Overcoming Vicinity Property and Ground Water Challenges at the FUSRAP Middlesex Sampling Plant Project-17529

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ABSTRACT

The US Army Corps of Engineers (USACE) is addressing the Formerly Utilized Sites Remedial Action Program (FUSRAP) Middlesex Sampling Plant Site (MSP) in accordance with the Comprehensive Environmental Response, Compensation, & Liability Act (CERCLA). The MSP has been an active FUSRAP site since the early 1980's and was listed on the National Priority List (NPL) in 1999.
Two challenges that the project team are currently addressing are Ground Water (GW) movement through fractured bedrock and Vicinity Properties (VP) assessments.

USACE and the US Environmental Protection Agency (USEPA) signed a Record of Decision (ROD) for soils remedial action in 2005 and USACE completed the soils remediation at MSP in 2008, however, VPs were not a part of the soils ROD. Additionally, the State of New Jersey recently identified a potential contaminated VP of the site. VPs are any property in the vicinity of a CERCLA "facility." The contaminated VPs of the MSP were addressed prior to the adoption of the CERCLA process to address FUSRAP sites. Since the 1980's many changes to potential Applicable or Relevant and Appropriate Requirements have occurred. As such USACE has begun reassessing the previously addressed VPs for inclusion under the soils ROD as part of the CERCLA process. USACE does expect to have to revisit and potentially remediate up to 12 VPs. This paper will discuss the approach, some challenges, and lessons learned in adequately addressing VPs both from a field work and a post ROD regulatory perspective.

USACE is currently in the Feasibility Study phase of the CERCLA process for GW. The project team has encountered and overcome significant challenges with regard to contaminant plume bounding and groundwater movement through the secondary porosity of dipping bedding plane partings and fractured bedrock of the Passaic Aquifer beneath the site. This paper will discuss the challenges, the approaches used, and lessons learned while delineating these contaminants.

This paper's discussions are useful for anyone addressing an environmental site with soils contamination on VPs or with delineating contaminants in fractured bedrock.

INTRODUCTION

Site Background

The Middlesex Sampling Plant (MSP) was established in 1943 as part of the Manhattan Engineering District (MED) to sample, store, test, and transfer ores containing uranium, thorium, and beryllium. Over the years that MSP was operational, the buildings, grounds, and nearby land parcels became contaminated, predominantly with radium and uranium. The site, no longer operational, is being addressed under the Formerly Utilized Sites Remedial Action Program (FUSRAP). Figure 1 below shows the location of the MSP.

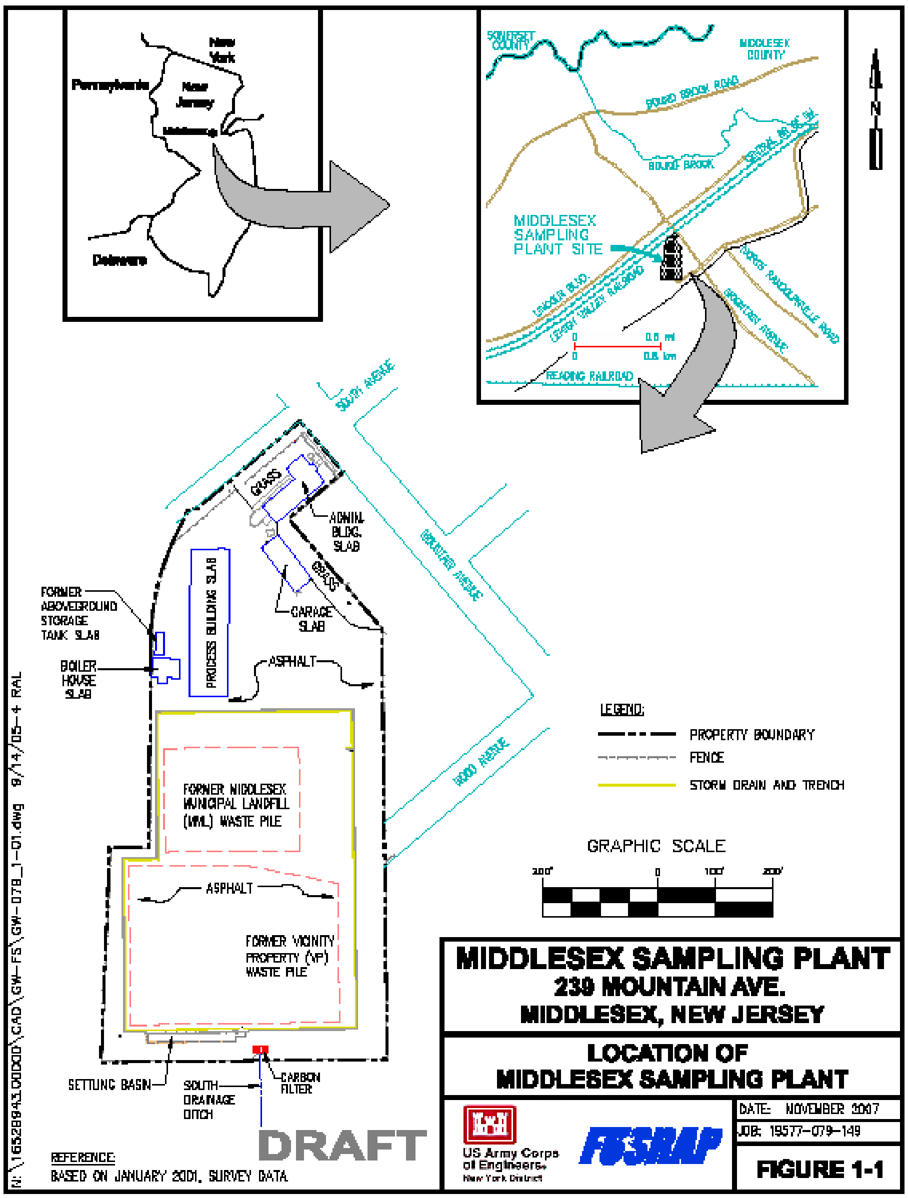

Fig. 1. Location of Middlesex Sampling Plant

The U.S. Atomic Energy Commission (AEC), a predecessor to the U.S. Department of Energy (USDOE), established FUSRAP in 1974 to identify, remediate, or otherwise control sites contaminated with residual radioactivity resulting from activities of the MED and early operations of the AEC. On February 18, 1999, MSP was added to the National Priorities List (NPL).

Industrial operations at the Middlesex site began in 1910 with the construction of a plant for the manufacture of asphalt paint. At this time, the plant included a brick warehouse, a boiler house, a garage, an administrative building, a dye warehouse, and four smaller buildings [1].

In October 1943, the MED leased the brick warehouse from American Marietta Corporation and converted it into the former Process Building to sample, store, test, and transfer ores containing uranium, thorium, and beryllium (as well as a chemical precipitate, magnesium diuranate, supplied by African Metals Corporation beginning in 1950). Between 1943 and 1955, uranium assay analysis, conducted by the United Lead Company under contract with the AEC, was the primary operation.

In 1946, MED was deactivated and MSP operations were continued under the direction of AEC. The leased facility was purchased through condemnation by AEC from American Marietta Corporation, and various new buildings were constructed. These new structures included a replacement for the administrative building, a replacement garage, a thaw house, and a storage house. A chain-link fence was installed around the site and approximately 7.9 acres of the 9.6 acres were paved with asphalt for use as a drum storage area.

Throughout the late 1940s and early 1950s, the site received and shipped various research and decontamination wastes. In addition, low-level combustible waste was incinerated on the site. The incinerated ashes and noncombustible scrap were reportedly placed in drums and transported off-site for disposal. MSP was also used to prepare contaminated wastes for shipment and disposal at sea.

During 1951 and 1952, MSP became the intermediate point for the shipment of uranium bars from the Lake Ontario Ordnance Works in Niagara Falls, New York, to the American Machine and Foundry Company in Brooklyn, New York, where the bars were experimentally machined into slugs. Scraps from this operation were then returned to MSP for shipment to a uranium recovery processor. Before operations ceased, they also included assaying beryllium ore for shipment to Brush Beryllium in Luckey, Ohio.

During the years that MSP was operational, the buildings, grounds, and nearby land parcels became contaminated with uranium and its associated decay progeny (radium). It is unlikely that the magnesium diuranate processing had significantly impacted the ground surface or adjacent properties due to the more controlled handling of the material. The handling of uranium ore sacks likely resulted in spillage, and subsequent migration mechanisms caused localized radiological contamination, both on and off-site. It should be noted, however, that the facility management practices used at MSP were standard industry techniques, considered appropriate at the time.

AEC terminated primary operations at MSP in 1955. However, it continued to be used for storage and limited sampling of thorium residues. AEC activities at the site ended in September 1967, after decontamination of the structures and certification of the site for unrestricted release was complete. In 1968, AEC returned the MSP property to the General Services Administration, which transferred the site to the U.S. Department of the Navy. The site served as a U.S. Marine Corps reserve training center from 1969 to 1979 before being placed back in the custody of USDOE in 1980.

Previous Investigations and Remediation

During 1976, due to changes in radiological standards and release guidelines, the MSP was re-evaluated for residual radioactive contamination [2]. The site was placed back in USDOE custody in 1980 after contamination above then current guidelines was found at MSP and at surrounding Vicinity Properties (VPs), both residential and commercial guidance levels were exceeded. Residual contamination that originated from the MSP was also identified at the Middlesex Municipal Landfill (MML). This contaminated landfill material resulted from construction activities in 1948 when excess soil from grading operations at MSP containing small amounts of pitchblende ore (high-grade uranium ore) was taken to the MML. The contaminated material was subsequently covered to varying depths during landfill operations.

Cleanup of the VPs and the MML was initiated by USDOE in 1981 and completed in 1986 [3][4]. The excavated materials generated from these actions were temporarily stored on specially constructed pads at the MSP in two piles, the VP and MML interim storage piles. As their names imply, the VP pile contained the excavated materials from the cleanup of the VPs (a total of 35,200 cubic yards [yd^3]), and the MML pile contained the excavated materials from the cleanup of the MML (a total of 31,200 yd^3). The VPs and MML piles were the subject of CERCLA removal actions conducted by USACE, which resulted in transportation of the waste materials to off-site licensed or permitted disposal facilities pursuant to an Action Memorandum by USACE officials in 1997 and 1999 [5][6].

Remedial investigations of soil and groundwater at the MSP were addressed in two Operable Units (OUs) by the USACE from 1999 through 2005. OU-1 addressed radioactive and non-radioactive soil and debris contamination. OU-2 initially addressed radioactive groundwater contamination and the RI was completed in 2005. However, groundwater data indicated persistent elevated levels of VOCs in two of the three bedrock wells monitored. After evaluating this data, the USACE determined that additional bedrock monitoring wells (MWs) and sampling for volatile organic compounds (VOCs) was necessary to fully characterize the vertical and horizontal extent of MSP site contamination.

The USACE cleanup of contamination under the Soils OU Record of Decision (ROD) at MSP began in September 2006 and was completed in the spring of 2008. The site Remedial Investigation (RI) identified radium-226, uranium, poly-aromatic hydrocarbons and lead as site soil contaminants. The Soils OU ROD for MSP estimated approximately 24,600 yd^3 of radiological soil and debris and approximately 23,200 yd^3 of non-radiological soil and debris to be remediated. During the Remedial Action (RA), a revised estimate of 48,000 yd^3 of radiological waste and 10,000 yd^3 of non-radiological waste was expected to be excavated and transported to an off-site permitted or licensed disposal facility. The final totals were approximately 41,244 yd^3 of radiological waste and 4,454 yd^3 of non-radiological waste excavated and transported to an off-site permitted or licensed disposal facility during the soils RA. Additionally, clean backfill material was placed in excavation areas. No remedial/removal actions were conducted for groundwater at MSP, however, approximately 1.5 million gallons of water was removed from the excavation, treated, and discharged in accordance with the Soils OU ROD during the soils RA.

A hydrogeologic study of the shallow bedrock aquifer system beneath the northern portion of the site was conducted during September and October 2010. This study helped to refine the conceptual site model to better define the movement of groundwater flow in the bedrock aquifer and was used as the basis for designing the bedrock monitoring well network site installed between 2010 and 2016 as part of delineating VOCs, primarily carbon tetrachloride (CT) and trichloroethylene (TCE), emanating from the MSP site.

DESCRIPTION

Description of Ground Water Issues

Site geology is divided into two units; overburden deposits and bedrock. The overburden deposits at the site consist of artificial fill (OU1 remedial backfill), unconsolidated sediments (clayey fine sands to silty sands of eolian origin) with thickness ranging from 0.45 meter (1.5 feet) to more than 3.5 meters (11 feet), and decomposed shale of the Passaic Formation. The bedrock beneath the MSP site consists of late Triassic Passaic Formation, a major formation within the Newark basin in central New Jersey. The Passaic Formation provides a major aquifer in the western part of Middlesex County and adjoining Essex County. In the MSP area, bedrock of the Passaic Formation strikes N 56° E and dip at 11° NW [7]. The dominant rock types in the study area are red mudstone and red silty mudstone.

The hydrogeologic conceptual site model for this area has evolved over the course of site investigations at MSP. The aquifer beneath the MSP site was originally described as a “single aquifer” composed of unconsolidated material (both sediment and weathered bedrock) and fractured bedrock” [8]. More recent interpretations indicate that the aquifer in the area of the MSP site consists of a thin overburden unit that contains a thin perched groundwater unit above a thick bedrock aquifer system. The bedrock is conceptualized as a leaky, multiunit aquifer system, in which a few transmissive bedding fractures act as discrete aquifer units for bedding-parallel groundwater flow and contaminant migration pathways. The leakage occurs through subvertical joints within the aquitard beds between the transmissive bedding fractures [9][10].

DISCUSSION

Discussion of Ground Water Issues

Radiologic contamination of groundwater, primarily uranium, largely remained in the perched overburden unit with little lateral or vertical migration and concentrations that decreased significantly following the OU1 soil remediation. However, low levels of carbon tetrachloride (CT) and trichloroethylene (TCE) persisted in on-site bedrock wells and additional investigations were launched in 2010 to determine whether or not there was a source onsite. This investigation was conducted in a two-step process that first focused on re-evaluating the aquifer a leaky, multi-unit aquifer system, and then delineating contaminants within those units. Contaminants released into a given transmissive bedding plane partings or fractures of the Passaic Aquifer, tend to remain within that impacted stratigraphic interval and follow the generic bedrock flow pathway [9][10]. Based on results of downhole geophysical studies (natural gamma logging, acoustic televiewer, caliper surveys, borehole flow, et al) and aquifer tests (packer tests, tracer tests, and depth discrete sampling), this initial investigation identified three major transmissive zones and named them Unit B, Unit C, and Unit D. Groundwater investigations focused on delineating CT and TCE within the most contaminated unit, Unit B.

Literature describing the hydrogeology of the Passaic Aquifer suggest that primary flow is along strike in this dipping formation but that a downdip flow component is present within the bedding fissures in the recharge areas before becoming more parallel with the strike of bedding in deeper reaches of the bedding fissures [8][9]. Early investigations geared toward delineating contaminants, used a site conceptual model of groundwater flow along the strike of the dipping bedrock. Wells place along the strike from source area wells exhibiting elevated concentrations of CT and TCE but sampling results did not coincide with the site conceptual model. For example, a significant concentration of CT (13,000 micrograms per liter) was detected in a well near the former process area on the northern portion of the site but wells place along strike within the same unit were found to contain little to no CT. Groundwater elevation measurements indicated a downdip flow direction and the conceptual model was adjusted to match that. A series of five wells were installed 335 meters (1,100 feet) offsite, in the direction of the bedding plane dip (perpendicular to strike). These wells were installed with the same unit at depths varying between 73 meters (240 feet) and 97 meters (320 feet). The variance in depth corresponded with the distance from the site. Unit B was identified in these wells by predicting the depth of the unit using the geometry of the dipping beds (11^0) and using a natural gamma log signature identified onsite just above Unit B. Site related contaminants were detected in these wells and indicate groundwater flow carried the contaminants sub-perpendicular to strike. The delineation was completed by installing one additional well downgradient in the direction of groundwater flow.

CONCLUSION

Conclusion of Ground Water Issues

Bounding of the contaminant plume was conducted in a two-step process. The first step was focused on advanced characterization of the local aquifer to develop the site conceptual model. The bedrock aquifer at the MSP site is contained within the secondary porosity of dipping shale/mudstone bedding planes and fractures and was characterized to located and identify the transmissive units that are located between aquitards. These transmissive aquifer units provide flow paths for groundwater and carry contaminants within those zones. The aquifer units were identified using a series of borehole geophysics that included acoustic televiewer surveys, resistivity logging, and natural gamma borehole logging. The borehole geophysic data was supplemented with aquifer testing that included tracer tests, packer tests, and depth discrete sampling. The shallowest aquifer unit, Unit B, contained the most mass of CT and delineation focused on this unit. Minor downward vertical leakage to lower transmissive units was observed during the study. Early investigations relied on a site conceptual model that groundwater flow moved primarily along the strike of the bedding planes but contaminant data collected did not match this model. Later investigations relied on a site conceptual model that allowed for downdip groundwater flow, perpendicular to bedding plane strike. Unit B containing the highest concentrations of CT and TCE, was located using a natural gamma signature identified onsite above it, the geometry of the formation, and vertical profile sampling. The findings of the investigation indicate that groundwater flow direction is primarily down-dip, sub-perpendicular to strike, and contaminants traveled more than 335 meters (1,100 feet) offsite and to depths of more than 90 meters (295 feet) below ground surface.

DESCRIPTION

Description of Vicinity Property Issues

The FUSRAP has addressed sites across the nation for almost 40 years. Multiple stake holder pressures, multiple regulations [Applicable or Relevant and Appropriate Requirements (ARAR) (and changes to those ARARs)], and process changes occur over such long time periods. The USACE currently addresses FUSRAP sites in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process as required by Public Law 105-245, October 7, 1998.

The term Vicinity Property (VP) is used here to mean any property in the vicinity of a CERCLA “facility.” Many of the VPs to current FUSRAP sites were addressed prior to the adoption of the CERCLA process.

Review of previously identified VPs is required for a number of reasons. To begin, initial FUSRAP work was not performed under a CERCLA ROD. Early FUSRAP work used DOE Orders or the Uranium Mill Tailings Radiation Control Act (UMTRCA) standard as ARARs. The current MSP ROD contains different ARARs, resulting in a different cleanup criteria. This VP review is also required for National Priorities List (NPL) delisting of the site and to assess data limitations.

DISCUSSION

Discussion of VP Issues

The first step in the process of evaluated VPs was to identify all potentially impacted MSP parcels. This proved challenging in that the lot/block number of many of these parcels had changed over the years. Some reports referred to lot/block, some to addresses, and some to the parcel number. The inventory assessment resulted in identifying 44 land parcels in the vicinity of the MSP. These properties are listed in TABLE I below. Those properties were reviewed to determine if they met the release criteria established in the MSP ROD.

Data and Evaluation Reporting

All survey, characterization, remedial action, and independent verification reports for previous work done at the MSP VPs was reviewed. Any property that did not meet the current ROD criteria were listed as warranting additional investigation.

The Soils Operable Unit Record of Decision for the MSP identifies a remedy consisting of soil excavation and off-site disposal to meet the following criteria:

- An average of 0.19 Bq/g [5 picoCuries per gram (pCi/g)] of radium-226 (Ra-226) above background for surface and subsurface soils.
- Radiological soil remediation on the MSP property will meet the dose limit specified in New Jersey Administrative Code (NJAC) 7:28-12.8(a)1 [11].

The standardization of release survey approaches by the Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM) in the late 1990’s and its revision in August 2000 was the last such major change. MARSSIM presents a federal agency (USEPA, USDOE, USDOD, and USNRC) agreed approach to site release surveys. Prior to MARSSIM a standard approach did not exist. As a result differences in approaches to release surveys existed between programs. FUSRAP prior to 1998 utilized its own guidance which changed over time. USACE utilizes the MARSSIM approach, thus previous data is viewed with the MARSSIM approach and principles in mind.

One point of consideration is the Survey Unit (SU) size limitations in MARSSIM. In reviewing past release survey data USACE has considered several approaches to account for this. Use of a “floating SU” approach has stood out as easily implementable. This approach is to simply assume any 2,000 square meter area must meet the release criteria. In this manner large areas are not divided thus possibly splitting elevated data between SU.

TABLE I. Inventory of All Potentially Impacted MSP Parcels/Properties

Parcel #	Property	Parcel #	Property
1	Middlesex, Block 318, Lot 1-6	22B	Piscataway, Block 412, Lot 1-14
2	Middlesex, Block 318, Lot 7-9	23	Middlesex, Block 318, Lot 50
3	Middlesex, Block 318, Lot 10	23A	Piscataway, Block 413, Lot 1
4	Middlesex, Block 318, Lot 11-12	23B	Middlesex, Block 345, Lot 1
5	Middlesex, Block 318, Lot 13-15	24	Middlesex, Block 318, Lot 38A-41A, 48-49
6	Middlesex, Block 318, Lot 16-18	25	Middlesex, Block 371, Lot 4
7	Middlesex, Block 318, Lot 19-20	26	Piscataway, Block 185, Lot 1
8	Middlesex, Block 318, Lot 21-29	27	Middlesex, Block 298, Lot 1-3
9	Middlesex, Block 319, Lot 34-35	27A	Middlesex, Block 310, Lot 1-19, 33-49
10	Middlesex, Block 319, Lot 36-37	28	Middlesex, Block 318, Lot 50A
11	Middlesex, Block 319, Lot 38	29	Middlesex, Block 345, Lot 2B
12	Middlesex, Block 319, Lot 39-44	30	Middlesex, Block 344, Lot 1
13	Middlesex, Block 319, Lot 19-22	31	Middlesex, Block 371, Lot 5A
14	Middlesex, Block 319, Lot 23-25	32	Middlesex, Block 287, Lot 1A
15	Middlesex, Block 319, Lot 26-29	33	Middlesex, Block 287, Lot 2A
16	Piscataway, Block 389, Lot 40-43	34	Middlesex, Block 319, Lot 13-18
17	Piscataway, Block 389, Lot 44-50	35	Middlesex Block 10, Lot 28
18	Middlesex, Block 319, Lot 47	36	Union Carbide, Bound Brook, NJ
19	Piscataway, Block 395, Lot 1-24	37	Middlesex, Block 345, Lot 1.02
19A	Piscataway, Block 395, Lot 25-27	38	Middlesex, Willow Lake
20	Middlesex, Block 318, Lot. 43	39	Middlesex, 756 Drake Ave
21	Middlesex, Block 318, Lot 44-45A	40	Middlesex, Block 289, Lot 1
22	Piscataway, Block 396, Lot 17-18	41	Middlesex, Block 289, Lot 60
22A	Piscataway, Block 396, Lot 1-16	None	MSP and Drainage Ditch

Other considerations include: data quality (does past data meet today's quality standards), data type (does past data allow comparison to the ROD criteria), sufficient data (is there sufficient data to perform statistical tests), and how to handle elevated sample results.

Data Quality can be demonstrated by reviewing quality standards, plans, and quality control data from survey reports. Validation of past data sets can also be conducted using today's standard approaches. USACE uses its Radiological Data

Validation procedure to assess the quality of radiological data [12]. USEPA data validation guidance is used for chemical data [13]. The Multi-Agency Radiological Laboratory Analytical Protocols (MARLAP) guidance is also utilized by USACE [14].

Data type is typically easily assessed by comparing the ROD criteria units of measurement (e.g. pCi/g) to the past data units. Occasionally data must be converted to ROD units by simple conversion factors or by modeling. An example of modeling is to convert the ROD criteria into exposure rate data to compare to past data (regulator acceptance of this process is strongly suggested).
Sufficient data may also be easily addressed by performing the required sample number calculations in MARSSIM and comparing to past data. Statistical power and probability graphing can also be done per MARSSIM. Occasionally, past remediated areas are small and data is limited. An evaluation of the site conceptual model to determine if use of MARSSIM guidance on SU with areas less than 100 square meters is appropriate could then be conducted.

Accounting for elevated sample results is a more challenging task. Again a review of the Site conceptual model should be conducted to determine if use of the MARSSIM Elevated Measurement Criteria is appropriate. The reviewer may also choose to limit all data to the ROD criteria and recommend further remediation. Given that most VP, remediated prior to use of CERCLA, were addressed in reports and property owners received letters stating their properties were cleaned, some approach to elevated data should be taken. USACE typically finds that the MARSSIM Elevated Measurement Comparison (EMC) approach is acceptable.

Phase 1 consisted of 5 properties that were remediated by DOE in 1980, certified and released for unrestricted use [15]. The New Jersey Department of Environmental Protection (NJDEP) concurred that all 5 Phase 1 properties were remediated to the standard of 0.19 Bq/g of Ra-226. USACE review of the certification docket for the phase 1 properties finds that the residual contamination on the phase 1 properties meets the requirements of the 2005 ROD.

Phase 2 consisted of 29 properties (over 34 parcels) that were remediated in 1981 and 1982, certified and released for unrestricted use [4].

In reference documents parcels that were broke up into multiple parts, for example 23, 23a, and 23b are all counted as 1 property, resulting in 29 Phase 2 properties.

NJDEP concurred that all Phase 2 properties were remediated to the standard of 0.19 Bq/g of Ra-226. USACE review of the certification docket for the phase 2 properties finds that the residual contamination on the phase 2 properties meets the requirements of the 2005 ROD.

Phase 3 was originally designated as the Sampling Plant site, to include the old processing building and interim-storage piles. This phase was addressed By USACE under the 2005 ROD. Table II lists the properties addressed in phase 3.

TABLE II. Phase 3 Property Inventory

Property	Township
MSP (Includes old processing building and interim-storage piles)	Middlesex
MSP Drainage Area – Parcel 23 –	Middlesex

Both properties meet ROD requirements.

Other Properties

Other properties investigated under this assessment are listed in Table III.

TABLE III. Other Properties Inventory

Assigned Parcel #	Property	Township
35	305 Bound Brook	Middlesex
36	Union Carbide	Bound Brook
37	Historic Main Stream	Middlesex
38	Willow Lake	Middlesex

Parcel Assessment

To evaluate compliance with the Soils ROD criteria, this assessment relies on soil concentration data. In some cases empirical data is used to demonstrate protectiveness. Primarily with regard to hot spots, otherwise known as EMC areas. MARSSIM equation 8-2 is utilized to assess hot spots in combination with the average radionuclide concentration within survey units. USDOE surveys also addressed hotspots using insitu-gamma spectral analysis. USACE reports this data however, conversations with state officials indicate this data could not be relied on exclusively. Insitu-gamma spectral analysis data is therefore only evaluated qualitatively.

Assessment Criteria

During Phase 2 remediations the criteria to be applied changed from the UMTRCA criteria of 0.19 Bq/g (5 pCi/g) Ra-226 in the surface and 0.56 Bq/g (15 pCi/g) Ra-226 in the subsurface to 0.19 Bq/g Ra-226 regardless of depth. Accordingly, NJDEP reviewed each property based on its criteria applied at the time of the survey. For purposes of this assessment, compliance with the ROD criteria, including the MARSSIM EMC approach, was utilized. Table IV presents a summary of data and screening utilized in this assessment.

TABLE IV. Parcel Assessment Screening[A]

Parcel #	Max Ra-226 net Bq/g	Mean Ra-226 Bq/g	# Hot Spots > 0.19 Bq/g Ra-226	Hot Spot/s Passes Equation 8-2[B]	Insitu gamma Ra-226 of hot spots Bq/g	NJDEP release level[C] Bq/g	Further Evaluation Required
1	0.54	0.10	4	No	0.12	0.56	Yes
2	0.34	0.10	2	No	0.10	0.56	Yes
3	0.17	0.08	0	-	0.09	0.19	No
4	0.28	0.07	1	Yes	0.09	0.19	No
5	0.13	0.06	0	-	0.07	0.19	No
6	0.28	0.11	2	Yes	0.08	0.19	No
7	0.15	0.08	0	-	-	NA	No
8	0.18	0.11	0	-	0.08	0.19	No
9	0.20	NA	0	-	-	NA	No
10	0.10	0.04	0	-	0.10	0.19	No
11	0.16	0.06	0	-	0.10	0.19	No
12	0.19	0.06	0	-	0.08	0.19	No
13	0.37	0.05	1	No	0.08	0.56	Yes
14	0.13	0.13	0	-	0.10	0.19	No
15	0.10	0.05	0	-	0.09	0.19	No
16	0.06	-	0	-	-	NA	No
17	0.21	0.06	0	-	0.07	0.19	No
18	0.23	0.05	1	Yes	0.09	0.19	No
19	0.52	0.05	1	No	0.07	0.56	Yes
19A	NotReq	-	-	-	-	NA	No
20	0.37	0.06	1	Yes	0.09	0.19	No
21	0.21	0.05	0	-	0.07	0.19	No
22	0.22	0.06	0	-	0.07	0.19	No
22A	0.06	0.06	0	-	0.06	0.19	No
22B	0.03	0.03	0	-	-	0.19	No
23	0.74	0.06	3	No	0.06	0.56	Yes
23A	0.06	0.05	3	Yes	0.06	0.19	No
23B	0.26	0.10	1	Yes	0.07	0.19	No
24/24A	0.21	-	0	-	-	0.19	No
25	0.15	-	0	-	-	NA	No

26	0.20	0.09	0	-	0.08	0.19	No
27	0.19	0.09	0	-	0.07	0.19	No
27A	0.13	-	-	-	-	0.19	No
28	0.48	0.07	2	No	0.06	0.56	Yes
29	0.33	-	7	No	-	NA	Yes
30	0.26	0.13	2	Yes	0.11	NA	No
31	NotReq	-	-	-	-	NA	No
32	0.15	0.13	0	-	-	0.19	No
33	0.14	0.04	0	-	0.08	NA	No
34	0.27	0.13	3	No	0.10	0.56	Yes
35	333	-	Many	No	NA	NEW	Yes
36	55	-	-	-	-	-	Yes
37	-	-	-	-	-	NEW	Yes
38	0.09	0.05	0	-	-	NA	No

A = Parcels 39-41 excluded
B = MARSSIM EMC and Average SU equation 8-2
C = NJDEP Property Evaluation
NotReq = Remediation determined not to be required by DOE
NA = Not Applicable

RESULTS

A review of Table IV data results in the parcels listed in Table V below as requiring further investigation.

TABLE V. Parcel/Properties Warranting Additional Investigation

Parcel #	Property
1	Block 318, Lots 1-6.
2	Block 318, Lots 7-9.
13	Block 319, Lots .19-22.
19/19A	Block 395, Lots 25-27 Lots 1-24, Town of Piscataway,
23	Block 318, Lot 50.
28	Block 318, Lot 50A.
29/30	Block 345, Lot 2B.
34	Middlesex, Block 319, Lot 13-18
35	305 Bound Brook
36	Union Carbide
37	Historic Main Stream

CONCLUSIONS

Conclusions of VP Issues

The VP assessment of the MSP has resulted in identification of parcels that require further assessment and possible remediation to comply with the ROD. Assessing the VPs moves the USACE one step closer to site closeout and ultimately, delisting from the NPL.

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