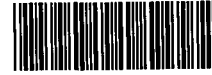


SDMS Document



109608

Five-Year Review Report
for the
U.S. Radium Superfund Site
Essex County, New Jersey

July 2011

Prepared by:

U.S. Environmental Protection Agency
Region II
New York, New York

Five-Year Review Report

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EXECUTIVE SUMMARY

A five-year review for the U.S. Radium Superfund site located in Essex County, New Jersey has been completed. This is the first five-year review for the site. It was triggered by the signing of a Preliminary Site Close Out Report for the site in September 2006. The remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. However, it is the policy of the U.S. Environmental Protection Agency (EPA) to conduct five-year reviews when remedial activities, including monitoring, will continue for more than five years. Because it may take more than five years to attain federal or state drinking water standards, EPA has conducted a policy review.

Three Records of Decision (RODs) have been signed for the site. The first ROD was signed in September 1993 and selected a remedy to address radium-contaminated soil and building material for Operable Unit 1 (OU1) of the site. The second ROD was signed in August 1995 and selected essentially the same remedy as the 1993 ROD, but for a different set of properties (OU2). The third ROD was signed in September 2006 and selected a no-action, with monitoring, remedy for groundwater at the site (OU3). The site is now considered construction complete, after the signing of the Preliminary Site Close Out Report in September 2006. All of the work covered by the three RODs has been funded by EPA and the State of New Jersey.

Remediation of the site is essentially complete. The contaminated soil and building material portion of the remedy (OU1 and OU2) was completed in September 2005, with the exception of one residential property that could not be remediated due to access issues. This residential property is planned to be addressed at some time in the future. The groundwater portion of the remedy (OU3) was completed in September 2006 with the signing of the OU3 ROD, and groundwater monitoring is ongoing. All work has been performed in accordance with the RODs and Remedial Designs prepared for the site, with oversight by EPA and, in some cases, the U.S. Army Corps of Engineers. The New Jersey Department of Environmental Protection (NJDEP) has concurred with all activities conducted as part of OU1 and OU2 of the site. NJDEP has deferred concurrence on the OU3 ROD until it can evaluate the post-ROD monitoring results.

Based upon a review of the RODs, a number of reports, and

inspections of the site, EPA has been concluded that the remedies at the site continue to function as intended by the RODs and continue to protect human health and the environment.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from WasteLAN): U.S. Radium Corp.		
EPA ID (from WasteLAN): NJD980654172		
Region: 2	State: NJ	City/County: City of Orange Township, Essex County
SITE STATUS		
NPL status: <input checked="" type="checkbox"/> Final <input type="checkbox"/> Deleted <input type="checkbox"/> Other (specify)		
Remediation status (choose all that apply): <input type="checkbox"/> Under Construction <input checked="" type="checkbox"/> Constructed <input checked="" type="checkbox"/> Operating		
Multiple OUs?* <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	Construction completion date: 9/28/2006	
Has site been put into reuse? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A		
REVIEW STATUS		
Lead agency: <input checked="" type="checkbox"/> EPA <input type="checkbox"/> State <input type="checkbox"/> Tribe <input type="checkbox"/> Other Federal Agency		
Author name: Stephanie Vaughn and Kristin Giacalone		
Author title: Remedial Project Manager	Author affiliation: EPA	
Review period:** September 2006 to September 2011		
Date(s) of site inspection: February 14, 2011		
Type of review: <input checked="" type="checkbox"/> Post-SARA <input type="checkbox"/> Pre-SARA <input type="checkbox"/> NPL-Removal only <input type="checkbox"/> Non-NPL Remedial Action Site <input type="checkbox"/> NPL State/Tribe-lead <input type="checkbox"/> Regional Discretion <input type="checkbox"/> Statutory		
Review number: <input checked="" type="checkbox"/> 1 (first) <input type="checkbox"/> 2 (second) <input type="checkbox"/> 3 (third) <input type="checkbox"/> Other (specify)		
Triggering action: <input type="checkbox"/> Actual RA Onsite Construction at OU #1 <input type="checkbox"/> Actual RA Start at OU# <input checked="" type="checkbox"/> Construction Completion <input type="checkbox"/> Previous Five-Year Review Report <input type="checkbox"/> Other (specify)		
Triggering action date (from WasteLAN): 9/28/2006		
Does the report include recommendation(s) and follow-up action(s)? <input type="checkbox"/> yes <input checked="" type="checkbox"/> no		
Is the remedy protective of the environment? <input checked="" type="checkbox"/> yes <input type="checkbox"/> no <input type="checkbox"/> not yet determined		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in WasteLAN.]

Five-Year Review Summary Form (continued)

Issues, Recommendations, and Follow-Up Actions

There are no recommendations or follow-up actions stemming from this five-year review, other than continuing to monitor the effectiveness of the OU3 remedy, and maintaining contact with the owner of the property that remains to be addressed as part of OU1.

Protectiveness Statement

OU1

The implemented remedy at OU1 is protective of human health and the environment because all properties where access has been allowed have been remediated to allow for unlimited use and unrestricted exposure. One residence exists where contamination has not been addressed due to access issues. This residence is planned to be addressed in the future when access is permitted. Since access is an issue and the resident is aware of site-related contamination, the status of this residence does not affect the protectiveness of the remedy.

OU3

The implemented remedy at OU3 is expected to be protective upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Because the remedial actions at all OUs are protective, the site is protective of human health and the environment.

**U.S. Radium Superfund Site
Essex County, New Jersey
First Five-Year Review**

I. Introduction

This first five-year review for the U.S. Radium Corp. site, located in Essex County, New Jersey, was conducted by the United States Environmental Protection Agency's (EPA's) Remedial Project Manager (RPM), Stephanie Vaughn. This policy five-year review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended, 42 U.S.C. §9601 *et seq.* and 40 CFR 300.430(f)(4)(ii) and in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001).

The purpose of five-year reviews is to ensure that implemented remedies are protective of human health and the environment and that they function as intended by the site decision documents. This remedy will not result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, but because it may take more than five years to attain federal or state drinking water standards, EPA has conducted a policy review. This document will become part of the site file.

The remedial action for the site has been divided into three separate operable units (OUs). OU1 and OU2 involved implementation of a remedy to address contaminated soil and building materials at the site. OU3 selected a no-action, with monitoring, remedy for the groundwater at the site.

The OU1 and OU2 remedies for contaminated soil and building materials were conducted concurrently, in phases, and were essentially completed in September 2005. Due to access issues, one remaining residential property is planned to be addressed at some time in the future. The OU3 remedy for groundwater was completed in September 2006 with the selection of a no-action, with monitoring, remedy. The trigger for this five-year review is the signing of the Preliminary Site Close Out Report, which occurred on September 28, 2006.

This five-year review finds that the selected remedies remain protective of human health and the environment.

II. Site Chronology

See Table 1 for the site chronology.

III. Background

Physical Characteristics

The former U.S. Radium Corporation facility, which covers 2 acres in the City of Orange Township, Essex County, New Jersey, is a former radium-processing plant where extraction, production, application, and distribution took place from about 1915 through 1926 (See Figure 1). Approximately $\frac{1}{2}$ to 2 tons of ore per day were processed and disposed of on and off the property. The U.S. Radium Corporation also conducted operations at a number of properties in the vicinity of the processing plant. As a result of those operations, the processing plant buildings and soil became contaminated with radionuclides. In addition, radium-contaminated soil and debris were identified at approximately 250 non-contiguous properties in the vicinity of the former plant and at various other locations throughout the municipalities of Orange, West Orange, and South Orange. The non-contiguous affected properties are occupied by residences, light industries, offices, grocery stores, and apartment buildings. The site is comprised of the former processing plant and the non-contiguous properties contaminated with radionuclides. The main portion of the site is located in a densely populated, urban residential neighborhood. All area residents and businesses are supplied with municipal water.

Land and Resource Use

The land use at the site and in the vicinity of the site is mostly residential, with some commercial and light industrial establishments. The State of New Jersey has classified the aquifer as Class II-A, a current source of drinking water. All area residents are supplied with municipal water provided through state-regulated water supply companies.

History of Contamination

The U.S. Radium Corporation, formerly known as the Radium Luminous Materials Corporation, operated a radium processing plant at the corner of High and Alden Streets in Orange, New Jersey from 1915 through 1926. The U.S. Radium Corporation also operated facilities at various satellite properties in the early 1900s. A primary activity at the High and Alden Streets processing plant was the extraction and purification of radium from carnotite ore. Because each ton of ore produced only a few

milligrams of radium, large volumes of ore were required. As a result, large quantities of process wastes, or "tailings", were generated which contained radioactive elements at elevated levels. The tailings were temporarily discarded on unused areas of the processing plant and ultimately disposed of off-site.

In addition to the production and sale of radium itself, the U.S. Radium Corporation also manufactured a radium-based luminous paint. At one time, the company employed more than 100 workers to paint instruments and watch dials with this luminous paint. Reports indicate that dial painting took place at the High and Alden Streets processing plant and at several satellite properties. U.S. Radium Corporation discontinued radium processing operations in 1926, while continuing its dial painting business. In the 1940s, the U.S. Radium Corporation sold its properties at High and Alden Streets, and no subsequent occupants of the properties are known to have processed or used radium.

Initial Response

In 1979, EPA and the New Jersey Department of Environmental Protection (NJDEP) initiated a program to identify and investigate locations within New Jersey where radium-processing activities had taken place. The former U.S. Radium Corporation processing plant was included in this program. In May 1981, EPA conducted an aerial gamma radiation survey covering approximately 12 square miles centered on the High and Alden Streets processing plant. This aerial survey located about 25 acres around the High and Alden Streets processing plant where elevated readings of gamma radiation were detected. This same survey identified areas of elevated gamma radiation in the nearby communities of Montclair, West Orange and Glen Ridge; the affected properties in these areas comprise two other Superfund sites, the Montclair/West Orange Radium site and the Glen Ridge Radium site.

In 1982, the site was proposed for inclusion on the National Priorities List (NPL) of Superfund sites, and the site was placed on the NPL in September 1983. Ground level surveys conducted in the early 1980s showed elevated gamma radiation and radon gas in most of the buildings at the High and Alden Streets processing plant. In 1984, NJDEP performed preliminary field investigations of 31 properties near the processing plant. While these studies found elevated levels of gamma radiation at some properties, NJDEP found only small pockets of radium-contaminated soil, and detected no elevated radon gas levels. Working from U.S. Radium Corporation documents and other historical records, EPA and NJDEP initially identified 22

satellite properties at which the U.S. Radium Corporation had conducted operations. Initial investigations of some of the satellite properties in 1983 and 1986 indicated elevated levels of gamma radiation, with a few instances of elevated radon gas in basements.

EPA initiated a full remedial investigation and feasibility study (RI/FS) in October 1989 to determine the nature and extent of contamination at the site. By October 1992, over 160 investigations had been performed, and 63 radium-contaminated properties had been identified. As part of a removal action begun in 1991, EPA installed radon mitigation systems and gamma radiation shielding at four properties where elevated radiation levels were detected early in the RI.

In October 1992, with the investigation of the former processing plant and the satellite properties still ongoing, EPA elected to organize the other properties into a first operable unit (OU1), and to propose a remedy for these properties. With about 160 investigations completed, it was clear that performing studies on additional properties would not assist EPA in better understanding the problem, and would unnecessarily delay the process of proposing a remedy and cleaning up the radium-contaminated properties. An RI/FS report was prepared in 1993 which documented the nature and extent of contamination at the already-investigated properties, and provided a detailed evaluation of remedial alternatives.

Groundwater sampling was conducted during the initial RI/FS at the site, but the results were not conclusive. Therefore, a full comprehensive groundwater investigation was initiated in 2003, after most of the contaminated source material was removed from the site. As a result of this investigation, EPA identified a small area of uranium remaining in the soil at the High and Alden Street property. In August 2006, EPA excavated approximately 250 cubic yards of soil with slightly elevated concentrations of uranium from the location of the former processing plant, and the investigation was completed in September 2006.

Basis for Taking Action

Remedial action at this site was necessary to protect human health and the environment from actual and potential releases of hazardous substances from the site into the environment. The contaminants found in the soil and groundwater at the site included radionuclides, particularly radium (in soil) and uranium (in groundwater). The following pathways were evaluated during the risk assessment:

- Inhalation of radon decay products by residents, or occupants at commercial properties;
- Exposure to external gamma radiation emanating from radium-contaminated material, resulting in elevated exposures to residents/occupants;
- Ingestion of radionuclides in soil by residents/occupants;
- Ingestion of radionuclides in locally grown produce by residents; and
- Inhalation of radioactive particulates by residents/occupants.

IV. REMEDIAL ACTIONS

Remedy Selection

Based on the results of the RI/FS, a Proposed Plan for the first operable unit (OU1) was released to the public on April 28, 1993. OU1 consisted of mostly residential properties. On September 21, 1993, a Record of Decision (ROD) was signed for the OU1 properties, selecting a remedy of excavation of radium-contaminated material from affected properties, restoration of the excavated areas, and off-site disposal of the radium-contaminated material.

A Proposed Plan for the second operable unit (OU2) of the site was released to the public on May 23, 1995, along with an OU2 RI/FS Report. OU2 consisted of the remainder of the site; namely, the former U.S. Radium processing plant at High and Alden Streets, plus four other commercial properties used by the former U.S. Radium Corporation. On August 29, 1995, a ROD was signed for the OU2 properties, selecting essentially the same remedy as that for the OU1 properties: excavation of radium-contaminated material, restoration of the excavated areas, and off-site disposal of the radium-contaminated material.

The remedial action objectives for OU1 and OU2 were:

- Prevent exposure to gamma radiation in excess of 20 micro Roentgen per hour (uR/hr) above background;
- Prevent exposure to indoor concentrations of radon gas

levels in excess of 4 picocuries per liter (pCi/l) and radon decay products in excess of 0.02 Working Levels (WL);

- Prevent ingestion of and general contact with radium contaminated material (e.g., soil) with concentrations in excess of 5 picocuries per gram (pCi/g); and
- Prevent migration of material contaminated with radium in excess of 5 pCi/g that could result in the exposures described above.

Based on the results of the groundwater (OU3) RI/FS, a no-action remedy, with monitoring, was selected in a September 2006 ROD. A small area of elevated concentrations of uranium currently exists in the shallow aquifer. However, after careful consideration of the site-specific details and analysis of all data collected, EPA determined that a no-action approach is protective of human health and the environment, primarily because the shallow aquifer is not currently used as a drinking water source. Since nearby residents are supplied with municipal water, its use as a drinking water source in the future is considered highly unlikely; and because the source of contamination in the soil has been removed, the concentration of uranium in the groundwater in this limited area should decrease with time.

To summarize, the OU1, OU2, and OU3 remedies included the following major components:

Soil and Building Materials:

- Excavation of radium-contaminated material above remedial action objectives from all affected properties;
- Off-site disposal of the radium-contaminated material; and

Groundwater:

- No action required other than appropriate environmental monitoring to ensure the effectiveness of the remedy.

Remedy Implementation

Soil and Buildings

Field work for the first group of OU1 properties was initiated in 1997. Investigations of additional area properties continued during the cleanup and, when additional radium-contaminated properties were identified, designs for their cleanup were prepared. The OU1 and OU2 remedial actions are now essentially complete. Overall, approximately 650 properties were investigated during the remedial design. Of these properties, approximately 250 were identified as requiring remediation under the selected actions.

The OU1 and OU2 cleanup was performed in phases. Phase 1 and Phase 2 of the remedial action were completed in December 1998 and resulted in the removal of approximately 25,000 cubic yards (approximately 38,400 tons) of radium-contaminated material. Phase 3 was completed in October 1999 and resulted in the removal of approximately 9,000 cubic yards (approximately 14,400 tons) of radium-contaminated material. Phase 4, completed in September 2001, included the former U.S. Radium Corporation processing plant located at High and Alden Streets, and resulted in the removal of approximately 34,000 cubic yards (approximately 54,400 tons) of radium-contaminated material. Phase 5 was completed in December 2002 and resulted in the removal of approximately 10,000 cubic yards (approximately 16,000 tons) of radium-contaminated material. Phase 6 was completed in September 2003 and resulted in the removal of approximately 5,000 cubic yards (approximately 8,000 tons) of radium-contaminated material. Phase 7 was completed in September 2005 and resulted in the removal of approximately 1,996 cubic yards (approximately 3,200 tons) of radium-contaminated material. Due to access issues, one remaining residential property is planned to be addressed sometime in the future.

Groundwater:

As part of the no-action remedy, a groundwater monitoring program was implemented to assure that the no-action remedy remains protective of human health and the environment. The monitoring program is modified on an ongoing basis depending on the sampling results obtained. Additional action, such as the installation of additional monitoring wells, may be taken if monitoring shows that it is warranted. If all results clearly show that uranium concentrations in groundwater decrease to levels below drinking water standards, then monitoring may be discontinued.

System Operations/Operation and Maintenance

Soil and Building Materials:

No operation or maintenance activities are being conducted for OU1 or OU2 of the site, nor are they considered necessary. A Quality Assurance/Quality Control (QA/QC) program was used in the development of the remedial design and throughout the remedial action. All necessary sampling and testing results indicated that the cleanup and restoration work was properly implemented to the degree needed to assure that the remedial action was implemented properly and consistent with the RODs.

The excavation areas were determined during the remedial design. In order to assure that all soil that was supposed to be removed was addressed samples from the sides and bottom of each excavation were analyzed. Where appropriate, wipe or other sampling techniques were utilized to assure the cleanup was complete. The U.S. Army Corps of Engineers (USACE) conducted inspections of all cleanup activities. All site activities were conducted in accordance with the relevant Health and Safety and QA/QC plans. All material brought to the site for restoration, including general backfill, structural fill, and topsoil, was tested for contamination prior to use. In addition, fill placed in all restored areas was compacted to specified levels to assure its structural integrity and surveyed to assure appropriate elevations were met.

Groundwater:

The first round of post-ROD groundwater sampling was conducted in December 2006. A total of nine post-ROD sampling events have been conducted, the most recent in February 2011. Groundwater sampling is continuing quarterly.

Institutional Controls

No institutional controls were required at this site.

V. Five-Year Review Process

Administrative Components

The five-year review team included Stephanie Vaughn (EPA-RPM), Kristin Giacalone (EPA-RPM), Edward Modica (EPA-Hydrologist),

Marian Olsen (EPA-Human Health Risk Assessor) and Pat Seppi (EPA-Community Involvement Coordinator). This is a fund-lead site.

Community Involvement

A notice was published in the Orange Transcript, a local newspaper, on March 17, 2011, notifying the community of the five-year review process. It was also indicated that once the five-year review is completed, the results will be made available at both local site repositories: the Orange Public Library, 348 Main Street, Orange, New Jersey, and the West Orange Public Library, 46 Mount Pleasant Avenue, West Orange, New Jersey, as well as at the U.S. Environmental Protection Agency Records Center, 290 Broadway, 18th Floor, New York, New York 10007-1866. In addition, the notice included the RPM's address and telephone number for public inquiries related to the five-year review process for the U.S. Radium site. No phone calls or letters from the public have been received as a result of the above-described Public Notice.

Document Review

The documents, data, and information which were reviewed in completing the five-year review are summarized at the end of this document.

Data Review

Soil and Building Material:

Since the actions taken to address soil and building material at the site were considered final, and no further monitoring is required, there were no data to review as part of this five-year review. On February 8, 2011, EPA did speak with the owner of the one remaining residential property, a non-contiguous property, which still has not been remediated due to an access issue. The access issue still exists, so the remedial action on this property, which will consist of the excavation and off-site disposal of radium-contaminated material, cannot yet be completed. Note that EPA has a legal agreement in place with the owner of the property to assure that the work can be completed once the access issue is resolved, and EPA periodically contacts the owner in order to check on the status of the situation.

Groundwater:

As was noted above, a total of nine post-ROD groundwater

sampling events have been conducted. Figure 2 shows the location of the 7 wells that are being tested as part of the post-ROD monitoring program. Groundwater from each well is being analyzed for the following radiological parameters: uranium-234, uranium-235, uranium-238, radium-226, and radium-228. The water is also being analyzed for the following metals and other physical parameters: calcium, iron, magnesium, manganese, potassium, sodium, alkalinity (as calcium carbonate, or CaCO₃), bicarbonate (as CaCO₃), carbonate (as CaCO₃), chloride, ferrous iron, nitrate plus nitrite as N, phosphate (Ortho as P), sulfate, total fluoride, and total organic carbon.

The rationale for the list of parameters selected for analysis is as follows: during the OU3 remedial investigation, the only parameter that was detected at elevated concentrations (i.e., above federal and state drinking water standards, also called Maximum Contaminant Levels, or MCLs) was uranium. Thus, EPA is focusing its efforts on monitoring uranium concentrations in groundwater over time. However, since radium was the primary contaminant of concern in the soil, EPA decided to include radium (and its isotopes) in the monitoring program. The other parameters listed above are being analyzed in order to monitor the conditions that EPA anticipates will cause the concentration of uranium in groundwater to decrease over time due to natural attenuation processes. Very basically, the geochemical balance of the groundwater in this area is such that the uranium should precipitate and/or adsorb from the water onto the soil over time, thus reducing the concentration in groundwater. Once in the soil, the concentrations will remain low enough that they will pose no unacceptable risk to human health or the environment. EPA is analyzing the groundwater for the geochemical parameters listed above to assure that the physical characteristics of the groundwater do not change over time in such a way that the uranium concentrations will stop decreasing naturally.

Since the time of the RI, all monitoring results have been consistent with the above-described scenario. All radium results continue to remain well below groundwater cleanup levels and uranium concentrations in the two wells closest to the area of uranium contamination in the soil that was removed in July 2006, which are the only two wells to show concentrations above MCLs, are decreasing.

Figure 3 shows uranium concentrations over time for three of the wells being monitored. Two of the wells depicted, MW-P2 and MW-P7, have had uranium concentrations above the MCL for uranium of 30 micrograms/liter (ug/l) since at least the time that the ROD was signed for OU3. The figure shows that uranium

concentrations in both of these wells have decreased significantly since removal of the source area of soil contamination from the former processing plant was completed (note that the figure includes pre-ROD results). In fact, concentrations of uranium in MW-P7 are now below the MCL.

Data for a third well, MW-P3, is also included on the figure. While the uranium results at this well are all below the MCL, they are elevated above what may be considered naturally occurring background conditions. As such, EPA is tracking the results at this well to assure that the remedy remains effective. Note that even if concentrations in this well were to increase above the MCL, the remedy would remain protective since there is no exposure pathway to this water.

Table 4 shows the actual total uranium data collected at all wells being monitored. The data shows that at wells P4, P5, P6, and P7D detected concentrations of uranium have remained at relatively consistent levels, but still below the MCL, with minor fluctuations over time.

Site Inspection

The RPM conducts periodic visits to the site. Members of the five-year review team visited the site on February 14, 2011. Conditions observed indicate that there is no change in site use or zoning.

VI. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

Yes, the remedy is functioning as intended by the OU1, OU2, and OU3 RODs. Work at the majority of the site is complete, and the groundwater continues to be monitored to assure protectiveness.

Question B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of the remedy selection still valid?

There have been no changes in the physical conditions or land uses of the site that would affect the protectiveness of the remedy.

- **Are the exposure assumptions and toxicity data used at the time of the remedy selection still valid?**

a. Soil and Building Material. The exposure assumptions

and toxicity values that were used to estimate the potential cancer risks and non-cancer hazards in the risk assessment supporting 1993 and 1995 RODs for human health followed the Risk Assessment Guidance for Superfund and other appropriate risk assessment guidelines and policies. The process that was used in the human health risk assessment is still valid. Now that the remedy has been implemented, no radium-contaminated material is known to remain on the site, with the exception of the material on the one remaining non-contiguous residential property that has not yet been addressed due to access issues. As such, the site-related risk due to exposure to contaminated soil and/or building material has been eliminated, with the above exception.

b. Groundwater. The exposure assumptions and toxicity values that were used to estimate the potential cancer risks and non-cancer hazards in the risk assessment supporting the 2006 ROD which selected a remedy for groundwater followed the Risk Assessment Guidance for Superfund and other appropriate risk assessment guidance and guidelines. The process that was used in the human health risk assessment is still valid. The ongoing groundwater monitoring is assuring that the remedy remains protective. The exposure assumptions used in the 2006 ROD, including the land-use patterns and restrictions in the area have not changed - the area remains a densely developed, urban-residential neighborhood; and all drinking water in the community continues to be supplied by state-regulated municipal sources. As such, there is no exposure pathway to the area of contamination and, thus, no site-related risk due to exposure to contaminated groundwater.

c. Vapor Intrusion. Vapor intrusion is not a concern related to this site as the only contaminants of concern are radionuclides. However, radon gas, which can become elevated indoors much like other volatile contaminants that pose a risk of vapor intrusion, was investigated as part of the site. All properties investigated were tested for radon gas, and elevated radon readings were not commonly found. However, when elevated radon results were obtained, in nearly all cases EPA removed the source of the radon contamination (through excavation of radium-contaminated material, since radon gas is a radioactive decay product of radium) rather than install a mitigation system.

• **Are the Cleanup Values Selected in the ROD(s) Still Valid?**

Yes, the cleanup values selected in the 1993, 1995, and 2005 RODs remain valid. No federal standards for soil or groundwater have changed since the signing of the RODs, and the state does not have its own standards for the contaminants of

concern.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Based on the evaluation of the potential human exposures at the site, there is no new information that has been developed that could call into question the protectiveness of this remedy. It was determined that an ecological risk assessment was not required at this site and that decision remains valid.

Technical Assessment Summary

According to the data reviewed and the site inspection, the soil and groundwater remedies are functioning as intended by the RODs. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. There have been no changes in the toxicity factors of the contaminants of concern or in the risk assessment procedures that would affect the protectiveness of the remedy.

VII. Recommendations and Follow-Up Actions

There are no recommendations or follow-up actions stemming from this five-year review, other than continuing to monitor the effectiveness of the OU3 remedy, and maintaining contact with the owner of the property that remains to be addressed as part of OU1.

In particular, EPA will continue to periodically check on the status of the one remaining residential property from OU1 that has not yet been addressed, to determine if the access issues have been resolved. Once resolved, the contamination from that property is planned to be removed, as per the terms of the OU1 ROD, and the OU1 remedy will be complete.

In addition, EPA will continue to monitor the results of the groundwater monitoring program as part of OU3, and may decide to install another well downgradient of Well P-3, which is currently the most downgradient well in the area of uranium contamination where soil was removed in August 2006. This additional well would serve as a sentinel well downgradient of the edge of contamination. Assuming that contamination is not detected in this well, it could then be used in the continuing monitoring program to confirm that the contamination does not advance beyond the areas of contamination. EPA will also continue to adjust the frequency of testing the monitoring wells, as needed, and on an ongoing basis.

XIII. Protectiveness Statement

The implemented remedy at OU1 is protective of human health and the environment because all properties where access has been allowed have been remediated to allow for unlimited use and unrestricted exposure. One residence exists where contamination has not been addressed due to access issues. This residence is planned to be addressed in the future when access is permitted. Since access is an issue and the resident is aware of site-related contamination, the status of this residence does not affect the protectiveness of the remedy.

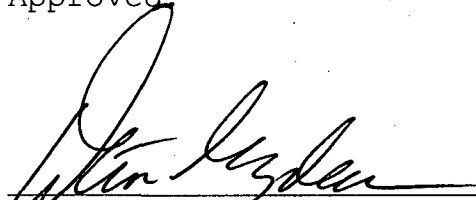
The implemented remedy at OU3 is expected to be protective upon completion, and in the interim, exposure pathways that could result in unacceptable risks are being controlled.

Because the remedial actions at all OUs are protective, the site is protective of human health and the environment.

X. Next Review

The remedies selected in the September 21, 1993 OU1 ROD, the August 29, 1995 OU2 ROD, and the September 27, 2006 OU3 ROD will not result in hazardous substances remaining at the site above levels that allow for unlimited use and unrestricted exposure. However, since hazardous substances do remain on one OU1 property and it may take more than five years to attain federal or state drinking water standards as part of the OU3 no-action remedy, another policy review may be conducted within five years of this review to ensure that the remedy remains protective.

Approved:



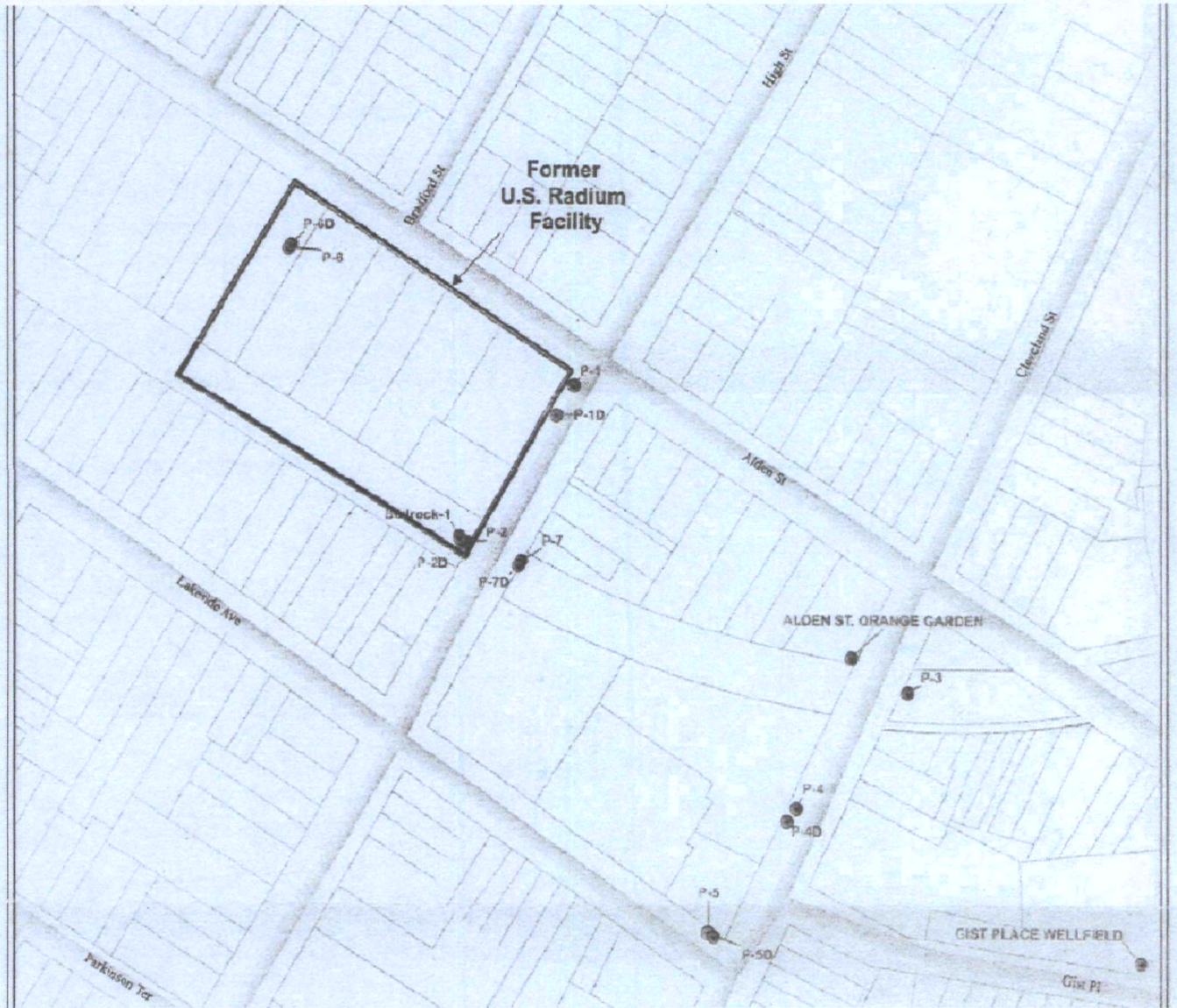
Walter Mugdan, Director
Emergency and Remedial Response Division

7/13/2011
Date

Figure 1
Site Location Map



Figure 2
Well Location Map



Legend

● Monitoring Well Location

N

0 100 200
Foot

Figure 3

Total Uranium Concentration over Time

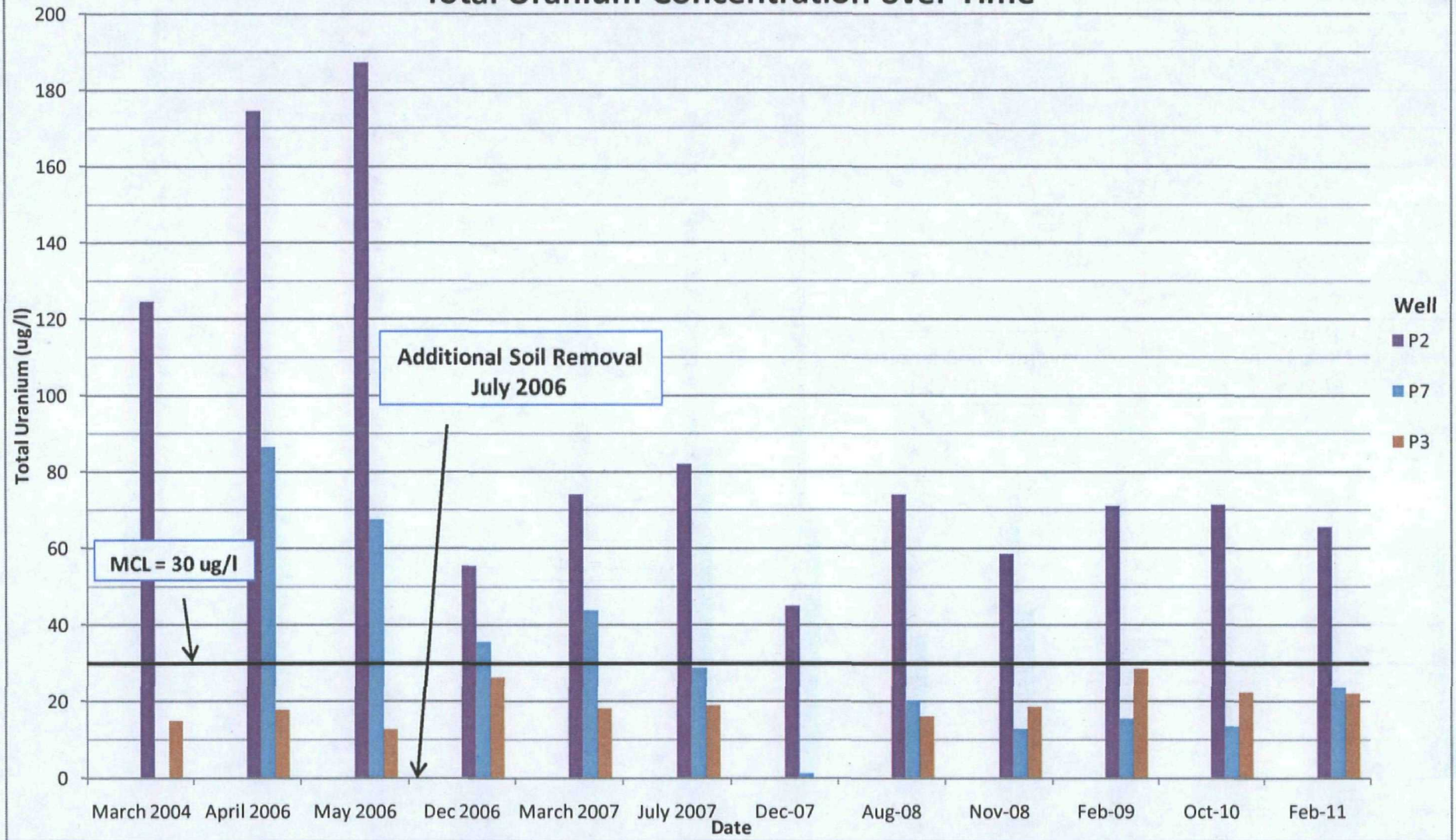


Table 1
Chronology of Site Events

Event	Date
EPA and NJDEP initiate a program to identify and investigate locations in New Jersey where radium processing activities had taken place.	1979
EPA conducts an aerial gamma radiation survey covering approximately 12 square miles centered on the High and Alden Street properties. This aerial survey locates about 25 acres around the High and Alden Street properties where elevated readings of gamma radiation were detected.	May 1981
U.S. Radium Corporation Facility and the associated Vicinity and Satellite Properties are proposed to be added to the NPL.	December 1982
The U.S. Radium site is placed on the NPL.	September 1983
EPA initiates an RI/FS to determine the nature and extent of contamination at the site	October 1989
The RI/FS report for OU1 is released to the public.	April 1993
EPA signs the ROD for OU1 which includes 59 residential properties.	September 1993
Remedial Design for Phase I/II initiated.	September 1993
MPI completes the RI/FS for OU2.	May 1995
EPA signs the ROD for OU2 which includes four commercial properties and the U.S. Radium Corporation property.	August 1995
Remedial Design for Phase I submitted, which includes 18 properties.	October 1995
Remedial Design for Phase II submitted, including 41 properties.	May 1996
Field work for Phase I/II is initiated.	January 21, 1997

Remedial design for Phase III initiated.	September 17, 1996
Remedial design for Phase III complete, which includes 44 properties.	August 8, 1997
Remedial design for Phase IV initiated.	October 1, 1997
Remedial design for Phase V initiated.	May 21, 1998
Field work for Phase III is initiated.	July 27, 1998
Remedial design for Phase IV submitted.	August 12, 1998
Field work for Phase IV is initiated.	February 12, 1999
Remedial design for Phase VI initiated.	September 10, 1999
Phase III restoration is substantially completed. EPA, COE and SES perform a final site inspection for Phase III.	October 21, 1999
Remedial design for Phase V complete.	June 26, 2000
Field work for Phase V is initiated.	April 24, 2001
Phase IV restoration is substantially completed. EPA, COE, and SES perform a final site inspection for Phase IV.	May 3, 2001
Remedial design for Phase VI complete.	September 26, 2001
Remedial Design for Phase VII initiated.	November 30, 2001
Phase V restoration is substantially completed. EPA, COE, and SES perform a final site inspection for Phase V.	August 22, 2002
Remedial design for Phase VII complete.	September 24, 2002
Remedial design for Phase VIII (remaining property with access issues) initiated.	September 28, 2002
Notice to Proceed for Phase VII is issued.	May 27, 2003

Phase VI restoration is substantially completed. EPA, COE, and SES perform a final site inspection for Phase VI.	June 19, 2003
Phase VII restoration is substantially completed. EPA, COE, and SES perform a final site inspection for Phase VII.	April 28, 2005
OU3, groundwater, RI/FS is completed.	August 2006
EPA signs the ROD for OU2.	September 27, 2006
EPA signs the Preliminary Site Closeout Report for the site.	September 28, 2006

Table 2
Comparison of Remediation Goals in 1993 and 1995 RODs to
Current NJDEP Soil Cleanup Criteria

Contaminant	1993 ROD (pCi/g ^a)	1995 ROD (pCi/g ^a)	NJDEP Standard
Radium-226	5	5	none
Uranium-238	5	5	none
Thorium-230	5	5	none
Thorium-232	5	5	none
Radon-222	4 ^b	4 ^b	none
Gamma Radiation Rate	20 uR/hr ^c above background	20 uR/hr ^c above background	none

a: pCi/g = picocuries per gram

b: Radon is measured in units of pCuries per liter, or pCi/l

c: uR/hr = micro Roentgen per hour

Table 3
Federal and State Drinking Water Standards (MCLs)

Analyte	Federal MCL	State MCL
Radium-226 and Radium-228 (combined)	5 pCi/l	NS
Total Uranium	30 ug/l	NS
Gross alpha	15 pCi/l	NS
Gross beta	4 mrem/year (1)	NS
Isotopic Thorium	NS	NS
Radon-222	NS	NS

Notes:

(1) 4 mrem/yr is approximately 30 pCi/l

MCL = Maximum Contaminant Level

pCi/l = picocuries per liter

NS = No Standard

ug/l = micrograms per liter

Table 4

Total Uranium Results Over Time

	Oct 2003	March 2004	April 2006	May 2006	Dec 2006	March 2007	July 2007	Dec-07	Aug-08	Nov-08	Feb-09	Oct-10	Feb-11
	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6	Round 7	Round 8	Round 9	Round 10	Round 11	Round 12	Round 13
Well	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
P2	41.02	124.55	174.58	187.22	55.41	74.08	82.05	44.89	74.02	58.56	71.05	71.34	65.50
P7	-	-	86.39	67.48	35.58	43.79	28.80	1.16	20.30	12.81	15.46	13.41	23.60
P3	11.09	14.95	17.84	12.72	26.28	18.19	18.91	-	16.02	18.58	28.42	22.38	22.10
P4	1.04	0.39	2.68	2.68	1.34	1.69	-	0.89	2.92	5.02	8.95	6.90	7.82
P5	-	-	5.11	2.97	4.58	2.50	3.36	2.54	2.07	3.24	2.72	2.11	4.02
P6	-	-	1.87	1.43	1.28	0.65	1.10	nd	nd	nd	nd	nd	nd
P7D	-	-	2.88	2.53	4.10	3.15	2.58	2.32	2.18	2.04	2.90	1.30	2.47
Notes:	Final soil uranium-contaminated soil removal was completed in July 2006. Thus, Round 5 may be considered the first post-remediation sampling round.												
	The Maximum Contaminant Level of Total Uranium in Groundwater is 30 micrograms per liter (ug/l). Elevated results are shown in bold.												
	nd = non-detect												

List of Documents Reviewed

- Record of Decision, EPA, September 1993
- Record of Decision, EPA, September 1995
- Record of Decision, EPA, September 2006
- Superfund Preliminary Site Close Out Report, EPA, September 2006
- Final Remedial Investigation Report, Operable Unit 3 - Groundwater, U.S. Radium Superfund Site, Orange, New Jersey, prepared by CDM under contract to the USACE, August 2006
- Groundwater Site Assessment for Isotopic Uranium and Radium, U.S. Radium Site, prepared by Lockheed Martin under the ERT/REAC contract, Trip Reports covering work completed December 2006, March 2007, July 2007, December 2007, August 2008, November 2008, and February 2009
- Groundwater Site Assessment for Isotopic Uranium and Radium, U.S. Radium Site, prepared by Lockheed Martin under the ERT/SERAS contract, Trip Reports covering work completed October 2010 and February 2011
- Comprehensive Five-Year Review Guidance, EPA Office of Emergency and Remedial Response, EPA 540-R-01-007, OSWER No. 9355.7-03B-P, June 2001