouth occupies approximately 1,350 acres and is comprised of two operational areas, the Main Post and the Charles Wood Area, which are located about one mile from each other. The installation was the home of the Army Materiel Command's Communication and Electronics Command (CECOM), whose mission is to research, develop, produce, and sustain technologically superior prototypes of communications and other electronic equipment for use by the U.S. Armed Forces. The Charles Wood Area houses the research and development (R&D) area for CECOM and housing for the installation. The Main Post houses mostly administrative buildings.

The Army established the Fort Monmouth-Main Post property in 1917 on approximately 590 leased acres of a former racetrack. It was originally called Signal Corps Camp at Little Silver and provided Army basic training in technical communications during World War I (WWI). Later in 1917, the installation was renamed Camp Vail. In 1925, the camp received permanent status, and the Army bought the property and renamed it Fort Monmouth in honor of the soldiers of the American Revolution who died in the battle of Monmouth Court House. During World War II (WWII), the installation was expanded to its current size when various properties were acquired, including the former Monmouth Country Club, where the Charles Wood Area was established. The Evans Area was also acquired around this time. It used to be a hotel and a farm and is located 10 miles to the south of the Main Post, in Wall Township.

The forerunner of the Army Air Corps and the U.S. Air Force had its roots at Fort Monmouth. In 1928, the first radio-equipped meteorological balloon soared into the upper reaches of the atmosphere, a precursor of a weather sounding technique universally used today. In 1938, the first U.S. aircraft detection radar was developed here. In 1946, space communications was proved feasible when the Diana Radar was used to bounce electronic signals off the moon. The Myers Center was constructed in 1954 to house the Signal Corps Laboratories.

The Patterson Army Health Clinic was dedicated in 1958, its mission being to provide and coordinate high quality care for all beneficiaries in the highest tradition of military medicine, while promoting optimal health and maintaining readiness. Patterson Clinic is now home to Monmouth County's first Veterans' Affairs Health Clinic.

The 1993 BRAC round affected two areas at Fort Monmouth: the Charles Wood Housing Area (102 acres) and the Evans Area (215 acres). Under BRAC, the Housing Area was transferred to the Navy, while the Evans Area was transferred to the local township and community college. Recently, the Navy returned the Housing Area to the Army.

Today, Fort Monmouth is the home of the Communications-Electronics Lifecycle Management Command (CELCMC) and the major organizations located there include CECOM, the Program Executive Office for Command, Control, and Communications Tactical (PEOC3T), and the Program Executive Office for Intelligence, Electronic Warfare, and Sensors (PEOIEWS). These organizations, together with the Program Executive Office for Enterprise Information Systems (PEOEIS) and the Communications, Engineering, Research, and Development Center

(CERDEC) are known as Team Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (Team C4ISR) (Ref. 025, Ref. 068, Ref 073).

TABLE 5-1: OPERATING HISTORY OF FORT MONMOUTH

Time Period	Significant Events
1910s	• June 1917 – The Main Post is established as Camp Little Silver.
	• September 1917 – The camp is re-named Camp Alfred Vail.
	• The Pigeon Breeding and Training Section is established to train pigeons and handlers
1920s	• August 1925 – Camp Alfred Vail attains permanent status and is renamed Fort Monmouth.
	• August 1929 – The Signal Corps' Electrical Laboratories (Washington) and the Research Laboratory (New York) merge with the Radio Laboratories at Fort Monmouth to form the Signal Corps Laboratories.
1930s	• 1935 – Squier Hall is built at the Main Post for the laboratories.
1940s	• 1941 – Property is purchased for the Charles Wood Area.
1950s	• 1954 – Laboratory operations at Squier Hall move to the Charles Wood Area.
	• The Pigeon Service is discontinued, and the pigeons are sold or donated to zoos.
1960s	• August 1962 – The Army disbands the technical services and establishes the Electronics Command at Fort Monmouth to manage Signal Research and Development (R&D) and logistics support.
1970s	• The Signal School moves to Fort Gordon.
1980s	• 1981 – The Communications-Electronics Materiel Readiness Command and the Communications Research and Development Command merge to form the CECOM.
1990 – present	• 1993 – BRAC 1993 ordered the closure of the Evans Area.
	• 2005 – BRAC orders the closure of Fort Monmouth.

Source: (Ref. 025)

5.2 Overview of Radiological Operations

5.2.1 Summary of Current Installation Tenants/Operations

The presence of radioactive materials at Fort Monmouth has been predominantly limited to certain areas and functions of the installation. Historically, laboratory research and development in the areas of radio and electronics use of vacuum tubes and radium dials, the use of ionizing radiation-producing machines, and military support equipment such as night vision goggles that contain radioactive commodities, have been among the most common uses of radioactive materials. Facilities, buildings, and rooms that contain or once contained equipment that produce X-Rays via AC or DC sources of energy are not sources of radioactive contamination. This equipment, which includes medical and dental diagnostic X-Ray machines, X-Ray security

inspection machines, X-Ray diffraction, electron microscopes, X-Ray based XRF equipment, and some high voltage electron tubes, only produce ionizing radiation when energized. Operation of this equipment will result in ionizing radiation fields being produced in and around the equipment only while activated, but will not result in radioactive contamination. Much of the activities of the past were performed as part of the Signal Corps Laboratories, first housed in the Squier Building (Building 283) and then in the Myers Center (Building 2700). Other work was performed in the Evans Area of the base, which was closed in the late 1990s due to BRAC 1993 activities, and the work transferred to the CECOM office and laboratory in the Charles Wood Area.

Presently, a research laboratory in Building 2540 in the Charles Wood Area is the only site to regularly use and store radioactive materials as part of the research and development activities performed on site. A designated storage area is set aside for drums containing material waiting for disposal, including tritium exit signs removed from Fort Monmouth buildings, smoke alarms containing RAM, and other instruments with associated check sources. These items are periodically removed to Wright Patterson Air Force Base for disposal/recycling (Ref. 049). The administrative arm of the CECOM Safety Office is housed in the adjacent Building, 2539, where they maintain files pertaining to the use of any RAM on the installation as well as active NRC licenses and ARAs for Fort Monmouth specifically, as well as for RAM use by the Army worldwide.

Throughout Fort Monmouth, equipment containing RAM is noted, particularly as used in chemical and explosives detectors operated by personnel working in security entrance areas, postal facilities, and shipping areas, and emergency responder personnel throughout the installation. Electron Capture Detectors containing Ni-63 are used in the Environmental Laboratory to analyze samples for pesticides and Polychlorinated Biphenyls (PCBs). All of these of equipment involve the use of sealed sources rather than research-type materials.

5.2.2 Permits and Licenses

The following U.S. Nuclear Regulatory Commission (NRC) Licenses and Army Radiation Authorizations (ARAs) are applicable to Fort Monmouth. Any other licenses applicable to Fort Monmouth activities are currently being pursued under a Freedom of Information Act (FOIA) request to the U.S. Nuclear Regulatory Commission (NRC).

- An U.S. Nuclear Regulatory Commission (NRC) License is held by the U.S. Army Tank-Automotive & Armaments Command at Rock Island, IL for use by all DoD installations and job sites as Byproduct Materials License (BML) 12-0072-06. This license is for radioactive materials use in armaments and artillery systems. This license expires 8/31/08.
- An U.S. Nuclear Regulatory Commission (NRC) License is held by the U.S. Army Armament & Chemical Acquisition and Logistics Activity at Rock Island, IL for use by all DoD installations and job sites as Byproduct Materials License (BML) 12-0072-13. This license is for radioactive materials use in Chemical Agent Detectors. This license expired 3/31/95.
- An U.S. Nuclear Regulatory Commission (NRC) License is held by the U.S. Army Armament & Chemical Acquisition and Logistics Activity at Rock Island, IL for use by

all DoD installations and job sites as Byproduct Materials License (BML) 12-0072-14. This license is for radioactive materials use in Chemical Agent Monitors. This license expired 3/31/98.

- An U.S. Nuclear Regulatory Commission (NRC) License is held by the U.S. Army Soldier & Biological Chemical Command at Aberdeen Proving Ground MD for use by all DoD installations and job sites as Byproduct Materials License (BML) 19-30563-01. This license is for radioactive materials use in Chemical Agent Detectors and Monitors. This license expires 10/31/10.
- An U.S. Nuclear Regulatory Commission (NRC) License was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at Fort Monmouth or other temporary job sites as Byproduct Materials License (BML) 29-01022-06. This license was for the use of byproduct radioactive materials in research and development and instrument calibrations. This license expired 2/28/05.
- An U.S. Nuclear Regulatory Commission (NRC) License was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at Building 2540A in the Charles Wood Area of Fort Monmouth as Byproduct Materials License (BML) 29-01022-07. This license was for the use of radiological materials in research and development, for instrument calibrations, analysis of test samples, as check sources, and for the storage of radiological materials. This license expires 10/31/12.
- An U.S. Nuclear Regulatory Commission (NRC) License was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at DoD installations and job sites as Byproduct Materials License (BML) 29-01022-14. This license was for the use of radiological materials in instrument calibrations, and superseded terminated licenses 29-01022-08, 29-01022-11, SMB-1300, SNM-1327, SNM-1896, SNM-1900, and SUB-1150 (Ref. 83). This license expired 10/31/03.
- An Army Radiation Authorization (ARA) was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at DoD installations and job sites as ARA 24-12-07. This authorization was for the use of radiological materials in lensatic compasses. The authorization expired 1/31/05.
- An Army Radiation Authorization (ARA) was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at DoD installations and job sites as ARA 29-10-06. This authorization was for the use of radiological materials as radioluminous paint. The authorization expired 1/31/05.
- An Army Radiation Authorization (ARA) was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at DoD installations and job sites as ARA 29-10-10. This authorization was for the use of radiological materials in electronic equipment. The authorization expired 1/31/05.
- An Army Radiation Authorization (ARA) was held by the U.S. Army CECOM Safety Office at Fort Monmouth, NJ for use at DoD installations and job sites as ARA 29-10-12. This authorization was for the use of radiological materials in Night Vision Devices. The authorization expired 1/31/05.

5.2.2 Authorizations and Protocols

Current authorizations and protocols include licenses found during records reviews and the following Army guidance protocols:

- Army Radiation Authorizations (ARAs)
- Commodity Management AR 700-52
- Inventory of Isotopes AR 700-52
- Labeling and Posting AR 385-30
- Radiation and Contamination Surveys AR 700-52
- Disposal of Radioactive Material AR 755-15
- Leak Test Records AR 700-52
- Radioisotope Committee (RIC) minutes/correspondence AR 700-52, AR 40-14
- Shipment and Receipt Records AR 55-55
- Appointment of Radiation Safety Officer (RSO) AR 700-52, AR 40-10

5.2.3 Waste Handling Procedures

Any radiological waste generated at the installation is closely monitored by the CECOM Safety Office, and properly stored until it can be disposed/recycled at Wright Patterson Air Force Base. Shipments are periodically sent to this location, the shipping manifests held by the CECOM Safety Office.

6.0 FINDINGS

A review of the documentation described in Section 4.0, as well as interviews with personnel familiar with RAM practices and procedures at the installation suggests that there are potentially impacted areas at Fort Monmouth due to the use or storage of RAM. The following sections describe the findings of this HSA, including radiological contaminants of potential concern, potentially impacted Buildings/Rooms and outside areas, and potential regulatory issues.

All of the necessary information to complete this HSA came from documentation and sources as summarized in Section 4.0. Inquiries to the U.S. Nuclear Regulatory Commission (NRC) resulted in the submission of a FOIA request, which is still pending as of the publication date of this HSA.

6.1 Summary of Potential Radiological Contaminants

A list of radionuclides used or stored at Fort Monmouth is provided in Table 6-1. All but radon-222 have relatively long half-lives. These radionuclides would be considered radiological contaminants of potential concern (RCOPCs), based on their half life and expected behavior and movement in the environment. While radon-222 is short-lived, it is continuously regenerated from naturally occurring radium in the soil. Kr-85 is a noble gas that does not produce radioactive progeny and is only an external radiation hazard. The remaining RCOPCs are limited by soil and building concentration guidelines addressing the 10 CFR 20.1402 unrestricted release criteria.

TABLE 6-1: PRIMARY RADIONUCLIDES USED/STORED AT FORT MONMOUTH (POTENTIAL RCOPCS)

Radionuclide	Name	Half Life	Notes
Am-241	Americium-241	432 y	Isotope referenced in RAD.inventory 1997 through 2000 files
Cf-252	Californium-252	2.64 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
C-14	carbon-14	5,730 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Cs-137	cesium-137	30.2 y	Isotope referenced in RAD.inventory 1997 through 2000 files; found in at least large irradiator.
Cl-36	Chlorine-36	301,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Co-57	Cobalt-57	270.9 d	Isotope referenced in Rad inventory 1994-1995 files. Likely totally decayed away if used in check source quantities.
Co-60	Cobalt-60	5.2 y	Isotope referenced in License 29-0102-07. Likely decayed away depending on the size of the original source.

Radionuclide	Name	Half Life	Notes
Eu-154	europium-154	8.8 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
H-3	hydrogen-3 (tritium)	12.3 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Used in self-illuminated exit signs and watches.
I-125	iodine-125	60 d	Isotope referenced in a 1983 Radiation Protection Survey. Used in hospital for thyroid treatment.
Kr-85	krypton-85	10.7 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use and radioactive test samples
Ni-63	Nickel-63	100.1 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use, explosive detectors, and radioactive test samples
Pu-238	plutonium-238	87.75 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Sealed Source use and radioactive test samples. Instrument check source
Pu-239	plutonium-239	24,131 y	Isotope referenced in Rad inventory 1994-1995 files.
Pm-147	Promethium-147	2.62 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Ra-226	radium-226	1,600 y	Isotope referenced in RAD.inventory 1997 through 2000 files. Used in check sources, luminescent dials and instruments in radios, compasses, night vision adapters, and other commodities
Rn-222	radon-222	3.8 d	Constituent of radon gas and progeny; despite short half-life, is continuously regenerated from Ra-226 parent.
Sr/Y-90	strontium-90/yttrium-90	28.6 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Tc-99	technetium-99	213,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
Th-232	thorium-232	14,050,000,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.
U-238	uranium-238	4,468,000,000 y	Isotope referenced in RAD.inventory 1997 through 2000 files.

6.2 Summary of Potential Contaminated Areas

Approximately 22 buildings or building complexes have been identified as areas where RAM was used, stored, or potentially disposed, based on review of records and interviews as outlined herein. A summary of these buildings is provided in Table 6-2. Specific findings for each building are provided in the HSA Building Fact Sheets provided in Appendix B.

A radon study was performed throughout all Fort Monmouth buildings in 1989 in which 1,132 detectors were deployed for 90 days in the Main Post, Charles Wood, and Evans Areas. 1,077 were retrieved, accomplishing a 95% recovery rate. All were analyzed and none showed levels above the EPA recommended action level of 4 pCi/L (Ref. 033, Ref. 081, Ref. 082).

No comprehensive inventory of tritium exit signs within existing facilities has been completed at Fort Monmouth. However, a program was instituted in 2003 by the Fort Monmouth Directorate of Public Works (DPW) to identify and properly dispose of all exit signs that contained tritium (H-3) in buildings prior to demolition. As part of the Building Demolition Checklist utilized by Fort Monmouth demolition contractor, all tritium exit signs are identified, removed and given to CECOM Safety for proper disposal, prior to the building demolition.

6.2.1 Impacted Areas – Known and Potential

Impacted Areas are based upon Army-1999 and MARSSIM criteria. These include MARSSIM Class 1, Class 2, and Class 3 areas. Included in Appendix B are Building Fact Sheets that provide summaries of all potentially impacted buildings visited and associated areas beneath the footprint of demolished buildings considered impacted.

6.2.2 Non-Impacted Areas

Non-impacted areas include those areas with no potential for residual contamination. HSA records do not indicate presence of any radioactive materials other than smoke detectors or exit signs with sealed sources. Those areas that had radioactive materials, but have survey records documenting decontamination and/or free release of the area are also considered non-impacted.

TABLE 6-2: FORT MONMOUTH BUILDING/AREAS WITH RAM USE/STORAGE HISTORY

Building Number	Building/Area Name & Use	Current Tenant and Conditions
116	Warehouse/Shipping & Receiving	Existing; used by Base Contractor for Garrison Supply, contains secure radiological storage areas.
173	Environmental Laboratory	Existing; Electron Capture Detectors are used for environmental sample analysis in designated room.
205	Wackenhut/Alutiiq Security Office	Existing; three explosives detectors are stored in Room 136.
275	Museum	Existing; several display items contain radioactive materials.
282	Main Post Fire Department	Existing; once used explosive detectors containing sources, have been removed.

Building Number	Building/Area Name & Use	Current Tenant and Conditions
283	Squier Building (Administrative)	Existing; housed Signal Laboratories before they were moved to 2700, renovated to administrative space.
292	Museum Storage	Existing; several items in storage contain radioactive materials.
451	Postal Facility	Existing; once used explosive detectors containing sources, have been removed.
602	High Security Fabrication & Testing	Existing; once used explosive detectors containing sources, have been removed.
1075	Patterson Health Clinic	Existing; used radioisotopes in thyroid treatment in late 1960's-early 1970's; may have used incinerator on the grounds that has since been demolished.
2535	Battery Test Facility	Existing; battery testing facility.
2502-2507	Fabrication and Integration	Existing; CERDEC fabrication and integration of materials into military vehicles.
2539	Communications and Electronics Command (CECOM) Safety Office	Existing; administrative area.
2540	Communications and Electronics Command (CECOM) Laboratory	Existing; research and development laboratory.
2560	Charles Wood Fire Department	Existing
2700	Myers Center (Administrative)	Existing; once used explosive detectors containing sources, have been removed.
2701	Charles Wood Entry Area	Existing; once used explosive detectors containing sources, have been removed.
2704	Environmental Test Facility	Existing; military environmental conditions testing facility.
2705	U.S. Army Communications, Engineering, Research, and Development Center (CERDEC) (formerly Army Research Laboratory (ARL))	Existing; formerly contained a Night Vision lab and had radioactive source use, currently administrative.

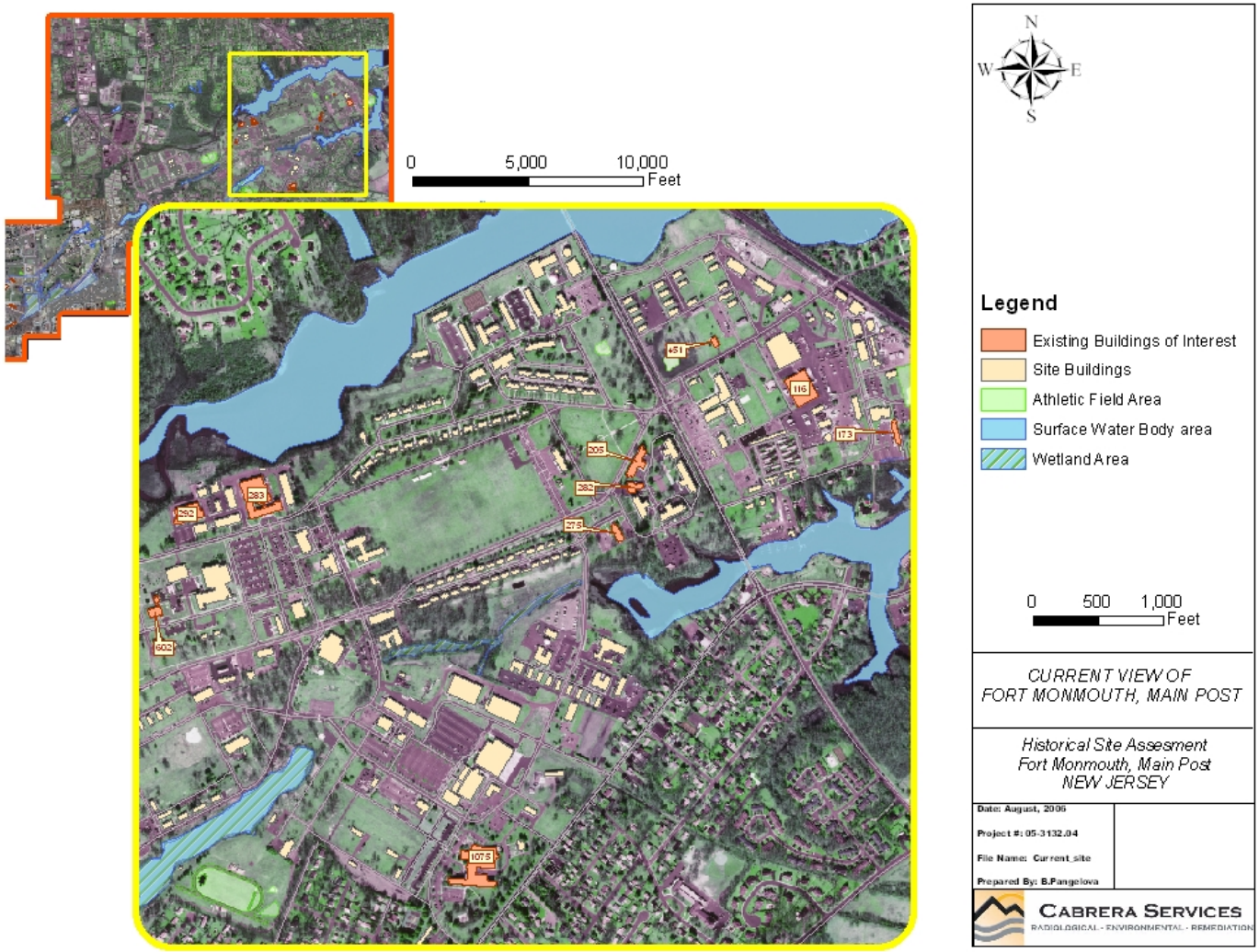


FIGURE 6-1: LOCATIONS OF POTENTIALLY IMPACTED BUILDINGS/AREAS - FORT MONMOUTH MAIN POST

FIGURE 6-2: LOCATIONS OF POTENTIALLY IMPACTED BUILDINGS/AREAS - FORT MONMOUTH CHARLES WOOD AREA

6.3 Location-Specific Findings

A summary of location-specific findings, listing building-specific radiological information, is given in Table 6-3. Appendix B provides Building Fact Sheets that provide greater detail of the radiological information, photographs, floor plans, and square footage by building and area for all locations evaluated as part of this HSA. Locations of the buildings classified as Potentially Impacted are shown on the Fort Monmouth maps in Figures 6-1 (Main Post) and 6-2 (Charles Wood Area).

Based on survey methods as described in Section 4.0, the following buildings where RAM was handled (Table 6-2) are considered "Non-impacted.": Buildings 116 (Warehouse); 173 (Environmental Lab); 205 (Security); 282 (Main Post Fire Department); 451 (Postal Office); 602 (Fabrication and Testing); 1075 (Patterson Health Clinic); 2535 (Battery Test Facility); 2502-2507 (Fabrication/Integration); 2539 (CECOM Safety Office); 2560 (CWA Fire Department); 2700 (Myers Center); 2701 (CWA Entry); 2704 (Environmental Test Facility); and 2705 (CERDEC).

Based on survey methods as described in Section 4.0, the following buildings where RAM was handled (Table 6-2) are considered "Impacted.": Buildings 275 (Museum); 292 (Museum Storage); 283 (Squier Building); and 2540 (CECOM Laboratory).

TABLE 6-3: SUMMARY OF LOCATION-SPECIFIC FINDINGS

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
116	Unknown	Warehouse storage	Building 116 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) and Radiation Protection Surveys (Ref. 048) list storage areas within the building for radiological materials to be held until recovered by the Safety Office.	Information obtained during the site visit identified a secure storage cage in the corner of the entrance/admin area that houses a detector (Ludlum Model 5 – QC done by CECOM) to check incoming material suspected to be radiological. Radioactive material storage area has been rotated in warehouse area of building, but has been controlled (not secure). They have not dealt with any radioactive materials for approximately 10 years; when it came through, it was stored in outside shelters or in designated cabinets until the Safety Office arrived to take care of it (CECOM would check monthly); Safety Office would perform a release scan for the Excess Department's files. If/when a radioactive item is found in the "Misdirected" area, it is shipped to whatever depot is scheduled to receive it only after CECOM demilitarizes the meter (survey would be on file with CECOM). According to Closeout Surveys of June 1998 and December 1999, affected storage areas used for radioactive commodities indicate no contamination above the lower limits of detection.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
173	Garage	Environmental Laboratory	Building 173 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) and the minutes of the Radiation Control Committee (Ref. 049) list the presence of radiological materials within the building, as well as Radiological Work Permits for the sources in the ECD instruments.	Six 15-mCi ECD (Electron Capture Detectors) are in use in the environmental lab, containing Ni-63 sources; used for pesticide and PCB analysis. The room is properly marked for radioactive materials. Environmental lab tests for gasoline spills, VOC measurements, monitoring well samples, drinking water samples, and explosives testing, but not radioactive analysis (must be sent to a different lab). The laboratory has two self-contained hoods with acid filters. No dosimetry is practiced in this laboratory; swipe test on Ni-63 source is only monitoring method, and is performed regularly with no evidence of leaks on record (Ref. 23).	Non-Impacted
205	Unknown	Security contractors (Allutiq Wackenhut Security Services)	Building 205 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) include the presence of explosives detectors and their associated Ni-63 sources.	During the site visit, two vapor tracers and one Itemiser 3 (explosives detectors containing Ni-63) were identified and are being kept in storage in Room 136 of this building. They are currently not in regular service. Swipe tests/leak tests are done regularly on these instruments, with no evidence of leaks on record (Ref. 022). Two private security companies (Allutiq Security & Technology LLC and Wackenhut Services Inc.) have been contracted since 2004.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
275	Communications-Electronics Museum	Communications-Electronics Museum	ARA 29-0122 is mentioned in Minutes from a Radiation Control Committee meeting, with specific reference to Ra-226 incorporated as radioluminous paint on meter movements, toggle switches, and circuit breakers, and electron tubes incorporating various radioactive materials (Ref. 049). The Communications-Electronics Museum was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety Office Radiation Protection Surveys (Ref. 048) detail the removal of radioactive materials and the performance of a closeout survey for Building 800, the prior location of the Museum and Museum Storage before moving in 1998-99.	Thoriated lenses (night vision lens), Kodak camera, a radium-containing component on a radio, and vacuum tube were among several museum display items that gave off readings above background level. The curator mentioned the removal of numerous items that contained radiological materials, which was done as part of the moving process to Building 275 from Building 800.	Impacted, MARSSIM Class 3
282	Fire Department, Main Post	Fire Department, Main Post	CECOM Safety inventory lists (Ref. 047) include the presence of explosives detectors and their associated Ni-63 and Kr-85 sources.	Department once had three Radiac meters, along with associated check sources, but CECOM retrieved them approximately three months prior to visit due to change in mission (no longer a response agency). There have been no leak or spill incidents related to the meters/sources and instruments were regularly tested and calibrated by the CECOM Safety Office. Mr. Nicholas Antonelli provided information that the only devices currently being used here are vapor tracers and itemizers found on trucks. According to leak test data for GL devices (Ref. 101) provided by Mr. Goldberg, GL devices previously existing inside the building have been moved to other buildings and affected areas used for radioactive commodities indicate no	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
				contamination above the lower limits of detection.	
283	Research laboratories; Signal School training (classrooms)	(PMDCASS) Administrative offices	A Special Investigation Report was issued in 1951 for the Squier Signal Laboratory Director to discuss a wipe test performed on samples of aluminum covered with polonium lacquer (~230 mCi) to ensure that no hazard was present (Ref. 036).	All evidence of drains were covered over, but janitorial closet sinks were original to building and existed during time when wet labs were active and may have residue in drain traps. Evidence of radio communication work was found in the basement work area (radio manual, wire used in radio circuitry) on shelves. Basement contains sump and new furnace; water sometimes leaks into area during storm events due to proximity of river; once had petroleum-like material spill, but testing revealed it to be coal tar (no radioactive materials); fallout shelter (original) exists in basement area.	Impacted, MARSSIM Class 3

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
292	N/A	Museum storage	Due to the presence of artifacts containing radiological materials, the Museum Storage was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety Office Radiation Protection Surveys (Ref. 048) detail the removal of radioactive materials and the performance of a closeout survey for Building 800, the prior location of the Museum and Museum Storage before moving in 1998-99.	A Chinese radio and a vacuum tube were radiological commodities identified with radiological readings above background levels. Radium-contaminated components were found in a posted radioactive storage locker. The curator mentioned the removal of numerous items that contained radiological materials, which was done as part of the moving process of the Museum to Building 275 from Building 800 in 1998-99. Before this occurred, the storage area contained approximately 65 items that contained RAM.	Impacted, MARSSIM Class 3
451	N/A	Postal Service facility	Building 451 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety Radiation Protection Surveys (Ref. 048) list Building 451 in a list of buildings where a survey was conducted in 2006. Radiation Work Permits were issued for package screening with x-ray machines in postal, shipping, and records areas (Ref. 067).	Post offices use an Ion Vapor Tracer 2 for explosives detection on packages that come on post; two are at this building and one is at the post office in the Myers Center (Building 2700). The Post office also possesses an x-ray machine. CECOM maintains calibrations on these instruments. According to leak test data for GL devices (Ref. 101), affected areas used for radioactive commodities indicate no contamination above the lower limits of detection.	Non-Impacted
602	N/A	(I2WD) Secure research and fabrication area	Building 602 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) mention the use of instruments containing a Ni-63 source.	Detecting equipment (ACADA) containing Ni-63 sealed source was integrated into field military vehicles. According to the managers and operators, these instruments are no longer kept at or used at this facility. Building 601 is currently an office and warehouse and is moving to the newly constructed Building 603 to allow space for new Research Labs. According to leak test data for GL devices (Ref. 101) provided by Mr.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
				Goldberg, GL devices previously existing inside the building have been moved to other buildings and affected areas used for radioactive commodities indicate no contamination above the lower limits of detection.	

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
1075	Garrison Hospital	(MEDDAC) Patterson Health Clinic	Safety-Kleen had a schedule of instrument removal (photographic units) in 2003-2004 from Building 1075 (Ref. 027).* X-Ray machine calibration and maintenance surveys were conducted at the Health Clinic, documented in 1995 (Ref. 029).* A Radiation Protection Survey completed in 1983 specifically mentions the use of I-125 in the "In-Vitro Clinic"; a small weekly volume of tests were performed and H&S monitoring was considered adequate. Waste disposal included flushing all liquids down the hot sink, containers were flushed with cold water and checked for contamination before disposal as normal lab waste (rad labels were defaced) (Ref. 035). The indicated use of I-125 in the hospital prior to 1990 results in a 'no detectable contamination situation' due to the small anticipated amounts of I-125 used for the *In-Vitro Clinic*, the short half life of the radioisotope (60 days), and no documented use of I-125 use after 2000. The reduction in any plausible I-125 radioactivity due to decay results in no detectable I-125 radioactivity in and around the hot sink, any containers used, or the general work areas where the radioactive material was administered or used. CECOM Safety Radiological inventory lists (Ref. 047) include Building 1075, but only in reference to the presence of x-ray machines.* **Note that these reports were reviewed, however X-Ray machines are not applicable to any NRC Licenses or HSA activities; these are provided for informational purposes only*.	Radiology Department uses only x-ray machines, but no radioactive isotopes. Film badges are only used by x-ray personnel. However, because X-Ray machines only produce ionizing radiation fields via AC or DC sources of energy, they are not considered sources of contamination and do not cause or result in HSA impacted areas. A nurse (Crystal Parrish, LPN) who was employed in late 1960s - 1970s remembered use of radioisotopes in the lab (I-125), where it was prepared and then taken to clinic for thyroid treatment in patients; employees working in these areas were monitored through use of film badges and bioassay tests. The hospital had used a pathological waste incinerator located on the west side of the building (from 1970 to 1992) to burn infectious paper and plastic and later Type 4 hospital waste (animal solids and organic wastes). Throughout its use, it tended to exceed emissions standards and was ultimately closed in 1992 and demolished in 1993. Following the demolition, the grounds around the incinerator location appeared free of ash and debris (Ref. 079) and the site is considered "Response Complete" (Ref. 080). Currently, all hospital waste is now shipped off-site; Steris Cycle is contracted to remove hazardous medical waste, although there is no record of radioactive waste included with these materials.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2502-2507	Food Commissary warehouses; general warehouses; vacant buildings	(CERDEC) Fabrication and Integration	Radiological monitors are sometimes part of equipment installed into the Humvees and other vehicles, but they do not have radiological sources. No indications of radiological materials or contamination were observed.	2502: Integration facility to incorporate electronics and other equipment into vehicles (usually Humvees) before sending out to field sites to test. Only waste here is aluminum. No tests involve radioactive sources and no materials would have radioactive commodities. 2503: Fabrication and machine shop; no evidence of radioactive materials. 2504: Offices, shipping and receiving. 2506: Paint and sign shop, installation facility (materials fabricated in 2502 are installed into the Humvees in this building). Two HazMat storage sheds are outside this building, along with a used oil tank. 2507: Bays to park Humvees and other vehicles for outfitting; final stop before vehicles are sent out for testing.	Non-Impacted
2535	Communications/ Radio Repair facility	Battery test facility	It was confirmed that none of the batteries tested would contain radioactive materials. No indications of radiological materials or contamination were observed.	Environmental tests have been done on batteries at this location for approximately 30 years; during testing, explosions may occur as a result; test chambers are sealed to prevent any contamination from battery contents, and chambers are decontaminated afterwards with cleaning materials disposed of as hazardous materials.	Non-Impacted
2539	N/A	CECOM Safety administrative offices	Building contains only administrative offices, with no radiological material use or storage. Records kept at this office show that no radiological incidents or spills have occurred on the Main Post or Charles Wood Areas. Additionally, no buildings have been decommissioned in these areas.	The field team received a CD-ROM from Mr. Silber with CECOM files, surveys, and reports. This office is POC for multiple Army-wide NRC licenses for radioactive commodities, but they are not stored at this location.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2540	N/A	CECOM Laboratory and Radiological testing; New World Technologies is current laboratory contractor	Due to the presence of several Health Physics Laboratories, a nuclear counting laboratory, and a Radioactive Waste Storage Facility, Bldg 2540 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) cite multiple radiological materials still in use and Radiation Protection Surveys (Ref. 048) are being regularly conducted in Building 2540, specifically mentioning calibration range (room 108), radiological lab, prep lab (room 102), calibration lab, radwaste storage, excess waste storage (room 109), exposure room, irradiator room, and panoramic range (106A). Some survey results show levels elevated beyond background in certain locations. The surveys note that a Mobile Laboratory that was considered part of this building had a closeout survey completed in August 2001. Minutes from Radiological Control Committee Meetings (Ref. 049) discuss the disposal of low-level waste (drums containing tritium exit signs and smoke detectors) by shipping to Wright Patterson AFB as well as an inventory of sources, smoke detectors, instruments, etc. Radiological Work Permits were issued for the use of x-ray machines, calibrator use of Cs-137, Pu-238, Tc-99, and Co-60, research and development use of Cs-137, a Ra-Be source, Cf-252, and Co-60, and demilitarization activities from excess storage of Th-232, Ra-226, and H-3 (Ref. 063).	Materials used on site are covered under NRC licenses and R & D licenses; testing is done in a low-level environmental lab (e.g., use of HPGe detector, scintillator, etc.); a 120 mCi storage area is at this location; building contains an irradiator room (Room 7) with a 2000-Ci Co-60 source (decayed) and activity of 500 mR/h; Cf-252 is used for calibration and instrument testing, along with various sealed sources. One of the laboratories has a fume hood, which has been regularly surveyed. Some work involving liquids has been done in the building (Ultima Gold Liquid Scintillation fluids). A storage room adjacent to the building (Room 109) contains unused sealed sources/devices, including Radiac meters (for training) and 10 55-gallon drums containing items such as smoke detectors and tritium compasses – dose is at mCi levels. [Items here are included under the Logistics License.] Nearby “Butler Building” is used to store Radiac equipment only, not sealed calibration sources.	Impacted, MARSSIM Class 1

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2560	N/A	Charles Wood Area Fire Department and Fire Training Academy	All Fire Department areas were noted as buildings of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045).	Chemical detectors, APD2000, containing a Ni-63 source (10 mCi), are used on the emergency response trucks. CECOM Safety is responsible for maintenance and calibration of these meters and test them regularly. Three Radiac meters were once kept at the facility, but were retrieved by CECOM Safety approximately three months prior to the site visit as part of an instrument rotation to put meters where they are currently needed. According to leak test data for GL devices (Ref. 101), affected areas used for radioactive commodities indicate no contamination above the lower limits of detection.	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2700	Research and Development Laboratories (ARL) from 1955 - 1996	U.S.A. Communications-Electronics Life Cycle Management Command (USCELCMC) administrative offices, computer labs, two R&D labs	Safety-Kleen had a schedule of instrument removal (photographic units) in 2003-2004 from Bldg 1075 (Ref. 027). A Water Quality Engineering special study was conducted in 1978 (Ref. 030) that discusses the Acid Neutralization Area utilized for HazWaste disposal (industrial waste) adjacent to Bldg 2700. As part of a Remedial Investigation, chemical analysis was done in the Area (Ref. 078) and it was earmarked for Remedial Design in 1997 (Ref. 079). Results for two sampling points are noted in the Water Quality Engineering study report. However, no radiological parameters were addressed in the study. Remedial actions were continuing into 2005, with compliance monitoring efforts via groundwater monitoring wells (Ref. 080). An Installation Assessment of Fort Monmouth (Ref. 034) was completed in 1980 by the U.S. Army Toxic and Hazardous Materials Agency (Aberdeen, MD). The report discusses the use of radiological materials in Bldg 2700 for experimental work, licenses, the use of sealed sources of Pu-238 in thermoelectric generators for research and development. CECOM Safety performed a Radiation Protection Survey in Bldg 2700 (Ref. 037) and specifically listed the presence of a Mossbauer Spectroscopy System with a 3 mCi Co-60 source in room 4C111. A Radiation Work Permit (RWP) (Ref. 067) was issued for these activities. Surveys were also referenced in a Memo to MACOM in 1988 completed in Bldg 2700 (Ref. 046).	Currently only two active “wet labs” still exist in the facility, neither is for radiological materials: one (2C211) for battery testing and fabrication and the other (2D310) is used in the handling of crystals and welding (contains solvents and corrosives). Most rooms in the building today are computer labs and office space. Building 2700 originally had three radiological labs, which were completely renovated into administrative areas, which included the removal of all laboratory equipment/furniture and the capping of all plumbing in those rooms, approximately 10 years ago when ARL moved out of the building. No radiological materials have been used at this location since 1997, effectively qualifying the majority of the building as non-impacted. DPW contracted to remove all tritium exit signs in 2004 (Ameresco was lighting replacement contractor). No indications of radiological materials or contamination were observed. A wastewater disposal area was located outside of the building, referred to as an Acid Neutralization Pit; it is currently under remediation monitoring, but not for radiological contamination. An extract of the Radiation Inventory for Year 1995 (Ref. 106) shows the listing of a Photometer containing four sources of Carbon-14, totalling 200 microcuries. Data for this Photometer, other than its listing as being identified with the Coding system as "C-04" and used in Building 2700, Room 4D312. Leak test data was	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
			Bldg 2700 was noted as a building of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) include Bldg 2700 in reference to the use of Co-57 and C-14; Radiation Protection Surveys (Ref. 048) note surveys done up to 2006; and minutes from the Radiation Control Committee meetings (Ref. 049) document a Radiation Work Permit issued for the use of x-ray machines for safety screening of incoming packages in the mail room.	not available since each source is less than the 100 microcurie limit requirement for leak testing of sealed sources (Ref. 103). According to leak test data for other sealed sources used in this building (Cobalt-57 Mossbauer Source, Building 2700, Room 4C111) (Ref. 104), affected areas used for radioactive commodities indicate no contamination above the lower limits of detection, and therefore no contamination would be present in the sinks leading to the Acid Neutralization Pit either.	

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2701	N/A	Charles Wood Area entry/truck & vehicle inspection	The Charles Wood entry point was noted as an area of interest on a list provided by Barry Silber of the CECOM Safety Office (Ref. 045). CECOM Safety inventory lists (Ref. 047) list this area with reference to instruments containing Ni-63 sources.	Mr. Lou Poirer, the Security Chief, mentioned the use of vapor tracers in this area in the months following the 9/11 terrorist attacks, but they are no longer kept at the gate office unless there is a suspicion of an explosive item; they were removed from regular use due to ultra-sensitivity of the instruments and the excessive false positives that occurred. The instruments are now being stored at the Security Office in Building 205. During the interview with Mr. Barry Silber (Ref. 001), it was suggested that Cabrera investigate the Oceanport entry area as well; however, during the investigation of the Charles Wood Area entry, it was discovered that no radioactive materials were present at the Oceanport entry area, and thus it was not necessary to visit. According to leak test data for GL devices (Ref. 101) used in this building, affected areas used for radioactive commodities indicate no contamination above the lower limits of detection. Leak test data provided by Mr. Craig Goldberg (Ref. 101) referenced Building 977 (Provost Marshall). Building 977 had not previously turned up in any documentation or during the site visit. A conversation with Mr. Nicholas Antonelli (Ref. 102) showed that the commodity now showing up as being in Building 977, likely had been moved there from Building 2701. Since the results showed data below the lower limit of detection, Building 2701 can be considered non-impacted (and Building 977 is an area of non-interest).	Non-Impacted

Building Number	Original / Former Use	Current Tenant / Use	Radiological Data Summary	Additional Information	MARSSIM Classification
2704	N/A	Environmental Test facility	Karl Lasala, an employee since 1981, stated that a test may have been performed in this building, during his tenure, on a piece of electronic equipment containing a radioactive source. However, he also stated that specific records regarding this event would be extremely difficult, if not impossible, to locate. The operators reported that no specific procedures are in place for radioactive source or equipment handling unique to this facility, nor are there specific procedures are in place for leaks or spills unique to this facility. No indications of radiological materials or contamination were observed.		Non-Impacted
2705	Army Research Laboratory/Technical Operations Center (TOCs)	Future Combat Systems - Network Systems Integration, administrative offices and computer laboratories	CECOM Safety conducted a Radiation Protection Survey in Building 2705 in which two sources were noted to be in use in Room 825 (20 mCi of Co-60 and 5 mCi of Cs-137) (Ref. 037). Radiation Protection Surveys were referenced in a Memo to MACOM in 1988 completed in Building 2700 (Ref. 046).	Areas suspected of former radiological use (Night Vision Lab in Room 825) have been completed renovated into office space. The field crew was shown the only active laboratory in the building, the Systems Engineering and Experimentation Lab (Room 603), which is a computer lab with some office space. No indications of radiological materials or contamination were observed. According to leak test data for sealed sources used in this building (Cesium-137 source, Building 2705, Room 825) (Ref. 105), affected areas used for radioactive commodities indicate no contamination above the lower limits of detection.	Non-Impacted

6.4 Summary of Potential Contaminated Media

Building surfaces that are potentially impacted include those areas where instruments containing radiological materials were used, commodity maintenance and repair activities occurred, or where experimental activities occurred. Other, potentially lesser-impacted, areas would include buildings used for storage of radioactive commodities as well as areas surrounding potentially contaminated buildings that were demolished without documented contamination surveys. These areas may also have radioactivity in the surrounding soil. Areas where hazardous materials were disposed of (i.e., Acid Neutralization Pit) may contain contamination. Additionally, groundwater sources located nearby this site may be similarly affected.

Potential contaminated media include Class 1, Class 2, or Class 3 building interiors and surfaces, including potentially contaminated work spaces, storage cabinets, and disposal sinks. Outside soil area beneath the footprint of demolished buildings and soil and groundwater in disposal areas such as the Acid Neutralization Pit may also be contaminated.

Airborne radon in buildings and groundwater exceeding Federal concentration guidelines are also considered, although these radioactive constituents may be due entirely to naturally occurring radioactivity in the soil and rock formations underlying the site.

6.5 Routine Material Handling and Decontamination Potential Pathways

Standards of radioactive material control are more stringent today as compared to the 1950s, 1960s, and 1970s. There is a potential for spread of contamination from materials being moved onsite, being prepared for shipping, and from decontamination. The standards during operation of Fort Monmouth would not necessarily have called for documentation of low-level contamination that may have been released to the Fort Monmouth grounds.

6.6 Criteria for License Termination

Unrestricted use criteria and methodology considerations will be developed as part of the DQO process during subsequent phases of this investigation. The following technical documents are used by both private contractors and governmental agencies as bases for decommissioning and license termination in order to release buildings that have radiological contamination:

- "Radiological Criteria for License Termination," 10 CFR 20, Subpart E (NRC, 1997);
- U.S. Nuclear Regulatory Commission Regulation, NUREG-1757;
- U.S. Nuclear Regulatory Commission Regulation, NUREG-5512;
- U.S. Army Regulation, AR-11-9, "The Army Radiation Safety Program" (U.S. Department of the Army, 1999);
- American National Standards Institute, ANSI 13.12-1999, "Surface and Volume Radioactivity, Standards for Clearance" (ANSI, 1999);
- MARSSIM (USEPA, 2000);
- Soil Screening Guidance for Radionuclides: User's Guide (EPA, 1996);

- "Radiological Survey Policy for Base Realignment and Closure (BRAC) Sites Where Army Radioactive Commodities Were Present" (U.S. Army Materiel Command, 2004)

7.0 CONCLUSIONS

This HSA has reviewed the operating history, survey results, and potential pathways for radioactive and hazardous material release for Fort Monmouth. Survey information is available for facilities with authorization permits subject to the NRC radiological materials licenses.

Based on currently available information, using the survey methods outlined in Section 4.0, there are additional surveys and samples that will need to be collected for a complete characterization of the Fort Monmouth facility. Although the specifics of these additional surveys are yet to be developed, the following should be considered based on the state of the existing survey information.

7.1 Radiological Contaminants of Potential Concern

The radiological contaminants of potential concern (RCOPC) at Fort Monmouth are those associated with the use and storage of radioactive commodities by the Garrison and current and former tenants. In addition, radioactive calibration sources and research and development commodities used by CECOM may present additional sources of radioactive material at Fort Monmouth.

The list of RCOPCs shown in Table 6-1 is based on radionuclides known to have been used or be present at Fort Monmouth. One of the listed RCOPCs, radon-222, while associated with radium, was not used by itself in any commodity, but is potentially present in buildings due to naturally occurring levels of radium in the geologic features beneath buildings.

Additionally, uranium and radium may be present in groundwater as a result of the naturally occurring geologic features.

7.2 Potential Contaminated Areas

Fort Monmouth has potentially contaminated areas where instrument use and storage as well as commodity maintenance and repair functions occurred. Some of these possibly contaminated areas where levels might not be very high include buildings used for receiving, and storing, radioactive commodities as well as areas surrounding potentially contaminated buildings that were demolished without documented contamination surveys. These areas may also have radioactivity in the surrounding soil. Areas where hazardous materials were disposed of (e.g., Acid Neutralization Pit) may contain contamination.

Based on currently available information, as summarized herein, additional radiological survey activities, including direct measurements and/or discrete sampling will be required in order to support license actions and unrestricted release from applicable regulatory agencies. DQOs will be developed to support the investigative path forward, and details of recommended characterization survey activities to support the DQOs will be provided in a separate document to be provided to the Army for planning purposes. All proposed tasks will be in accordance with MARSSIM for the purpose of achieving unrestricted release of impacted areas.

The following table includes all areas considered Impacted along with proposed MARSSIM survey area classifications.

TABLE 7-1: FORT MONMOUTH POTENTIAL SURVEY AREAS

Building/ Survey Area	Description	Possible RCOPCs
275 (Museum)	Impacted, MARSSIM Class 3	Ra-226
283 (Squier Hall)	Impacted, MARSSIM Class 3 (in unrenovated areas)	Polonium
292 (Museum Storage)	Impacted, MARSSIM Class 3	Various
2540 (CECOM Laboratory)	Impacted, MARSSIM Class 1	Cs-137, Pu-238, Tc-99, Co-60, Ra-Be, Cf-252, Th-232, Ra-226, H-3

Note: Specific survey units will be determined when the survey plan is being prepared. This will include more detailed listing of systems.

These potential survey areas are shown in the Site Map in Figures 7-2 and 7-3.

7.2.1 Future Unrestricted Use Criteria Consideration

The values shown in Table 7-2 represent radionuclide concentrations that would be deemed in compliance with the 25 mrem/yr (0.25 mSv/yr) unrestricted release dose limit described in 10 CFR 20.1402.

TABLE 7-2: REGULATORY GUIDE 10 CFR 20.1402, DCGL CRITERIA FOR UNRESTRICTED RELEASE

ISOTOPE	DCGL[1]	
	pCi/g	dpm/100 cm^2
C-14 (carbon-14)	12	3.70E+06
H-3 (hydrogen-3, tritium)	110	1.20E+08
Kr-85 (krypton-85)[2]	--	--
Pu-239 (plutonium-239)	2.3	27.9
Ra-226 + C[3] (radium-226)	0.6	315
Rn-222 (radon-222)	--	--
Sr-90/Y-90 (strontium-90/yttrium-90)	1.7	8700
Th-230 (thorium-230)	1.8	36.9
U-238 (uranium-238)	14	101

Notes:

1. DCGLs are provided for soils and volumetric materials as pCi/g; DCGLs are provided for building surfaces as dpm/100 cm^2.
2. Kr-85 and Rn-222 do not have an associated soil or building DCGL since these are gases that do not combine or attach to soil or building structures; these disperse rapidly in open spaces.
3. + C represents value for the radionuclide with its decay chain progeny present in equilibrium.

7.3 Radiological Conceptual Site Model

A conceptual site model (CSM) is a basic description of how radiological contaminants enter a system, how they are transported around within the system, and where routes of exposure to organisms and humans occur. As such, it is used to assess the nature and extent of contamination, to identify potential contaminant sources, release mechanisms, exposure pathways, human and/or environmental receptors, and to develop exposure scenarios.

7.3.1 Known and Potential Release Mechanisms

The following mechanisms are proposed for possible contaminant release at Fort Monmouth:

- Leaks and/or spills: this possibility could result from sealed sources or storage containers that have been compromised, laboratory accidents, or the transfer of contamination from unsealed radiological commodities.
- Storage/disposal activities: materials that have been stored on the museum shelves or in the museum storage building (Buildings 275 and 292), any materials stored onsite awaiting offsite disposal, or any materials disposed of down laboratory sinks (either in

Building 2540 – CECOM laboratory or in Building 283 old research facilities) could then contaminate areas apart from where they were in active use.

Surface contamination of building materials (work surfaces, shelves, floors, walls, ceilings, etc.) is considered a primary transport mechanism. A secondary mechanism may contaminants leaching from soil or from leaky drain/sewer systems to groundwater. This could occur through the network of tributaries throughout Fort Monmouth and shallow aquifers that ultimately drain into the Shrewsbury River.

7.3.2 Known and Potential Migration Pathways

The following potential exposure pathways are proposed:

- Inhalation, ingestion, and/or dermal contact with contaminants found on building materials and/or transfer of contamination following dermal contact to other materials;
- Dermal contact/absorption and/or inhalation with subsurface soils during excavation activities or with building materials during demolition activities;
- Ingestion and/or inhalation of leachate in surface water and sediment downgradient of contaminated soil areas;
- Inhalation, ingestion, and/or dermal contact with or absorption of groundwater downgradient of contamination sources.

7.3.3 Known and Potential Human and Environmental Receptors

Human receptors potentially include Fort Monmouth occupational workers who are in daily contact with radiological materials or work in and around potentially contaminated buildings. In addition, any excavation workers on the base who are involved in soil excavation or building demolition activities would be potential receptors. Base and off-site local residents are potentially impacted via transfer of contamination obtained through contact with commodities or building materials, as well as contact with contaminated groundwater. Ecological receptors potentially include aquatic wildlife and terrestrial plants and wildlife in and around the base area, which also can translate to human receptors through activities such as game hunting or fishing. The likelihood of impact to any of these receptors is minimal.

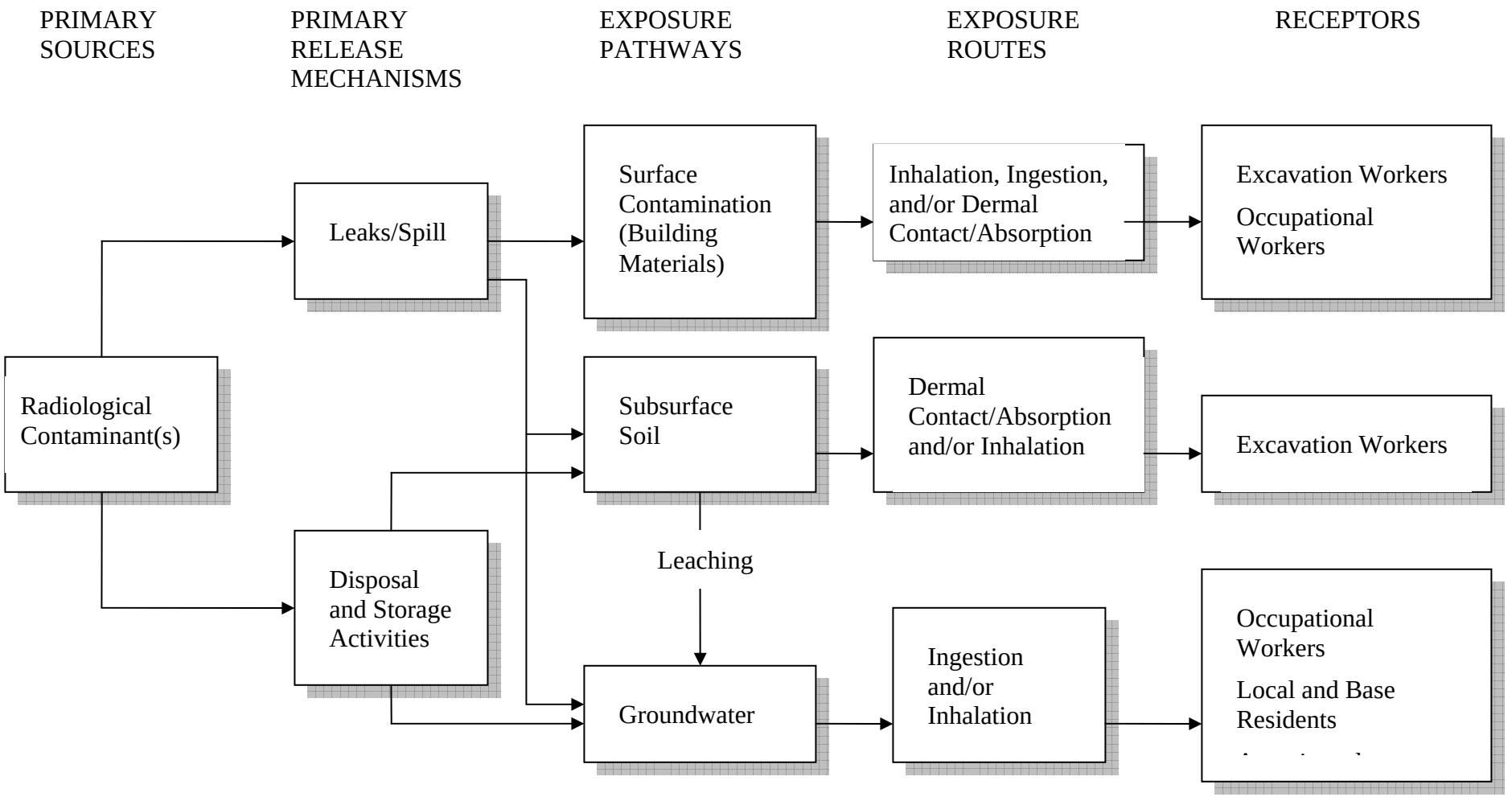


FIGURE 7-1: CONCEPTUAL SITE MODEL (CSM) FOR FORT MONMOUTH

FIGURE 7-2: LOCATIONS OF IMPACTED BUILDINGS FOR FORT MONMOUTH – MP

FIGURE 7-3: LOCATIONS OF IMPACTED BUILDING FOR FORT MONMOUTH – CWA

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APPENDIX A

HSA WORK PLAN

APPENDIX B

HSA BUILDING FACT SHEETS (FACT SHEETS, PHOTOS, FLOOR PLANS, ETC.)

APPENDIX C

PERSONNEL INTERVIEW FORMS

APPENDIX D

ADDITIONAL PHOTODOCUMENTATION AND FLOOR PLANS

(Provided on Accompanying Compact Disc)

APPENDIX E

ELECTRONIC DOCUMENT LIBRARY

(Provided on Accompanying Compact Disc)