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December 15, 2006
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J-7

Mr. James Kottan
Senior Health Physicist
U.S. Nuclear Regulatory Commission, Region I
Division of Nuclear Materials Safety
475 Allendale Road
King of Prussia, PA 19406

Subject: **Whittaker Site Decommissioning Plan**
Energy*Solutions* Document No. 82A9426, Revision 2
License No. SMA-1018 04007455
Control No. ~~137796~~
139943

Dear Mr. Kottan:

Energy*Solutions*, as preparer of the Whittaker Site Decommissioning Plan (Energy*Solutions* Document No. 82A9426) wishes that portions of the document be withheld from public disclosure under the provision provided in 10 CFR 2.390 because they contain financial information that is considered proprietary. Specifically, Energy*Solutions* requests that Table 15-2 located at the end of Section 15.0, "Financial Assurance," be withheld. Table 15-2 provides a project cost estimate based on proprietary labor rates for Energy*Solutions* personnel as well as propriety transportation and disposal rates for radioactive wastes being shipped from the project site.

Please complete and return the copy of the enclosed Energy*Solutions* Document Transmittal Form to indicate receipt of your controlled copy of this report.

If you have any questions or comments, please call me at 801-303-1027.

Sincerely,

Lee G. Penney
Director, Operations Remediation & Decommissioning Services

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Document Number 82A9426
Revision 2

This Document Contains Confidential Information Submitted Under 10 CFR 2.390

DECOMMISSIONING PLAN

U.S. Nuclear Regulatory Commission License No. SMA-1018
Whittaker Corporation Waste and Slag Storage Area
Transfer, Pennsylvania

Prepared for:
WHITTAKER CORPORATION
1955 N. Surveyor Avenue
Simi Valley, CA 93063

Prepared by:
Energy*Solutions*, LLC
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December 2006

CONTROLLED COPY No. 693

Project Application:	*Prepared by:*	*Date:*
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Approvals:	*Signature:*	*Date:*
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ABBREVIATIONS/ACRONYMS

2x2 NaI	2-inch by 2-inch Sodium Iodide Gamma Scintillation Detector
ACM	Asbestos Containing Material
AHP	Applied Health Physics, Inc.
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
CEDE	Committed Effective Dose Equivalent
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
cpm	Counts per Minute
CZ	Contaminated Zone
DAC	Derived Air Concentration
DAW	Dry Active Waste
D&D	Decontamination and Decommissioning
DCGL	Derived Concentration Guideline Level
$DCGL_{EMC}$	DCGL for elevated measurement comparisons
DEE	Deep Dose Equivalent
DOT	U.S. Department of Transportation
$dpm/100cm^2$	disintegrations per minute per 100 square centimeters
DQO	Data Quality Objective
EH&S	Environmental Health and Safety
EMC	Elevated Measurement Comparison
EPA	U.S. Environmental Protection Agency
ESFS RSO	Energy*Solutions* Field Services Radiation Safety Officer
FSS	Final Status Survey
FSSP	Final Status Survey Plan
FSSR	Final Status Survey Report
GM	Geiger-Mueller
HSA	Historical Site Assessment
HPT	Health Physics Technician
ISOCS	*In Situ* Object Counting System
K	Hydraulic Conductivity
LDE	Lens (eye) Dose Equivalent
LLRW	Low Level Radioactive Waste
m^2	square meters
m^3	cubic meters
MARSSIM	Multi Agency Radiation Site Survey and Investigation Manual, NUREG-1575
MCA	Multichannel Analyzer
MCRPC	Mercer County Regional Planning Commission
MDC	Minimum Detectable Concentration
mrem/yr	millirem per year
msl	Mean Sea Level
NCDC	National Climatic Data Center
NES	NES, Inc.

NRC	U.S. Nuclear Regulatory Commission
NUREG	Nuclear Regulation
ORAU	Oak Ridge Associated Universities
OSHA	U.S. Occupational Safety and Health Administration
OSL	Optically Stimulated Luminescent
PADEP	Pennsylvania Department of Environmental Protection
pCi/g	Picocuries per gram
pCi/L	Picocuries per Liter
PNNL	Pacific Northwest National Laboratory
PM	Project Manager
PSI	Pollution Standard Index
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
RACE	Radiological Assistance, Consulting, and Engineering, LLC
RCA	Radiologically Controlled Area
RESRAD	USDOE/ANL Dose Modeling Code
RWP	Radiation Work Permit
SDE	Shallow Dose Equivalent
SDMP	Site Decommissioning Management Plan, NUREG-1444
SRP	Standard Review Plan
SRSO	Site Radiation Safety Officer
SZ	Saturated Zone
TBD	Technical Basis Document
TEDE	Total Effective Dose Equivalent
URSA	Universal Radiation Spectrum Analyzer
USGS	U.S. Geological Service
UZ	Unsaturated Zone
μCi/ml	microcuries per milliliter

1.0 EXECUTIVE SUMMARY

This Decommissioning Plan, submitted pursuant to Title 10, Part 40, Section 42 of the Code of Federal Regulations (10 CFR 40.42) was prepared by Energy*Solutions*, LLC (consisting of the former decontamination and decommissioning (D&D) division of Scientech, LLC) for the Whittaker Corporation of 1955 North Surveyor Avenue, Simi Valley, California. The Whittaker Corporation's licensed facility, the Whittaker Site, is a waste and slag storage area that is regulated under U.S. Nuclear Regulatory Commission (NRC) Source Material License No. SMA-1018[1] for the possession of source material and the performance of specified surveillance, maintenance, and control activities. This Decommissioning Plan was prepared using the guidance provided in the NRC's Regulatory Guidance (NUREG)-1727, *NMSS Decommissioning Standard Review Plan*[2]. The Whittaker Corporation, as the licensee, requests the amendment of NRC License No. SMA-1018 to incorporate this Decommissioning Plan.

The Whittaker Site is located in the Reynolds Industrial Park in Transfer, Pennsylvania, approximately 3.5 miles south of the borough of Greenville. The site location is shown in Figure 1-1. The site is an irregularly shaped parcel of land with a total area of approximately 5.8 acres located between the Greenville Metals Plant at 99 Crestview Drive and the Shenango River.

This parcel was built up over time through the repeated disposal of foundry slag, scrap metal, building rubble, and debris from general metal manufacturing operations. Adjoining property owners include Greenville Metals, the Reynolds Water Company, and the U.S. Army Corps of Engineers (COE). A fourth adjoining property is a privately owned parcel.

The Whittaker Corporation, as well as prior owners of the site, used raw source material containing licensable quantities of thorium and uranium to process rare earth metals on site. The source materials consisted mainly of Brazilian and Canadian Pyrochlore, a mineral found in some granatic geologic formations. Manufacturing operations, which produced the thorium- and uranium-containing slag as a byproduct, commenced in 1966 and terminated in 1974. These slag byproducts were disposed of in areas within the boundaries the present site. The radiological contaminants consist of natural thorium and uranium and their daughter products in approximate secular equilibrium. Analysis of slag materials also shows that uranium-238 exists in some materials in disequilibria with its decay daughters.

[1] NRC License No. SMA-1018, Amendment No. 14, Expires September 30, 2010
[2] NRC, September 2000, NUREG-1727, *NMSS Decommissioning Standard Review Plan*

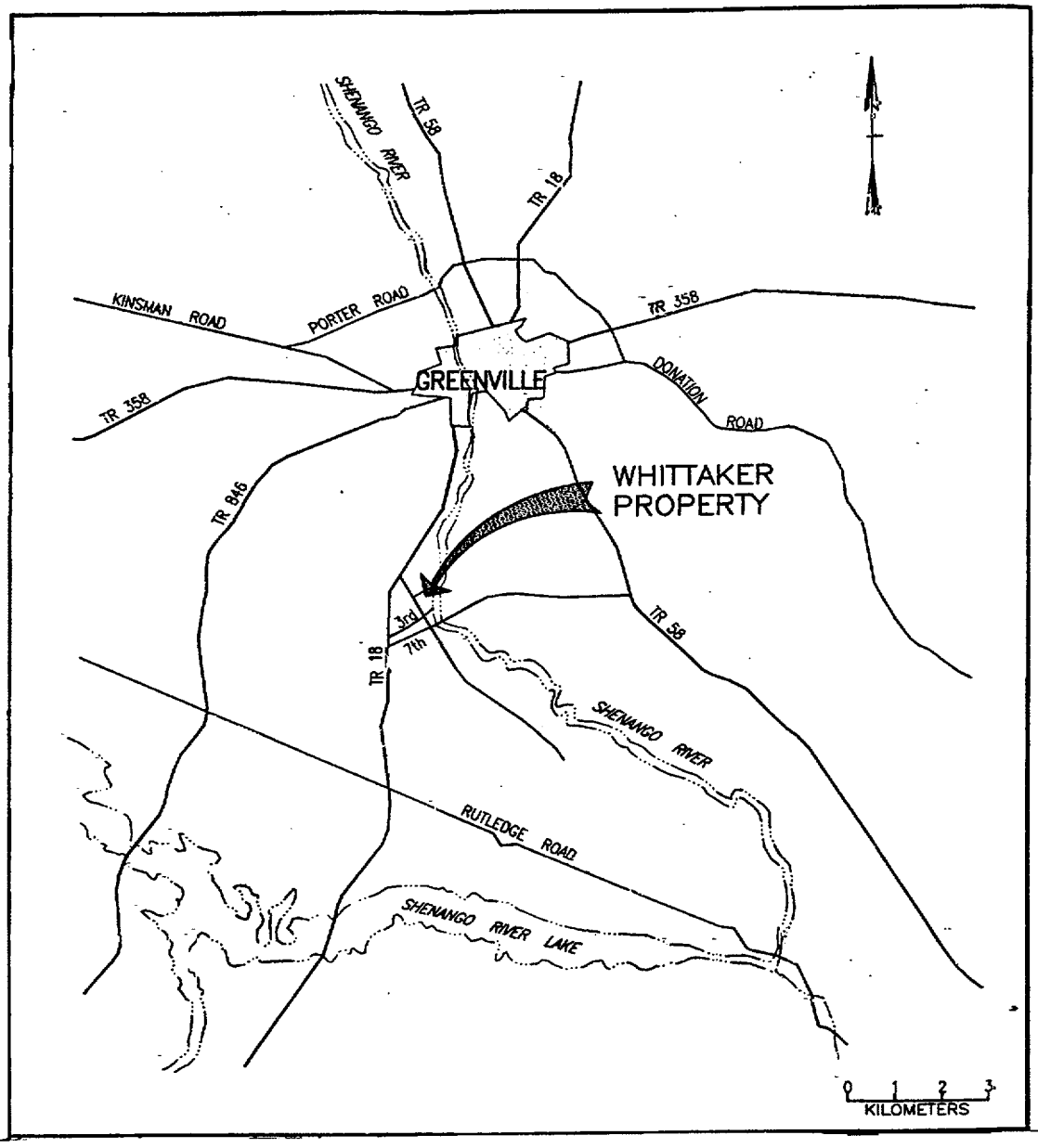

FIGURE 1-1

WHITTAKER SITE LOCATION (STREET MAP)

The objective of the decommissioning activities will be to remediate the site to levels that will permit license termination for unrestricted use in accordance with 10 CFR 20, Subpart E criteria[3]. This will be accomplished by excavation and removal of slag and soil/slag mixture that contains residual radioactive contamination in excess of the dose-based derived concentration guideline levels (DCGLs. Site-specific DCGLs were established by performing site-specific dose modeling using relevant information from site characterization studies in the RESRAD computer model (Version 6.1)[4]. Remediation to the established DCGLs will reduce the total effective dose equivalent (TEDE) from residual radioactivity distinguishable from background to less than 25 millirem per year (mrem/yr) for the average member of the critical group. Additionally, the dose to all future occupants will be as low as reasonably achievable (ALARA). DCGL values, the methodology for determining these values, and a discussion of ALARA considerations are presented in detail in subsequent sections of this decommissioning plan.

Remedial action and final status surveys will confirm that remediation of subsurface and surface media to the established DCGLs. The final status surveys will be designed and performed in accordance with applicable portions of guidance provided in the NRC's *Multi-Agency Radiation Site Survey and Investigation Manual* (MARSSIM)[5] and NUREG-1727.

Metal and concrete materials will be surveyed for contamination and released for unrestricted use in accordance with NRC Policy and Guidance Directive FC 83-23[6] (the limits are also commonly referred to as the NRC Regulatory Guide 1.86[7] limits). Because it is not possible to distinguish between radioactive emissions from thorium and uranium using conventional counting and field survey instrumentation, the more restrictive thorium limits will be utilized as the release criteria for non-slag or non-soil materials. Table 1 of FC 83-23 indicates acceptable average surface contamination levels for natural thorium as 1,000 disintegrations per minute per 100 square centimeters (dpm/100cm^2) for fixed contamination and 200 dpm/100cm^2 for removable contamination.

On-site D&D activities began in July 2004. It is anticipated that D&D activities will continue through 2006 with license termination in 2007. The Energy*Solutions* (then Scientech D&D division) site crew mobilized to the project site in July 2004 and worked until early December. Energy*Solutions* then temporarily demobilized and remobilized in March 2005. During this period, the site was cleared of vegetation, site obstructions, and miscellaneous debris and a thorough subsurface exploratory characterization was performed. Between March 2005 and November 2005, Energy*Solutions* excavated more than 20,000 tons of soil and slag separating out more 10,000 tons of LLRW. More than 6,000 tons of LLRW was shipped off-site for disposal in 2005. Beginning in April 2006, Energy*Solutions* returned to the site to continue

[3] Title 10 Code of Federal Regulation (CFR), Part 20, Subpart E, *Radiological Criteria for License Termination.*
[4] Scientech, LLC, 2004. *Dose Assessment in Support of Establishing Derived Concentration Guideline Levels for the Whittaker Decommissioning Site.* Document No. 82A9534, Revision 1. August 10.
[5] NRC, December 1997, NUREG-1575, *Multi-Agency Radiation Site Survey and Investigation Manual (MARSSIM)*
[6] NRC, August 1987, Policy and Guidance Directive FC 83-23, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*
[7] NRC, June 1974, Regulatory Guide 1.86. *Termination of Operating Licenses for Nuclear Reactors.*

shipping LLRW to Clive, Utah. In 2006 Energy*Solutions* also plans to complete excavations of radioactive materials and ship the remaining materials for LLRW disposal.

Much of the slag materials have been excavated and sorted based on whether or not concentrations in the slag are expected to exceed the DCGLs. Soils and slag expected to be below the DCGLs are staged for replacement on site as fill material. Slag materials with uranium and/or thorium concentrations which exceed the DCGLs are staged and loaded into end-dump trailers. The slag materials are then transported to a transload facility in Wampum, Pennsylvania and dumped into gondola rail cars. The railcars containing the low-level radioactive waste (LLRW) are then shipped to the Energy*Solutions* LLRW disposal site in Clive, Utah.

2.0 FACILITY OPERATING HISTORY

The following sections describe history of the Whittaker site. The history of the site and area are extensive, dating back to the 1940's. The license history dates back to 1966.

2.1 LICENSE NUMBER, STATUS, AND AUTHORIZED ACTIVITIES

The Whittaker Site is currently regulated under NRC License No. SMA-1018, Amendment No. 14, which authorizes the possession of thorium and uranium in any chemical and/or physical form in quantities that were present in contaminated materials at the site as of June 1, 1985. The current license was renewed 2004 and expires September 30, 2010.

License No. SMA-1018 also authorizes the performance of specific activities related to D&D and the ongoing surveillance, maintenance, and control of licensed materials on site. Site activities performed under SMA-1018 include site surveillance to monitor and maintain the integrity of the radiologically controlled area (RCA), groundwater monitoring to detect potential hazards caused by site assessment activities, routine and non-routine maintenance of the RCA, ongoing excavations, radioactive material segregation and stockpiling, and loading radioactive materials for transportation are being conducted under existing and previous license amendments.

2.2 LICENSE HISTORY

Much of the area of the existing Reynolds Industrial Park was a World War II-era U.S. Army base called Camp Reynolds. After the base's closure, ownership of this property changed hands. Beginning in the 1960s, a portion of this area was used by Mercer Alloys, a predecessor of Whittaker Metals Corporation, to produce metal alloys.

In February of 1966, Mercer Alloys received NRC License No. SUB-864[8], which allowed it to possess 250 pounds of uranium in the form of calcium uranate for a ferro-molybdenum production process. Natural uranium was to be received in impure calcium molybdate sludge with a weight distribution of 45% water, 41% calcium molybdate, and 14% impurities including the natural uranium. The impurities contained up to 1.5% natural uranium by weight. The sludge was to be blended with uranium-free molybdate to reduce the uranium content to less than 0.05% by dry weight, charged to a rotary drum drier, then charged to an arc furnace to produce ferro-molybdenum slabs. License SUB-864 was not renewed and was allowed to expire in February of 1969.

In December of 1969, Mercer Alloys received NRC License No. SMA-1018 in response to an application for a new license[9]. License No. SMA-1018 authorized the possession of a maximum

[8] NRC, February 28, 1966, License No. SUB-864, Mercer Alloys Corporation, Reynolds Development, Greenville, PA., Docket No. 40-7455

[9] NRC, December 15, 1969, License No. SMA-1018, Mercer Alloys Corporation, #1 Alloy Road, Reynolds Development, Greenville, PA., Docket No. 40-7455

quantity of 16,000 pounds of uranium and thorium in any form. Ores containing 1 to 2% thorium by weight were to be charged to an alumino-thermic reactor to produce ferro-columbium alloys. Natural uranium, depleted uranium, or thorium were also present as unwanted contaminants in various chemical forms in monel, copper, stainless steel, and other scrap metals that were melted in an arc-furnace process for a ferro-nickel production process. Thorium and uranium bearing waste slags were to be disposed of on-site in accordance with Section 20.301 of 10 CFR 20.

Between October of 1971 and February of 1973, certain assets of Mercer Alloys were leased to Noblemet International Corporation. In April 1973, the leases were terminated and the assets were transferred to a wholly owned subsidiary of the Whittaker Corporation, Whittaker Metals Alloy Division. The site NRC license was amended in 1973 to reflect these changes.

In early 1974, Whittaker Corporation decided to terminate all manufacturing operations involving source material at the Greenville site. In November of 1974, a request for renewal of SMA-1018 was submitted for the storage (possession) of up to 1,000,000 pounds of natural and depleted uranium and thorium in any chemical form[10]. The facility was sold to Exomet, Inc. in late 1974, with Whittaker retaining responsibility for source materials that remained on the premises.

Whittaker Corporation, with the assistance of several consultants, has been negotiating with the NRC on plans for terminating the license for this site. The site was placed on the NRC's Site Decommissioning Management Plan (SDMP) list for sites that exceed the criteria for release for unrestricted use, yet do not represent an immediate threat to the health and safety of the public[11]. The SDMP program, which now no longer exists within the NRC, generally applied to more complex sites that may present unique or difficult decommissioning issues, such as extremely large volumes of contaminated materials.

In mid-1999, Meggitt, LLC acquired Whittaker Corporation. The Whittaker Corporation name and organization remained unchanged as the licensee for the site.

License amendments in 2004, 2005, and 2006 approved the site DCGLs and adopted the original and revised *Erosion and Sediment Pollution Control Plan*[12] approved by the Mercer County (PA) Conservation District (MCCD).

[10] Whittaker Corporation – Metals Alloys Division, #1 Alloy Road, Reynolds Development, Greenville, PA., November 29, 1974, Application to renew USNRC License No. SMA-1018, Docket No. 40-7455
[11] NRC, August 1993, NUREG-1444, *Site Decommissioning Management Plan*
[12] Energy*Solutions*, LLC. May 2006. *Erosion and Sediment Pollution Control Plan for Phase 1 and Phase 2 Activities at the Whittaker Remediation Site.* Document No. 82A9519, Revision 2.

2.3 PREVIOUS DECOMMISSIONING ACTIVITIES

Decontamination activities and radiological surveys conducted from 1974 to 1983 resulted in portions of the original Whittaker property being certified as acceptable for release for unrestricted use. These areas are west of the existing perimeter fence. Contaminated equipment, rubble, and slag removed during these decontamination efforts were disposed of by placing them in the waste and slag storage area along the eastern portion of the Whittaker property (inside the fence). As a result of the plant operations and decontamination efforts, the Whittaker property was divided into two radiologically distinct areas. These two areas, shown in Figure 2-1, are the main manufacturing area of the plant (Greenville Metals property), which was released for unrestricted use, and the licensed and controlled slag and waste storage site. It is within the waste storage site that thorium and uranium bearing waste slag, raw materials, metal scrap, and contaminated production process equipment and building materials were stored. At the request of the NRC, Oak Ridge Associated Universities (ORAU) performed confirmatory radiological surveys of the main manufacturing area and the waste storage site during the summer of 1984. The results of the waste storage site radiological characterization are presented in the ORAU final report[13].

As shown in Figure 2-2, the ORAU characterization divided the waste and slag storage area into four distinct sections based on physical and radiological characteristics. These basic site subdivisions were used for the subsequent characterization and assessment activities described in the following sections of this Decommissioning Plan.

In 1991, Properties Enviro-tech, Inc. retrieved and disposed of over 1,000 drums of material that had collected on the embankments of the slag pile and in the lower floodplain areas[14]. Materials from drums that were unsalvageable or that had broken open during retrieval were repackaged and then surveyed to characterize them as radiological and/or hazardous material[15]. The majority of the drums and materials were determined to be releasable and were shipped off-site for disposal. A small volume of a black material exhibited elevated levels of trichloroethene and low ignitability; it was repackaged into four over-pack drums. A total of approximately 70 repackaged drums, including the four over-packs, remain stored on site as a result of the 1991 drum retrieval operation.

[13] ORAU, July 1988, Document No. 88/G-50, Radiological Characterization of the Waste and Slag Storage Area; Whittaker Metals Corporation Property; Greenville, PA

[14] Properties Enviro-tech, Inc.; September 1991; *Summary Report of Drum Retrieval at the Greenville, PA Site*

[15] Antech Ltd., reissued January 8, 1992, Waste Characterization Project #SWO-090; Greenville Site, Material Analysis; Collected October 29, 1991

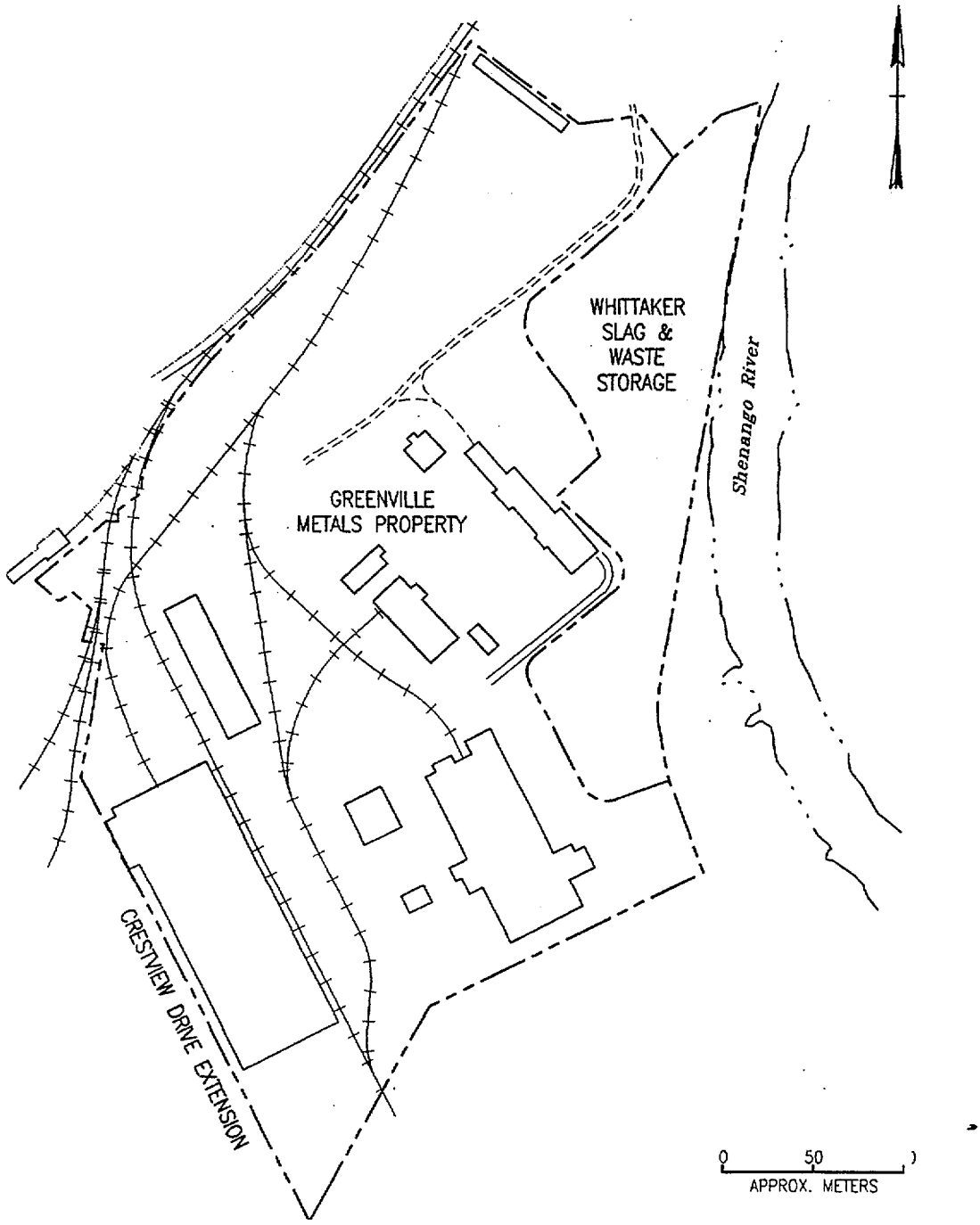

FIGURE 2-1
PROPERTY BOUNDARIES

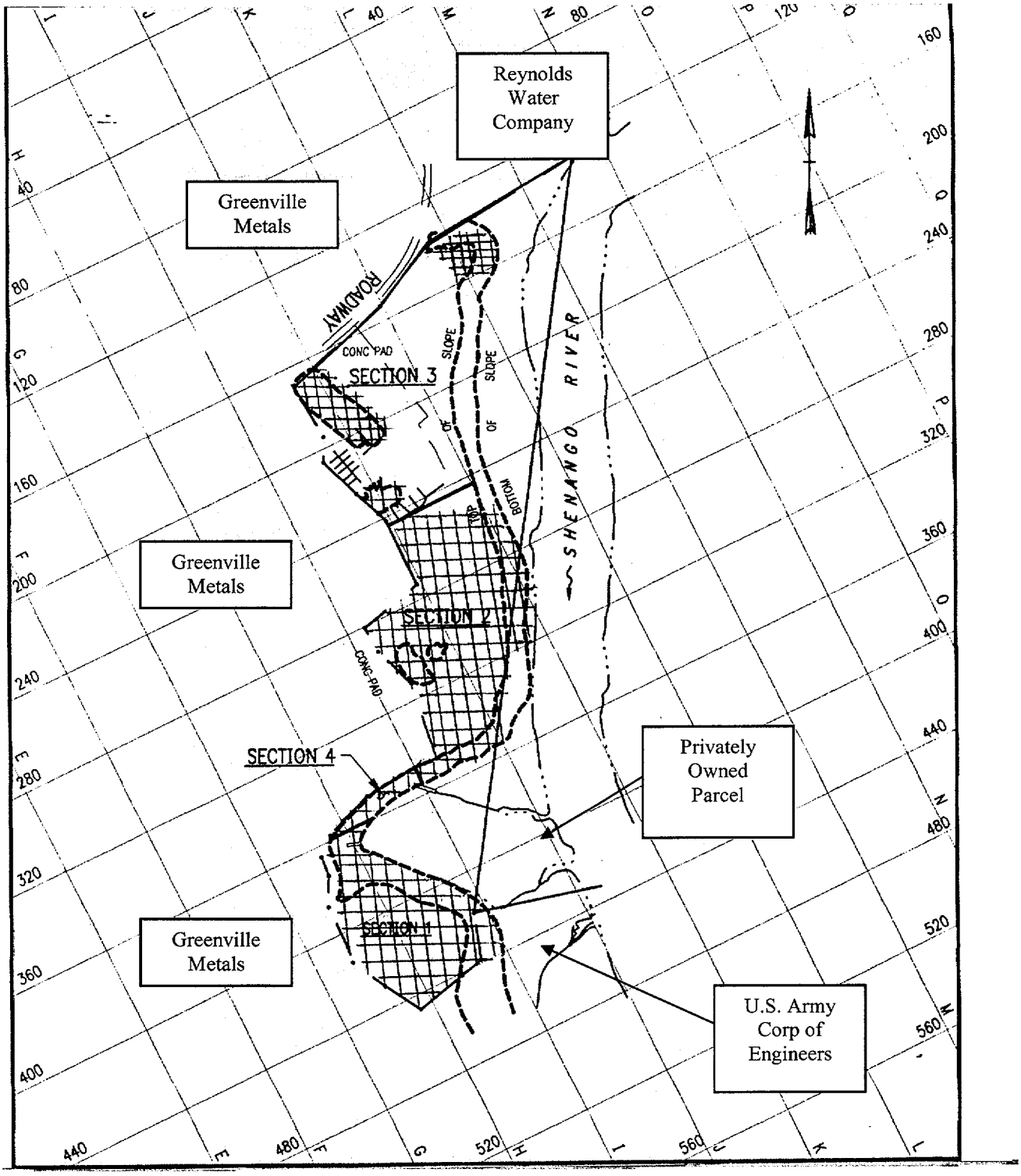

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FIGURE 2-2
WHITTAKER SITE AND ADJOINGING PROPERTY OWNERS

In November of 1999, Scientech remediated the area around a pile of slag that had been discovered in the Shenango River approximately six feet from the west shore near site perimeter fence post #200. The slag was removed and placed inside the radioactive materials area or radiological control area (RCA). Pieces of slag, gravel, and sediment were removed from the bed of the river in response to elevated readings from radiological scans taken above the surface of the water. Since the water level in the river was low, Scientech was able to survey large areas of exposed river bottom adjacent to the western shore after the radioactive materials were removed. This and subsequent radiological surveys have detected no slag or residual contamination in the exposed portions of the river bottom.

From October through December of 2000, Scientech cleared scrap metal in the form of tote bins, drums, process equipment, building steel, corrugated sheet metal, and other metal debris from the site[16]. Metal was collected, itemized, and radiologically surveyed for release to a scrap metal recycling company. The criterion utilized for release was for contamination not to exceed background levels. Metal that did not meet this criterion was segregated and stored on site for future disposition.

The Whittaker site remediation project began in July 2004 with the mobilization of the Scientech (now Energy*Solutions*) project crew. Some of the initial site activities included setting up field office trailers, clearing vegetation from the slag piles, and mechanically screening the large pile of slag in Section 3 to separate the soil from the slag shown in Figure 2-2. Early site operations also involved the removal of several tons of scrap metal and debris that was scattered about the site. Some of the material could not be surveyed sufficiently to free release it as clean waste for disposal or recycling. This material was shipped as LLRW to Radiological Assistance, Consulting, and Engineering, LLC (RACE) in Tennessee. Regulatory Guide 1.86 release limits were used to free-release the scrap metal and debris (see Section 14.1.2).

Much of the surface piles of slag located in Section 2 were relocated to the concrete pad in Section 3 late in 2004. This cleared the way for a detailed characterization into the slag pile in Section 2 to provide better estimates on the slag and soil volumes in Section 2. The project demobilized following the characterization effort in December 2004.

In March 2005, the Energy*Solutions* project crew remobilized to the Whittaker site and began full-scale excavation operations in Section 2. The section was almost completely excavated and the material was fed into a mechanical screener to separate the slag and other debris from the soil and sand mixed in with the slag. This resulted in stockpiles of suspected clean soil (less than the release criteria) and stock piles of slag of various activities.

Most of the waste materials from Section 2 have been excavated and are either stockpiled in Section 3 or have been shipped for disposal at the Energy*Solutions* Clive, Utah LLRW disposal facility. During 2005 approximately 6,000 tons of radiological waste was shipped for disposal. Approximately 4,500 tons of identical material was stockpiled in Section 3 in 2005 for shipment in 2006.

[16] Energy*Solutions*, Inc., January 2001, Document No. 82A9377, *Final Report for the Whittaker Site Metal Cleanup*

Section 3 also contains a large stockpile of soil that was separated from the slag and slag-like materials using a mechanical screen. Soil, along with slag materials that meet the release criteria, will be replaced on site as fill material to establish the final site grade.

2.4 PRIOR ON-SITE BURIALS AND SPILLS

Sections 1 through 4, shown in Figure 2-2, encompass the majority of the site. Waste was placed in areas that had been excavated to form trenches or holes but was not covered with clean material to form an encapsulated burial cell. More recently, waste material was piled directly on the ground surface in specific areas of the site. There is a record of one incident of radioactive materials migrating beyond the site perimeter is described in the following paragraphs.

In 1998, NES, Inc. (NES) (the predecessor company of the Scientech D&D Division) conducted a survey of areas between the site perimeter fence, adjacent to Sections 1 and 2, and the Shenango River. These activities were reported in NES Document No. 82A9139, "Final Report for Removing Migrated Slag Material From Whittaker Corporation's Greenville, PA Site." This report describes the survey that was conducted along the fence to the east of Section 2 and to the east and south of Section 1. During the survey, two pieces of radioactive slag were identified, one of which was just beyond the river bank. These pieces of slag were moved to within the perimeter fence. A section of the river adjacent to Section 2 was scanned because the water level was low and no radioactive materials were identified.

In August 1999, an "island" of radioactive slag was identified in the river. This "island," which was about 5 feet in diameter and about 12 feet east of fence post #198 (3 feet from the river's bank) was identified because the river was much lower than normal. The water in the area is typically 10 to 12 inches deep. The pile consisted of mostly large pieces of slag (20 to 30 pounds) and some small fragments.

In September 1999, the slag "island" was removed from the river bed by hand and the pieces of slag were placed inside the fence through a new gate that was installed to support the removal activities. Several other pieces of radioactive slag were also identified and excavated (by hand) near the river outside the fence between posts #198 and #200. A sediment sample was collected from the below the slag pile in August before it was removed and a second sample was taken after the slag pile was removed. While the results of the sample analysis showed contaminant concentrations slightly above background levels, the concentrations were well below the current release criteria. Additional surveys conducted north and south of the pile indicated no additional radioactive materials outside the fence.

3.0 FACILITY DESCRIPTION

3.1 SITE LOCATION AND DESCRIPTION

The Whittaker site is located in the northeast corner of the Reynolds Industrial Park in northeast Pymatuning Township, approximately 3.5 miles south of the borough of Greenville, Pennsylvania, at approximately 41° 21' 30" north latitude and 80° 24' 00" west longitude[17]. The site is an irregularly shaped parcel of land with a total area of approximately 5.8 acres located between the Greenville Metals Plant and the Shenango River. Figure 3-1 shows the location of the Whittaker Site on an area topographical map.

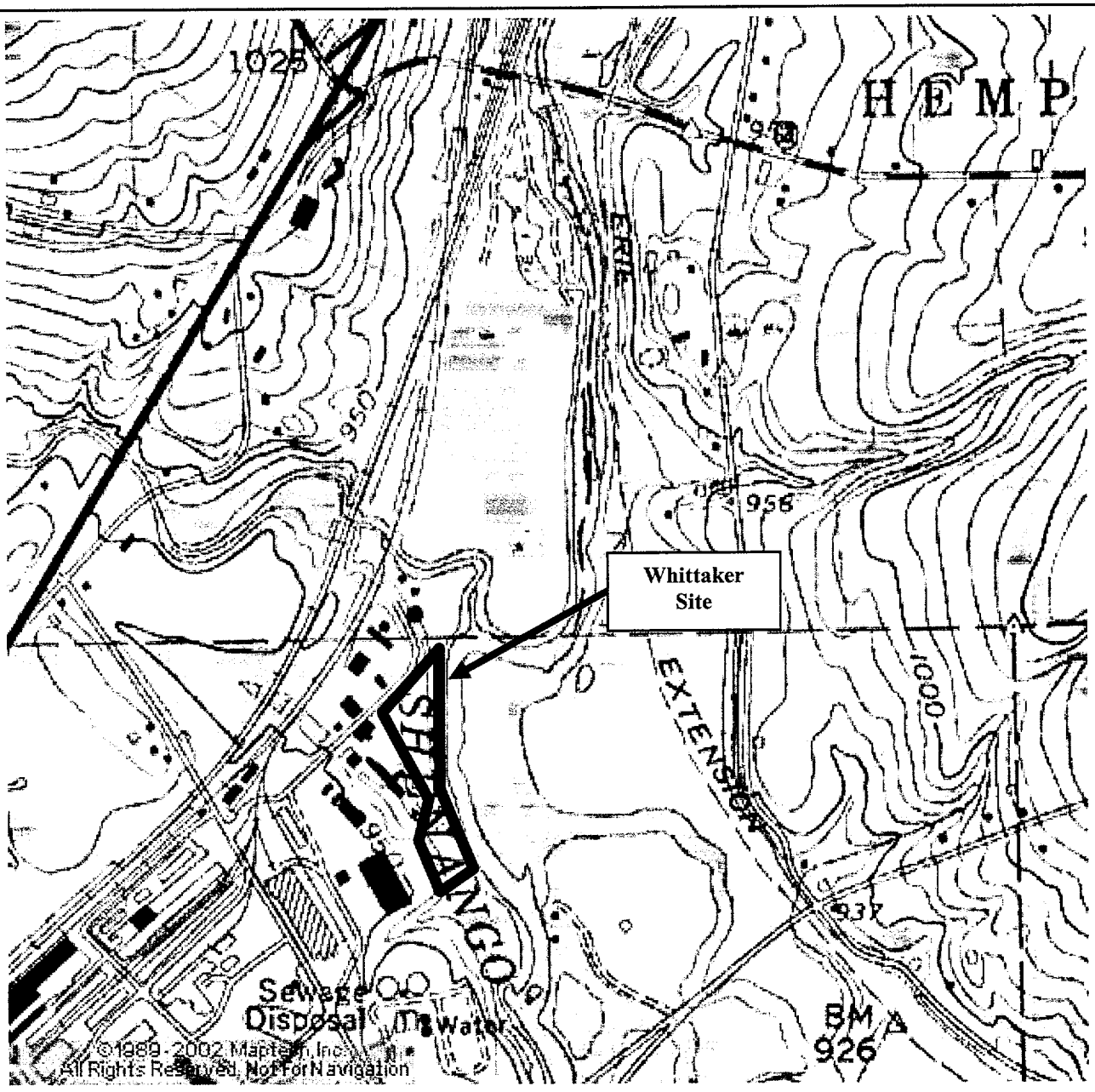
The primary adjoining property owners are shown in Figure 2-2. Greenville Metals surrounds the Whittaker Site on the northwest, west, and south. The Reynolds Water Company borders the site on the north; the COE property adjoins in the southeast; and the Shenango River forms the upper eastern border. The boundary between the Whittaker Site and the narrow, elongated triangular parcel forms the remaining eastern property line. This triangular parcel is a small portion of a privately owned parcel that is located primarily on the east side of the Shenango River. The Mercer County tax office has no records indicating the current owner of this parcel of land.

The Shenango River flows in a north to south direction along the east side of the site, then turns southeast for approximately 5 miles, where it discharges into the Shenango River Reservoir. The Shenango River Reservoir is a man-made lake formed by a dam downstream of the confluence of the Shenango River and Pymatuning Creek.

There are no buildings on the property. Repeated disposal of process slag, building rubble, scrap metal, and general trash during operations and facility decontamination has raised the elevation of the site. The unexcavated surfaces are generally level at an elevation of approximately 945 to 953 feet above mean sea level (msl), or approximately 7 to 9 meters above the adjoining river floodplain. This height reaches a maximum of approximately 10.5 meters in Section 3. Site dimensions range from approximately 259 to 381 meters north-south and 27 to 107 meters east-west. The largest portion of the site (Sections 2 and 3) is divided from a smaller portion to the south (Section 1) by a large, triangular shaped ravine, with the ravine sides meeting at the point of the triangle on the west and widening as they approach the river on the east. Two drainage culverts run under the Greenville Metals property and discharge into two small, separate ponds at the base of the west and north slopes of the ravine, within the boundaries of the Whittaker property. From these ponds, separate streams flow to the east and discharge into the Shenango River.

The following paragraphs described the four sections of the site as delineated by the ORAU characterization. The sections are shown on Figure 2-2 in the previous section.

[17] Department of the Interior; U.S. Geological Survey; 1958, Photorevised 1981; *Sharpsville Quadrangle, Pennsylvania – Mercer Co.*; Reston, VA



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ENERGYSOLUTIONS

FIGURE 3-1

WHITTAKER SITE LOCATION (TOPO MAP)

3.1.1 Section 1

Section 1 is the southern portion of the site. It is bordered by the ravine's southern drainage stream on the north and northeast, by Greenville Metals on the west and south, and by the COE floodplain property on the east.

The Section 1 plateau terminates in steep embankments of up to 33° that drops to the floodplain level in an almost semi-circular line from the northwest to the southeast limits of the section. The area topography drops about 8 vertical meters from the edge of the plateau to the base of the slope.

Section 1 consists primarily of gravelly slag intermingled with numerous small pieces of metal scrap. Occasional large pieces of slag are found on the eastern embankment and toward the southeast portion of Section 1. The area of this section that contains slag is approximately 3,020 square meters (m^2).

Section 1 is sparsely vegetated, with only scattered weeds growing in the majority of the waste material. There are some small trees and a few more weeds growing in the western portion of the section where there is more soil and less slag. The embankment media is primarily soil and contains mature trees and dense undergrowth. There are no structures, fixed equipment, or paved areas in Section 1.

3.1.2 Section 2

Section 2 is the central portion of the site located between Section 3 on the north, Greenville Metals on the west, the ravine on the south, and the floodplain on the east. The base of the eastern slope of the site is the closest to the Shenango River in Section 2, with less than 2 meters of floodplain between the property boundary fence and the edge of the river.

Through November 2005, more than 20,000 tons of slag, slag-like debris, and soil were excavated from Section 2. The previous height of the slag pile, from the original Section 2 plateau to the base the eastern slope, ranged from about 6 meters on the east to 5 meters on the south. There were more topographical irregularities in Section 2 than in Section 1. At one point in the western half of Section 2, the elevation reached a height of more than 10 meters above the floodplain. Maximum slopes were nearly 40° on the southern and eastern slopes.

The extent of vegetation in Section 2 was similar to that in Section 1. The areas that were predominantly slag were devoid of vegetation or contained only sparsely distributed weeds.

3.1.3 Section 3

Section 3, the northernmost section of the waste and slag storage area, is the largest in size at approximately 6,188 m^2. It is bounded by the water company property to the northeast, Greenville Metals to the north and west, Section 2 to the south, and the floodplain to the east. The height of this section varies from 6 to nearly 8 meters from the bottom of the embankment to the plateau, with the steepest slope at approximately 43°.

The eastern half of Section 3 is a large flat plateau that terminates in a steep embankment down to the river floodplain on the east. This area is mostly soil with numerous small pieces of metal scrap on the surface. A few scattered pieces of radioactive slag were identified on the surface and near the surface during a walk-over survey in August 2005. These pieces were removed to clear an area for the clean soil stockpile. An area of the northeast embankment appears to contain more significant volumes of subsurface slag and waste material. Much of the radioactive slag was selectively excavated in April 2005. There are no structures, fixed equipment, or paved areas in the eastern half of Section 3.

The western half of Section 3 formerly contained a of a very large pile of a slag and soil mixture, large three-sided storage bins, rows of full 55-gallon drums, scrap process equipment, and smaller tote bins and drums containing radioactive slag. A large concrete slab that was used to stage and store materials for use in an adjacent processing building covers this area.

The pile of soil and slag formerly on the concrete pad was screened to remove the soil in August 2004. The waste materials from the tote bins and drums were consolidated according to the radioactive concentrations of the materials into the stockpiles in Section 3. The three-sided bins were removed along with a large volume of scrap metal and other debris in 2004. Additional scrap metal will be shipped off site as LLRW during various stages of the remainder of the project.

The concrete pad in Section 3 is currently used to stage the stockpile of LLRW slag. End-dump trailers are backed through the site gate located on the northern side of the Section 3 and loaded from the stockpile. Approximately 70 drums containing non-radiological contaminated soils are also staged on the concrete pad in Section 3.

3.1.4 Section 4

Section 4 consists of a narrow strip of steep embankment connecting Section 1 in the south to the southwest tip of Section 2. The embankment averages about 15 meters wide at the base and 6 meters above the ravine and contains an area of approximately 502 m^2. The north and west borders are contiguous with the Greenville Metals property and its eastern edge is at the bottom of the slope in the ravine. The vegetation is similar in type and density to all the other embankments. There are scattered pieces of slag, metal, and

debris throughout this section but characterization surveys indicate that the material in this section is not radioactive.

3.1.5 Ravine and Floodplain

In addition to the four waste and slag storage sections, there is a large triangular shaped ravine area within the boundaries of the Whittaker property. This area is located between Section 2 to the north, Section 4 to the west, and Section 1 to the south. A barbed-wire fence delineates most of its eastern border. The ravine's maximum dimensions are approximately 61 meters, both east-west and north-south. The principal features of this section are two small discharge ponds, their two west-to-east flowing drainage streams, and an east-west ridge of land that separates the streams and rises above them approximately 6 meters. The vegetation consists of heavy undergrowth in the lower floodplain and more trees of various sizes along the upper elevations. There appears to be slag or other debris located only at the bases of the slopes of the adjoining site sections. There are no structures, paved areas, or fixed equipment in this section, other than the two large concrete culverts that discharge from the Reynolds Industrial Park to the two ponds.

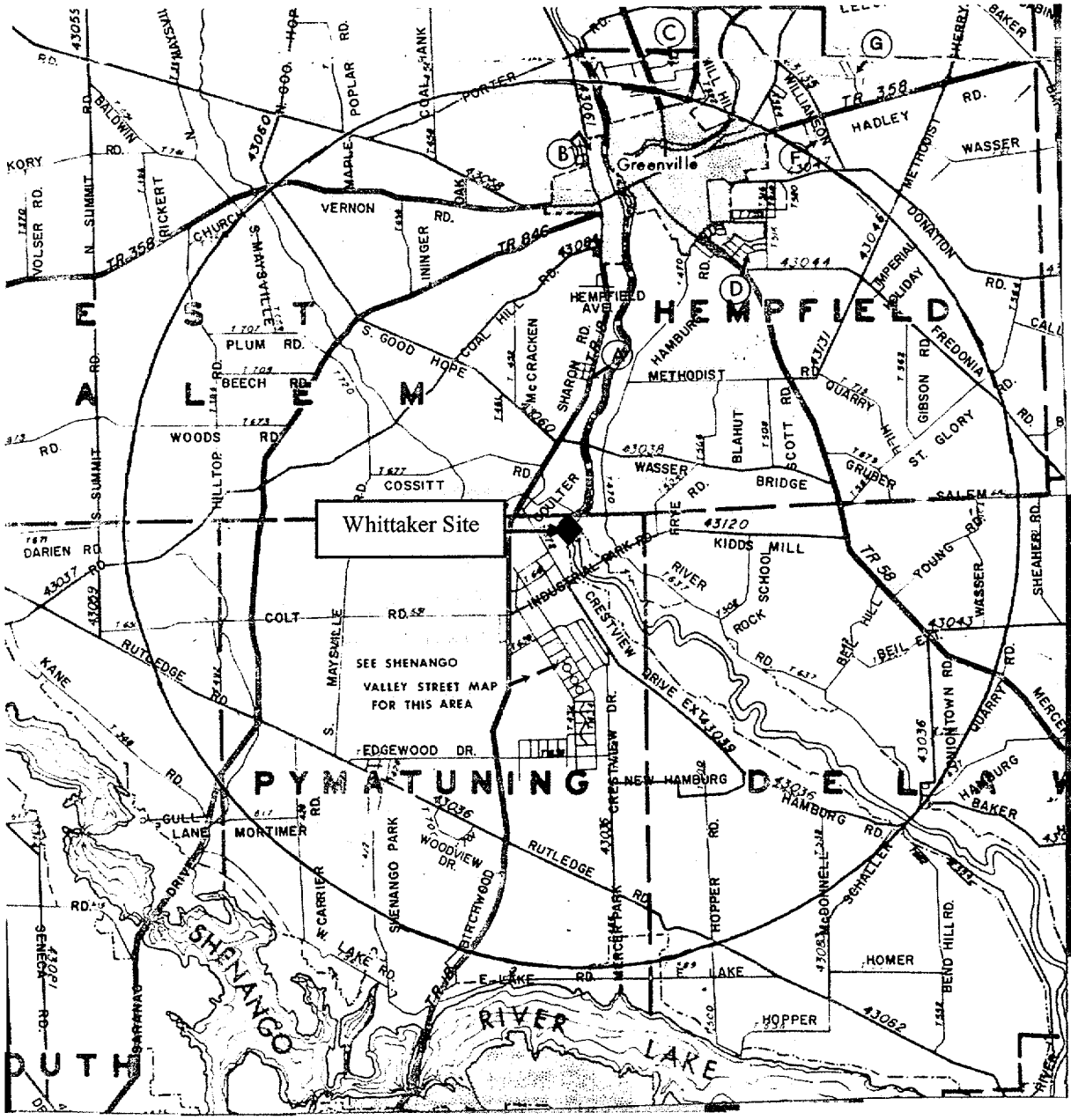
The majority of the river floodplain adjacent to the Whittaker Site is outside the boundaries of the Whittaker property. This floodplain forms a border between the site and the Shenango River to the east that varies in width from less than three meters in the central portion of the site to a maximum of approximately 46 meters in the southeast and at the northern tip. Vegetation in the floodplain is moderate to dense and varies from weeds and grasses to large, mature trees.

As described in Section 2.4, NES removed radioactive slag from the river bed in 1999. This material was placed near the river bank inside the perimeter fence at the base of the Section 2 slag pile. Another small area of radioactive slag, enough to fill one 55-gallon drum, was cleaned up from the area between the creeks.

3.2 POPULATION DISTRIBUTION

The center of the borough of Greenville is approximately 3.5 miles to the north of the site. Figure 3-2 shows the land area within a 4-mile radius of the center of the site including the entire borough of Greenville, most of Pymatuning and Hempfield Townships, half of West Salem Township, and a quarter of Delaware Township. This area is sparsely populated with a combined population of less than 20,000[18]. This would equate to a population density of less than 400 people per square mile within the 4-mile radius. The borough of Greenville has the highest population of the boroughs and townships in the area with more than 6,300 residents. The nearest private residences to the site are approximately 430 meters northeast in Hempfield Township and 460 meters west, 490 meters east, and 1,100 meters south in Pymatuning Township.

[18] Mercer County Census Information, http://www.mcrpc.com/community/2000census.htm



ENERGYSOLUTIONS

FIGURE 3-2
AREA WITHIN A 4-MILE RADIUS OF THE WHITTAKER SITE

The total population of Mercer County experienced its first significant recorded decline (-5.7%) from 1980 to 1990. From 1990 to 2000, this decline continued by an additional 0.6% to 120,293. The population of the borough of Greenville decreased by 5.3% while the populations of the surrounding townships all increased from 0.5% (West Salem) to 4.7% (Hempfield). The median age in the county increased from 36.4 years in 1990 to 39.6 years in 2000[19].

The cities and boroughs of Wheatland, Sharon, Farrell, Sharpsville, and Hermitage comprise approximately 76% of the minority ("non one-race white") population of Mercer County. The closest predominantly minority community to the site is more than 7 miles to the southeast. The minority population within the 4-mile radius of the Whittaker Site is about 410, accounting for approximately 5% of the minority population of Mercer County[20].

3.3 CURRENT AND FUTURE LAND USE

The Mercer County Regional Planning Commission (MCRPC)[21] has established the Northwest Planning Region, which includes the Reynolds Industrial Park and the Whittaker Site. The MCRPC has zoned the area for industrial development. However, current land use and zoning restrictions around the site vary. In Pymatuning, the closest non-industrial zoned area is approximately 460 meters to the south[22]. In Hempfield Township, located northeast of the site, the closest properties are zoned R-1 Rural-Residential[23]. The townships of West Salem (northwest of the site) and Delaware Township (southeast of the site) have no zoning process or requirements. The intervening land between the site and Delaware Township is floodplain that is wooded close to the river and a combination of wooded and agricultural land further from the river.

The Mercer County Comprehensive Land Use Plan intends to keep the Reynolds Industrial Park zoned for industrial development and has designated adjoining areas as "Growth Target Areas". These areas extend into West Salem Township to the north, across Route 18 to the west, and across the Shenango River along Kidd's Mill Road to the east. A Growth Target Area is defined as "new or expanded housing, commercial, or industrial development." The area to the south of the industrial park is designated as "Preserve Urban/Suburban" which restricts development to preserve existing uses and features. These areas in and around the present industrial park are designated as "New Development Areas" based on the currently existing water and sanitary systems and the potential to expand these systems into adjoining land. No areas around the site are within the MCRPC's designated "Agricultural Security Area."

[19] U.S. Census Bureau, http://quickfacts.census.gov/qfd/states/42/42085.html
[20] Mercer County Census Information, http://www.mcrpc.com/community/2000census.htm
[21] MCRPC Web Site, www.mcrpc.com
[22] MCRPC, Revised December 1982, *Pymatuning Township Base Map*
[23] MCRPC, Revised December 1982, *Hempfield Township Base Map*

3.4 METEOROLOGY AND CLIMATOLOGY

The climate in the area of the site is moist and temperate with warm summers and long cold winters. Prevailing air masses bring weather changes every few days and a plentiful supply of precipitation that is normally well distributed throughout the year and averages approximately 98 centimeters (38.55 inches) per year in Greenville[24]. Historically, February and June are the months with the least and greatest amounts of precipitation respectively. Extended severe droughts are rare in this area. Total annual precipitation has ranged from 63.5 to 129.5 centimeters per year (25 to 51 inches per year). One year in ten will have less than 81.3 cm (32 inches) or greater than 123.7 cm (48.7 inches) of precipitation. Precipitation intensity has been measured up to 4.95 centimeters per hour (cm/hr) for brief, intense summer rainfalls, with the probability of this occurring once every 25 years. The probability of a 3.81 cm/hr rainfall is anticipated once every 5 years. For less intense, longer duration precipitation that is more common the rest of the year, 8.38 cm/24 hours can be expected once in every 5 years and 5.59 cm/24 hours once per year[25].

The mean annual temperature for the area of the site is approximately 50°F. Average monthly temperatures range from 29°F in January to 72°F in July. On average, 5 days per year are 0°F or colder while 21 days per year are 90°F or greater. Recorded extreme temperatures range from -27°F to 104°F. The growing season, defined as the last 32°F-day in spring to the first 32°F-day in the fall, for the western part of Mercer County normally extends from mid-May through September, or approximately 134 days. In the river valleys of western Mercer County the growing season is somewhat shorter and has ranged from 110 to 157 days[26]. National Weather Service[27] and Water Information Center[28] data indicate an annual evapotranspiration rate of 0.635 meters per year (25 inches per year) for Mercer County.

National Climatic Data Center (NCDC)[29] information from the Youngstown-Warren, Ohio Airport (approximately 18 miles southwest of the Site) indicates that the prevailing wind direction is from the west-southwest at an annual average speed of 4.5 meters per second (10 miles per hour). The annual average relative humidity ranges from 83% in the mornings to 61% in the afternoons.

For air quality standards and monitoring requirements, the site is located in the Shenango Valley Non-Air Basin as defined by the Pennsylvania Department of Environmental Protection (PADEP). The PADEP monitors this basin at an air sampling station located in the city of Farrell (station No. 606) in southern Mercer County, located approximately 11 miles from the site. The closest air basin to the site is the Upper Beaver Valley Air Basin, which is monitored from a station in New Castle (station No. B21), approximately 25 miles south of the site. The

[24] NWS, http://205.156.54.206/er/pit/frameset.htm
[25] Department of Agriculture (USDA), Revised September 1972, *Soil Survey of Mercer County, PA*
[26] Department of Agriculture (USDA), Revised September 1972, *Soil Survey of Mercer County, PA*
[27] Department of Commerce, June 1982, *Evaporation Atlas of the Contiguous 48 United States*, National Oceanic and Atmospheric Administration, National Weather Service, NOAA Technical Report NWS 33
[28] Geraghty, J. J., et. al., 1973, *Water Atlas of the United States*, Water Information Center, Port Washington, NY
[29] National Climatic Data Center (NCDC), http://ncdc.noaa.gov/

most current air quality report available from PADEP[30] indicated that in 1999 the Mercer County station reported 0 days in the Unhealthful, Very Unhealthful, or Hazardous Pollutant Standards Index (PSI) categories. Of 287 reporting days, 191 were reported as Good and 96 were reported as Moderate PSI categories.

Table 3-1 presents NCDC data for the history of extreme weather events for Mercer County from January 1, 1950 to September 30, 2001.

TABLE 3-1
MERCER COUNTY, PENNSYLVANIA EXTREME WEATHER EVENTS[31]

Type of Event	Total No. of Events	Comments
Tornado	14	3 tornadoes of F4 or greater magnitude (all on 5/31/85)
Flood Events	24	Mostly minor, nearest affected area was Greenville
Hail Events	35	13 events with greater than 1-inch diameter hail size
Lightning	3	Property damage of approximately $13K
Precipitation	2	
Snow and Ice	23	Property damage of approximately $60.8M
Temperature	1	1/14-1/21/94, Extreme cold Arctic air mass, 20-40°F below normal
Thunderstorms and High Winds	117	More than 90% from T-storm winds. Only 16 events contain any detailed descriptions and magnitudes

In the past three years, the Shenango River has flooded on at least one occasion. The river reached a level of about 9 feet above normal flow levels at the Transfer, PA monitoring station during a flood in July 2003. In September 2004, heavy rains from Tropical Storm Ivan caused regional flooding, the river reached a level of about 6 feet above the typical flow level. In January 2005, heavy snow melt and rain contributed to the river reaching a level of more than 4 feet above normal flow level.

3.5 GEOLOGY AND SEISMOLOGY

Glaciers covered all of Mercer County at least twice. The land surface of the county consists of a maturely dissected plateau covered almost entirely by the glacial deposits of the Kent ice sheet of the Wisconsin Stage[32]. County land surface elevations range from 1,620 feet to 822 feet above msl. These elevations are the lowest in the southeast portion of the county and are the highest toward the east and northeast. The glacial deposits range in thickness from 0 to 122 meters and are thickest in the deep valleys.

[30] PADEP, *1999 Ambient Air Quality Monitoring Report,* Bureau of Air Quality
[31] NCDC, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
[32] Schiner & Kimmel (1976); *Geology and Ground Water Resources of Northern Mercer County, PA*; Water Resources Report #33; Commonwealth of PA; Dept. of Environmental Resources; Bureau of Topographic and Geologic Survey

The bedrock consists of rocks of Devonian, Mississippian, and Pennsylvanian age. Devonian age rock is not exposed in the area but is present beneath the glacial deposits in deep bedrock valleys. Mississippian rock is found along valley sides and some valley bottoms while Pennsylvanian rock generally underlies the uplands. Pennsylvanian and Mississippian rocks are composed mostly of alternating units of shale and sandstone with the Pennsylvanian being generally the more sandy of the two types.

The specific area of the site was covered by glaciers five to seven times and consists of multiple till deposits from the fluctuating front end of a southeast expansion of the Grand River sub-lobe of the major Erie ice lobe. These are classified as Kent till of the Kent Unit end moraine, Carey Sub-Stage, Wisconsin Stage deposits[33]. These stratified drift deposits range in depth from over fifty feet to greater than one hundred feet from the southern portion of the site toward the north (Site Section 1 toward Section 3). Elevations above msl, disregarding discrete slag and soil piles, range from approximately 920 feet at the Shenango River channel to approximately 950 feet in the southwest portion of the site. The cross section of the glacial deposits from the surface to bedrock is clay, till, sand and gravel interspersed with clay, and a sand and gravel mixture. The underlying bedrock consists of Orangeville Shale of the Cuyahoga Group of the Mississippian System. This area is not underlain by carbonate bedrock and is not characterized by Karst terrain or topography[34].

The most active seismic area of Pennsylvania is the Lancaster seismic zone of southeast Pennsylvania[35]. The greatest frequency and the largest magnitude earthquakes occur in this zone. The second most seismically active part of Pennsylvania is from the city of Erie southward along the Ohio border, north and west of the site. This area may experience intensity VI earthquake effects from earthquakes that have epicenters in this western part of the St. Lawrence seismic zone. The largest earthquake in the history of Pennsylvania occurred on September 25, 1998 and registered a 5.2 on the Richter Scale. The epicenter was near Jamestown, or approximately 10 miles north of the site. The most significant effect of this quake was the effect on the underlying hydrogeology of a specific area between Jamestown and Greenville. The earthquake affected the hydraulic conductivity of the underlying bedrock by apparently opening up fissures. This served to rapidly drain groundwater from an elevated ridge of land, where well water levels dropped by as much as 75 feet. This increased hydraulic conductivity also increased groundwater levels in wells in valleys adjacent to this ridge by as much as 62 feet. The long-term effects of the changes resulting from this earthquake are continuing to be investigated by the Pennsylvania Geological Survey[36] and U.S Geological Survey (USGS).

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[33] Shepps, V.C., et. al., 1959, *Glacial Geology of Northwest Pennsylvania*, Pennsylvania Geological Survey, 4th Ser., Bulletin G 32, 59 p.

[34] Kochanov, W.E., 1999, *Sinkholes in Pennsylvania*, Pennsylvania Geological Survey, 4th Ser., Educational Series 11, 33p.

[35] Scharnberger, C.K., 1989, *Earthquake Hazard in Pennsylvania*, Pennsylvania Geological Surveys, 4th Ser., Educational Series 10, 14p.

[36] Commonwealth of Pennsylvania, Department of Conservation and Natural Resources (DCNR), Hydrologic Effects of the Pymatuning Earthquake of September 25, 1998, in Northwestern Pennsylvania

The characteristics of the subsurface contaminated zones (CZ) vary at the site by section. The CZs in Sections 3 and 4 will be composed primarily of soil containing small volumes of pieces of slag or other process waste. The CZs in these sections will have physical and hydrological properties that are similar to the soils comprising the saturated and unsaturated zones. The CZs in Sections 1 and 2 are considerably different than their respective unsaturated and saturated zones. These areas predominantly consist of slag, other process wastes, and sand, mixed with a small amount of soil. Particle sizes range from large pieces of slag in excess of 0.5 cubic feet to various cobble sizes to sand. Based on these physical characteristics, it is estimated that these CZs would exhibit a hydraulic conductivity equal to, or greater than, the underlying unsaturated and saturated zones. The value selected for evaluation purposes was 200 meters per year. The pH of the waste in Sections 1 and 2 is greater than that of the background soils and ranges from 7.5 for the green, glassy slag to 11.0 for the large slag slabs and some drums of granular process waste. The gray granular slag that makes up the majority of the volumes of Section 1 and the northern portion of Section 2 exhibits a pH of 8.6. On-site density measurements were performed on individual pieces of slag and excavated slag/soil mixtures to determine a contaminated zone density. These values were greater than typical soil densities and were as high as 1.9 grams per cubic centimeter.

3.6 SURFACE WATER HYDROLOGY

The only surface water within the Whittaker boundaries is contained in two small ponds at the outfalls of the underground drainage culverts in the ravine area, and the two small streams that drain from these ponds to the river to the east. The streams are generally less than one meter wide and less than 0.3 meters deep. In addition to these ponds and streams, the floodplain area from the base of the Section 3 embankment to the eastern perimeter fence usually contains some standing water. This water trickles southward within the property and drains to the Shenango River by way of a tiny stream that exits the property at the southeast corner of Section 3.

An average annual surface water runoff rate for the area of the site is 0.48 meters (19 inches)[37]. Study of topographic and geologic survey maps produced an estimate of the site watershed at approximately 75,000 square meters[38]. According to the Mercer County Cooperative Extension, the only farm known to be utilizing irrigation to grow consumables in Mercer County is McClosky Farms near Greenville. According to R. McClosky[39], of McClosky Farms, his vegetable crops are irrigated six to eight times per year with approximately one inch of water per application. This would amount to a maximum annual irrigation rate of 0.2 meters per year, applied from overhead sprinklers.

A USGS flow gauging station (no. 03102850) is located in the Shenango River approximately 0.5 miles downstream from the site. Data from this station, and other USGS records at Transfer,

[37] Department of the Interior; U.S. Geological Survey; 1997; Ground Water Atlas of the United States; Segment 11; Hydrologic Investigations Atlas 730-L, Reston, VA

[38] Schiner & Kimmel, 1976, *Geology and Ground Water Resources of Northern Mercer County, PA,* Water Resources Report #33, Commonwealth of PA, Dept. of Environmental Resources, Bureau of Topographic and Geologic Survey

[39] R. McClosky, August 21, 2000, Telephone conversation with R. Racino (Energy*Solutions*)

Pennsylvania, were evaluated for flood frequency, mean flow, and low flow. These evaluations determined the high water marks and flows associated with the 10-year and 100-year floods and were summarized in a 1975 letter to the NRC[40]. The results are tabulated in Table 3-2. The 10-year flood flow rate was exceeded in July 2003 when the Shenango flow rate was measured at 6,580 cubic feet per second at the Transfer, PA station. Following Tropical Storm Ivan in September 2004, the flow rate was measured at 4,390 cubic feet per second.

TABLE 3-2
10 AND 100-YEAR FLOOD DATA

Return Interval (year)	Flow (cubic feet per second)	Elevation [a] (feet above Mean Sea Level)
10	6,350	927.5
100	12,200	943.5

Note:
[a] The elevation of the site plateau is about 945 feet above msl sloping gently to the west to about 950 feet on the Greenville Metals property.

Surface water from the Big Run Creek or, in a drought situation, the Shenango River is the source of all water for the Reynolds Water Company. The intake from the Shenango River is located at the Reynolds Water Plant on the northern border of, and upstream from, the Whittaker site. The Reynolds Industrial Park wells have not been used as a source of water for 30 years and all are either abandoned or awaiting proper capping and shutdown. Most communities in the Shenango River Reservoir area, and continuing south, are supplied by water from the reservoir, or from the river downstream from the dam[41].

3.7 GROUNDWATER HYDROLOGY

In the glaciated plateau terrain of Mercer County, there is a complex groundwater flow system with precipitation generally recharging the system in upland areas and discharging into streams that drain the areas[42,43]. Some recharge from precipitation moves downward and laterally, and is discharged from the sandstones through the glacial drift into smaller streams. The remainder moves downward to deeper sandstones and then moves laterally and upward to discharge in the major stream valleys.

Small to moderate supplies of groundwater collect throughout the area with the principal aquifers located in the deeper, thick sandstone formations or the unconsolidated sediments of the glacial

[40] Whittaker Steel Strip; December 23, 1975; Letter from Thomas J. Collins, Manufacturing Manager, to Kitty J. Dragonette, Materials Branch, USNRC; *RE: SMA-1018 and your letter of November 11, 1975*
[41] NES, Inc.; January 1999; Telephone Conversations with Richard Dykes, Supervisor, Reynolds Water Company
[42] Schiner & Kimmel (1976); *Geology and Ground Water Resources of Northern Mercer County, PA*; Water Resources Report #33; Commonwealth of PA; Dept. of Environmental Resources; Bureau of Topographic and Geologic Survey
[43] Fleeger, G.M., 1999, *The Geology of Pennsylvania Groundwater*, (3rd Ed.), Pennsylvania Geological Survey, 4th Ser., Educational Series 3, 34 p.

outwash deposits[44]. The outwash supplies are sufficient for domestic or livestock use but insufficient for industrial and municipal uses. Although the high permeability and transmissibility of glacial outwash deposits can yield large amounts of groundwater, they are largely undeveloped as a source. This can be attributed to the limited area covered by these deposits that restricts use under heavy drawdown and the abundance of available surface water. The wells on the Reynolds Industrial Park property provide examples of the limitations of groundwater use in the area. Five of these wells were installed in the 1940s and exhibited significant yields over a 22 to 27-hour pumping test period. However, since the wells were installed, water levels in nearby wells have declined and well yields have decreased.

In April of 2000, ten new monitoring wells were installed around the perimeter of the site to monitor groundwater in up and down gradient locations. These monitoring wells were installed in accordance with Pennsylvania regulations and Condition 14 of NRC License SMA-1018[45]. The wells are single-screened with a two-inch inner-diameter PVC casing. The installation borehole is filled with successive layers of sand pack, bentonite, and a bentonite/cement slurry. Each monitoring well has a cement curb box and a protective casing above ground.

Data from these wells was collected during their installation in April 2000, in May of 2000, and in April, June, September, and November of 2001. Locations of these monitoring wells are indicated on a site map in Figure 3-3. Monitoring well and groundwater data are summarized in Tables 3-3 and 3-4.

The dominant groundwater flow direction is eastward toward the Shenango River and ranges from 0.026 vertical feet per horizontal foot in site Section 4 to 0.053 vertical per horizontal foot in Section 1. There are, at most, 75 meters in Sections 1 and 2, 114 meters in Section 3, and 20 meters in Section 4 that run parallel to the dominant direction of the groundwater flow.

Slug tests were performed on six of the monitoring wells in June of 2000[46]. Monitoring wells #2, #4, #5, #6, #8, and #10 were selected based on their locations and elevations in the waste area, their depths to bottom, types of slag and soil penetrated, and the anticipated soil horizons represented by their screened sections. Based on the soil profiles in the area of the site, the screened sections of these wells are primarily located in the clay soil horizon. A portion of the bottom of well #5 and, possibly, of wells #4, #6, and #10 penetrate the till beneath the clay horizon.

[44] Schiner & Kimmel (1976); *Geology and Ground Water Resources of Northern Mercer County, PA*; Water Resources Report #33; Commonwealth of PA; Dept. of Environmental Resources; Bureau of Topographic and Geologic Survey

[45] NES Inc.; October 1999; Document No. 82A9103, Rev. 2: *Groundwater Monitoring Plan, Whittaker Corporation, Greenville, PA*

[46] Scientech, January 2002, Interoffice Correspondence, *Whittaker Site, Transfer, PA, Hydraulic Conductivity*

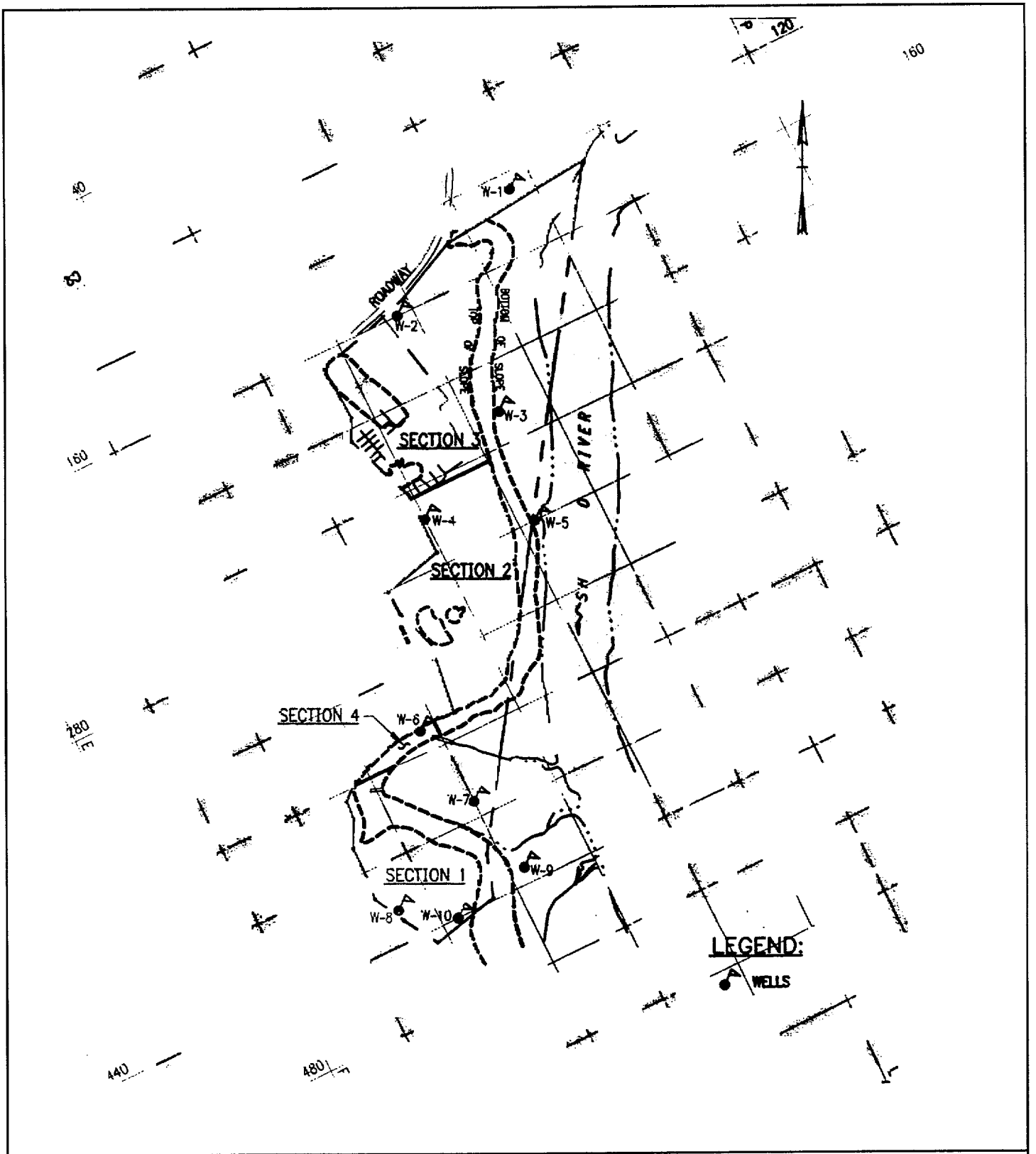


FIGURE 3-3
SITE GROUNDWATER MONITORING WELLS

TABLE 3-3
SITE MONITORING WELL AND GROUNDWATER DATA

Well #	Northing	Easting	Depth to bottom of well (ft)[a]	Length of Screen (ft)	Avg. Depth to Water (ft)[a]	GW Avg Elev (ft above MSL)	Avg pH
1	5096.5834	5146.9575	16.58	10	3.65	920.68	6.7
2	4900.5207	4943.4478	25.36	15	9.12	937.63	7.1
3	4721.3423	5108.5333	14.52	10	-0.36	925.54	6.7
4	4586.4167	4987.1860	30.10	15	14.47	931.60	7.3
5	4551.1128	5161.3390	20.55	15	5.29	920.33	7.3
6	4225.2667	4982.6127	30.10	15	18.67	927.79	7.1
7	4135.9865	5015.9360	12.88	10	2.75	924.15	7.0
8	3929.6480	4956.1256	26.56	15	17.88	935.61	6.4
9	4001.1357	5153.1711	13.92	10	-1.22	924.09	7.2
10	3931.4431	5063.2740	30.53	15	19.68	929.68	6.7

[a] - below ground level surface at well location

TABLE 3-4
SATURATED ZONE GROUNDWATER HYDRAULIC GRADIENTS

Well # to Well #	Site Section Represented by MWs	DTW Vertical Drop between wells (ft)	Direction of GW Vertical Drop	Horiz Distance Between MWs (ft)	Vert. ft / Horiz ft	Avg Ratio / Site Sec. #
2 to 1	3	16.95	NE	275	0.062	
2 to 3	3	12.09	SE	225	0.054	0.049 / Sec 3
4 to 3	3	6.06	NE	200	0.030	
4 to 5	2	11.27	E	175	0.064	0.042 / Sec 2
6 to 5	2	7.46	NNE	400	0.019	
6 to 7	4	3.64	SE	140	0.026	0.026 / Sec 4
8 to 7	1	11.46	NE	225	0.051	
8 to 9	1	11.52	ENE	200	0.058	
8 to 10	1	5.93	E	100	0.059	0.053 / Sec 1
10 to 9	1	5.59	NE	130	0.043	

Hydraulic conductivities (K) calculated from the test data for each well location are summarized in Table 3-5. Four of the wells indicated K values that were consistent with values expected based on USGS conductivity data[47]. The K results for wells #6 and #8 of 12,304 and 2,323 meters per year (m/yr) respectively, were far greater than values anticipated based on data for the types of soil encountered. The apparent low recovery rate of monitoring well #6 from field data and observations of sampling draw down and draw down rates seems to indicate that the value of 12,304 m/yr does not represent the aquifer conditions around the well. The conductivity of well #8 also seemed excessive, although field data and observations indicated a much better recovery than at well #6. For site dose modeling, a hydraulic conductivity value of 100m/yr was used for wells #6 and #8. This is the upper range value expected for the types of media identified around these wells based on the USGS conductivity data.

TABLE 3-5
GOUNDWATER HYDRAULIC CONDUCTIVITIES

Well # (by increasing bottom elev.)	Ground Surface Elevation	Bottom of Well Elevation	K Calculated (m/yr)	K Estimated (m/yr)	Zones represented by calculated & estimated Ks
5	925.62	905.07	60	-	Section 2 SZ
4	946.07	915.97	112	-	Section 2 UZ
6	946.46	916.36	12304	100	Section 4 UZ & SZ
10	949.36	918.83	47	-	-
2	946.75	921.39	28	-	Section 3 UZ & SZ
8	953.49	926.93	2323	100	-
Average 8 & 10	951.42	922.88	-	74	Section 1 UZ & SZ

3.8 NATURAL RESOURCES

According to the Pennsylvania Department of Conservation and Natural Resources[48] and the USGS[49] there is one nonfuel-mineral production facility, a sand and gravel facility, located within six miles of the site. This facility is located approximately 2 miles northwest of the Whittaker site, outside the main bituminous coal field that stretches from southwest to the west-central portion of Pennsylvania. There are scattered deep and shallow oil and gas fields in Mercer County, although none are active in the immediate vicinity of the site.

In May 2004, the Pennsylvania Historical and Museum Bureau of Historic Preservation reviewed the project in accordance with Section 106 of the National Historic Preservation Act of 1966, as amended in 1980 and 1992 Commission. The Bureau found that there was a high probability that prehistoric and historic archeological resources are located in the project area but that the project activity would have no effect on such resources[50].

[47] Heath, R. C., 1987, *Basic Ground Water Hydrology*, USGS Water- Supply Paper 2220
[48] DCNR, http://www.dcnr.state.pa.us
[49] USGS, http://minerals.usgs.gov/minerals/pubs/state/pa.html
[50] Pennsylvania Historical and Museum Bureau of Historic Preservation; May 17, 2004; Letter from Kurt Carr, Chief of the Division of Archeology and Protection, to Richard Moss, Energy*Solutions*

In June 2004, Energy*Solutions* received acceptance of its Erosion and Sediment Pollution Control Plan from the Mercer Country Conservation District[51,52]. Prior to this approval, Energy*Solutions* conducted a wetland delineation of the project site.

In September 2004, the PADEP issued a Water Obstruction and Encroachment Permit waiver for project work conducted within the defined floodway[53]. The waiver was issued based on the conditions provided in the site Restoration Plan, prepared by Energy*Solutions* and submitted to the PADEP[54].

3.9 ECOLOGY AND ENDANGERED SPECIES

The flora and fauna in the immediate vicinity of the site are typical of a low, narrow, wet environment bordering a small river in the northeast United States. Table 3-6 shows the number of each endangered or threatened species in Pennsylvania and the vicinity of the site and provides explanations, as necessary[55].

In reference to a 1999 NES proposal to conduct decontamination activities on COE property near the interface of Section 1 and the floodplain, the U.S. Fish and Wildlife Service concluded that, "Except for occasional transient species, no federally listed or proposed threatened or endangered species under our jurisdiction are known to occur within the project impact area." [56] A review of the same area and activities by the Pennsylvania Game Commission also concluded that "no state listed endangered or threatened species of birds or mammals are known to occur within the proposed project area" [57]. In May 2004, the Pennsylvania Fish and Boat Commission conducted a Species Impact Review and identified "rare or protected fish species are known from the vicinity of the project area." The Commission stated that as long as best management practices were instituted to control erosion and sediment, site activities would have no significant impact on the protected species [58].

[51] Mercer County Conservation District; June 22, 2004; Letter from Robert McDonald, Technician, to Kevin Taylor, Energy*Solutions*.
[52] Scientech, LLC; June 2004; *Erosion and Sediment Pollution Control Plan for Phase 1 and Phase 2 Activities at the Whittaker Remediation Site, EnergySolutions* Document No. 82A9519
[53] Pennsylvania Department of Environmental Protection; September 2004; Letter from Ricardo Gibson, Reginao Manager of the Water Management Division, to Eric Lardiere, Whittaker Corporation.
[54] Scientech, LLC; May 2004; *Restoration Plan*, Energy*Solutions* Document No. 82A9524
[55] DCNR, http://www.dcnr.state.pa.us/wrcf
[56] Department of the Interior; Fish and Wildlife Service; August 5, 1999; Letter from David Densmore, Supervisor, to Roy Racino, NES, Inc.
[57] Pennsylvania Game Commission; August 26, 1999; Letter from Anthony S. Ross, Wildlife Impact Review Coordinator, to Roy Racino, NES, Inc.
[58] Pennsylvania Fish and Boat Commission; May 4, 2004; Letter from Christopher Urban, Chief of the Natural Diversity Section, to Kevin Taylor, Scientech, Inc.

TABLE 3-6
ENDANGERED OR THREATENED FLORA AND FAUNA IN PENNSYLVANIA

Classification	No. Listed in PA	No. in NW Mercer Co.	Category	Comments
Fish, Reptiles, and Amphibians	29	1	Endangered	Eastern Massasauga snake
Birds and Mammals	20	1	Threatened	Upland Sandpiper
Invertebrates	2	0	N/A	
Plants	18	0	N/A	

4.0 RADIOLOGICAL STATUS OF THE FACILITY

4.1 CONTAMINATED STRUCTURES, SYSTEMS, AND EQUIPMENT

There are no buildings or systems located on the Whittaker Site. There is a concrete pad on the eastern portion of Section 3. A smaller concrete pad on the west side of Section 2 was removed during 2005 to accommodate excavation in that area. Scrap metal, in various forms, was stored in several three-sided bins along the southern border of Section 3. The three rows of metal bins were removed in 2004 to allow better access to the area for staging excavated slag materials. The steel walls of the bins were surveyed and released for recycle. Additional volumes of scrap metal will require disposal as LLRW.

4.2 SURFACE AND SUBSURFACE SOIL CONTAMINATION

Previous estimates of the extent of surface and subsurface contamination was developed using characterization data collected from ORAU and Scientech and from historical and operational records. A complete discussion of the characterization activities, sampling methodologies, and analytical protocols are contained in the ORAU[59] and Scientech[60] final reports. Scientech also conducted additional characterization in the fall of 2004. This characterization was performed for waste volume and cost estimating purposes.

4.2.1 Section 1

Initial ORAU and Scientech original characterization estimates of the volume of the slag pile in Section 1 ranged from approximately 7,800 to 8,200 cubic meters (m^3) (15,600 to 16,400 tons). Thorium and uranium concentrations were determined to be low and relatively homogenous in surface and subsurface sampling. The mean thorium-232 subsurface concentrations are reported as 1.2 ± 0.7 pCi/g and 1.5 ± 1.3 pCi/g in the Scientech and ORAU characterizations respectively.

The site characterization activities in November and December 2004 involved systematically trenching through the slag pile according to a grid pattern. This characterization showed that the Section 1 slag pile is approximately 5,300 m^3 (slag, sand, soil, etc.). Bulk surveys of representative material from each grid indicated that only about 320 m^3 (640 tons) (6% of the total volume) would need to be excavated and disposed of as LLRW. These areas will be targeted during the remediation of Section 1.

Figure 4-1 shows the results of an August 2004 walk-over survey of Section 1 conducted by Scientech using a global positioning satellite (GPS) position and gamma radiation logging instrument. The figure shows that the majority of the site is at background levels, less than 15,000 counts per minute (cpm). A few distinct areas of elevated

[59] ORAU, July 1988, Document No. 88/G-50, Radiological Characterization of the Waste and Slag Storage Area; Whittaker Metals Corporation Property; Greenville, PA

[60] Scientech, Inc., August 2000, Document No. 82A9354, Rev. 0, *Characterization Report for the Whittaker Corporation Site*, Greenville, PA

radioactivity are identified on the figure as areas with gamma count rates in excess of 25,000 cpm indicating the presence of surface or near surface radioactive slag materials. These areas, as well as those identified during the 2004 trenching activities, will be targeted during remediation of Section 1 in 2006.

Due to the unexpected increases in the radioactive material volume from Section 2 as described in the following section, the Section 1 radioactive slag estimate was increased to 1,000 tons.

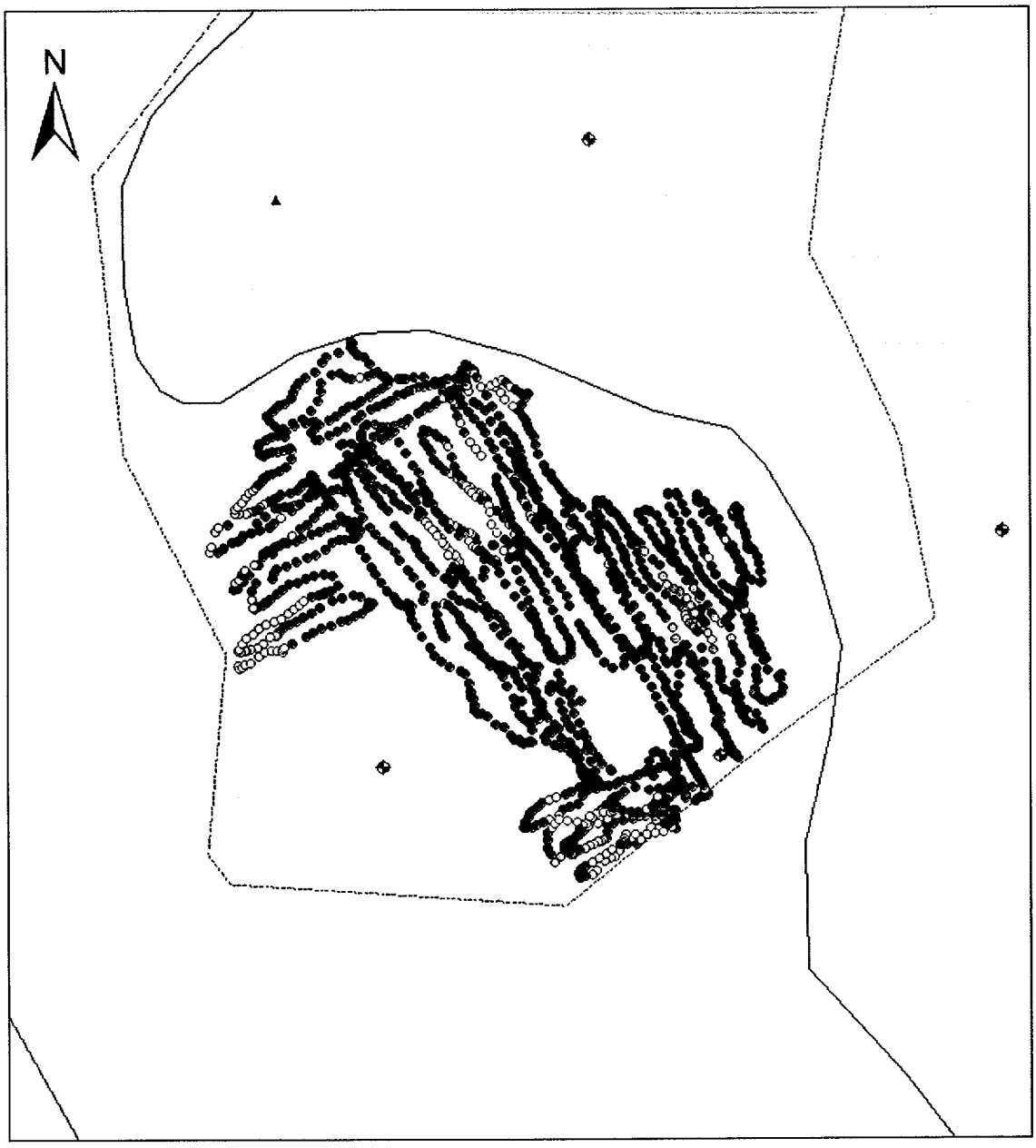
4.2.2 Section 2

Original characterization estimates of the volume of the entire slag pile in Section 2 ranged from approximately 14,000 to 16,700 m^3. The type of slag and slag-like materials varied greatly in this section. There was a significant volume of blue-green glassy slag that was at or below background concentrations. There was a significant amount of grey slag similar to the slag found in Section 1 that contained little or no elevated radioactivity. Section 2 also contained a large volume of high-activity materials on the surface and buried deep below the surface.

Figure 4-3 shows the results of a pre-excavation walkover survey was conducted in August 2004. The figure shows a significant amount of high-activity materials on or near the surface of Section 2. This volume of material also elevated the general background in Section 2 to more that 15,000 cpm.

Additional characterizations were performed in Section 2 by Scientech in November 2004. This characterization used trenching methods to determine the depth of the slag pile and the average concentrations of slag materials. Section 2 was divided into multiple grid sections measuring 30 feet by 30 feet. Large-volume samples (approximately 1.4 m^3) were surveyed and the grid section was assigned a designation as containing Type 1, Type 2, or Type 3 material. Type 1 material was defined as material with thorium concentrations exceeding the "source material" limits of 54.5 pCi/g. Type 2 material was material that had average concentrations less than the source material limits but greater than the DCGL. Type 3 material was expected to have average concentrations less than the DCGL. The characterization effort provided estimates of Type 1 and Type 2 waste totaling approximately 2,400 m^3 (4,800 tons).

Once excavations began in Section 2 in the spring of 2005, it became evident that the Section 2 radioactive waste volume estimate of 4,800 tons was too low. Radioactive materials were discovered in locations that were not identified by any site characterization efforts. Radioactive materials were also discovered at deeper depths than previously expected.



Legend

Detector Readings (CPM)

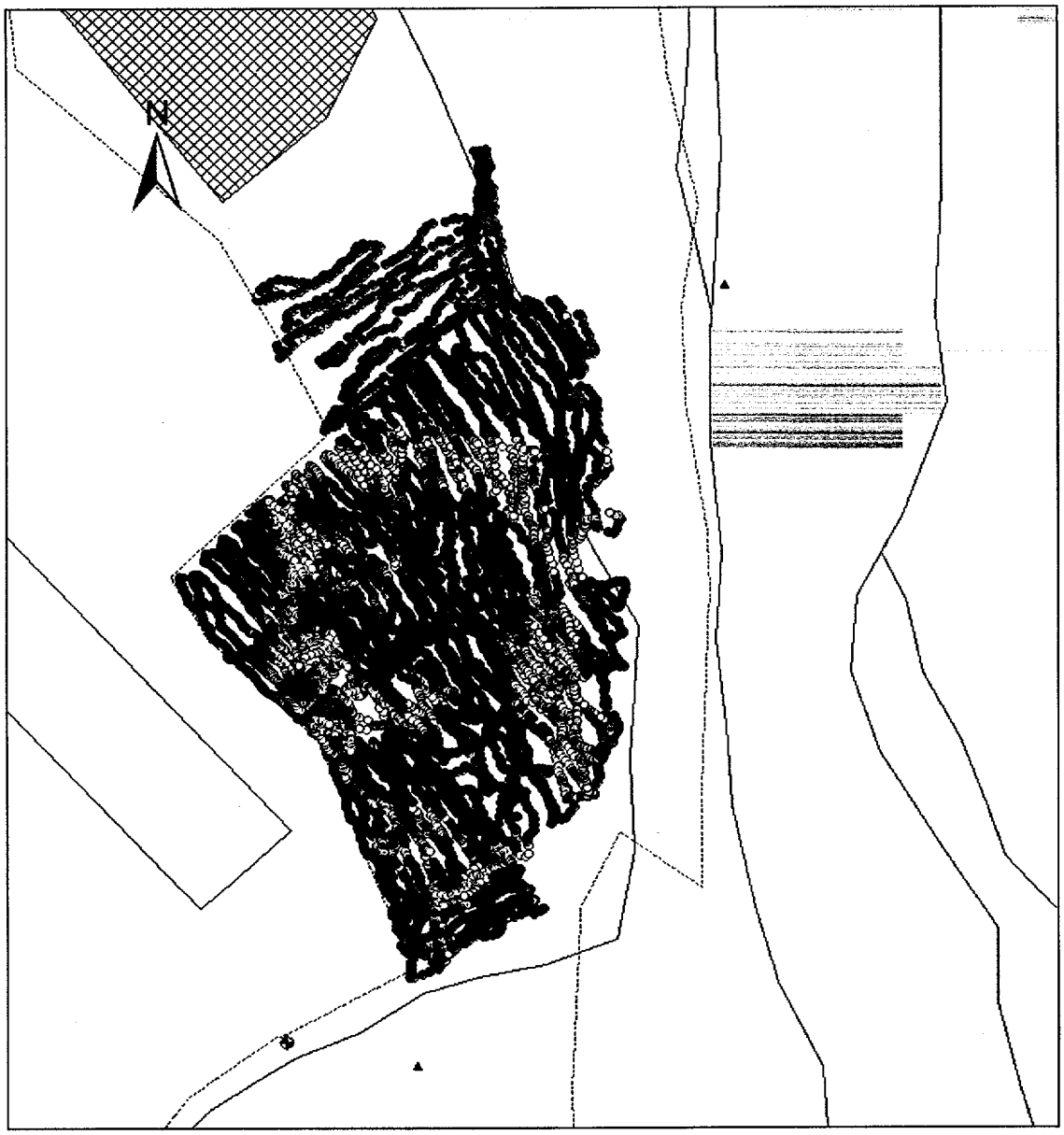
- 0.00 - 10699.99
- 10700.00 - 15000.00
- 15000.01 - 20000.00
- 20000.01 - 25000.00
- 25000.01 - 30000.00
- 30000.01 - 35000.00
- 35000.01 - 40000.00
- 40000.01 - 45000.00
- 45000.01 - 50000.00
- 50000.01 - 999999.00

Whittaker Decommissioning Site Basemap
Mercer County, Transfer, PA

0 25 50 100 Feet

ENERGYSOLUTIONS

FIGURE 4-2
SECTION 1 WALKOVER SURVEY



Legend

Detector Readings (CPM)

- 0.00 - 10699.99
- 10700.00 - 15000.00
- 15000.01 - 20000.00
- 20000.01 - 25000.00
- 25000.01 - 30000.00
- 30000.01 - 35000.00
- 35000.01 - 40000.00
- 40000.01 - 45000.00
- 45000.01 - 50000.00
- 50000.01 - 999999.00

Whittaker Decommissioning Site Basemap
Mercer County, Transfer, PA

0 45 90 180 Feet

ENERGYSOLUTIONS

FIGURE 4-3
SECTION 2 WALKOVER SURVEY BEFORE EXCAVATION

By the end of 2005, about 18,000 m^3 of slag and soil have been excavated from Sections 2 and 3. 65% of the total volume was separated from the slag using a mechanical screener and the soil and sand was stockpiled east of the concrete pad in Section 3. This resulted in approximately 6,300 m^3 (12,600 tons) of slag and other debris. Using radiological screening surveys, the scanned slag was then sorted into high-activity (>DCGL) and low-activity (< DCGL) stockpiles equaling to approximately 70% (8,820 tons) high-activity and 30% (3,780 tons) low-activity materials. The high-activity slag materials were moved to the concrete pad in Section 3 and stockpiled with the slag from Section 3 and the low-activity slag materials were stockpiled in Section 2.

Prior to 2006, nearly 6,000 tons of radioactive slag was shipped off-site for disposal. Of this volume, about 4,300 tons came from Section 2. The remaining volume of about 1,700 tons came from Section 3 as described in the following section. 4,500 tons of material removed from Section 2 was staged in Section 3 awaiting off-site disposal upon mobilization in 2006.

It is estimated that about 1,200 tons of additional radioactive material will be excavated from Section 2 and require off-site disposal in 2006. This includes material which may be discovered on Greenville Metals' property (see Section 8.9.8).

4.2.3 Section 3

Approximately 1,700 tons of radioactive slag was removed from Section 3 and disposed of in 2005. This volume came primarily from a large pile of slag and soil that was located on the pad. This volume also contained radioactive materials that were previously stored in several dozen 1.4 m^3 metal bins.

The eastern portion of Section 3 is almost entirely soil, with an extensive covering of small filings, turnings, punch-outs, and other small pieces of metal scrap. Most of these pieces are metallic and occasionally a piece will exhibit an elevated direct exposure reading. Several pieces of radioactive material (slag and thoriated nickel) were identified during a walkover survey in August 2004. These pieces were removed so that the clean soil stockpile could be placed east of the concrete pad. An estimated 100 tons of radioactive materials will need to be excavated from Section 3 after the clean soil pile has been moved.

The soil beneath the concrete pad in Section 3 was sampled to determine if subsurface contamination exists there. Seven samples of the soil below the concrete pad were analyzed in August and September 2004. Each of these samples indicated background concentrations of thorium-232 and uranium-238.

4.2.4 Section 4

Other than occasional pieces of slag located on the ground surface, there is little evidence of radioactive slag in this area. However, the Scientech characterization boreholes showed that there is an estimated 500 m^3 of non-soil fill (slag, concrete, etc.) and debris to depths of several meters. Scientech reported the mean thorium-232 subsurface concentration as 1.0 ± 0.2 pCi/g (1.1 pCi/g maximum) and the mean subsurface uranium-238 concentration as 1.2 ± 0.7 pCi/g (3.1 pCi/g maximum).

If radioactive materials are present in Section 4, the volume of material is not expected to be large enough to significantly impact overall project waste volume estimates and costs.

4.2.5 Ravine, Floodplain, and the Shenango River

Sampling by ORAU and Scientech in the ravine and floodplain areas indicate that thorium-232 and uranium-238 concentrations are at background levels. The bases of the slopes of the adjoining slag piles are most likely to be impacted by pieces of slag since migration of slag into the Shenango River has occurred as described in Section 2.4. It is anticipated that the probability of any additional slag in the river is limited to a small portion of the eastern slope of Section 2 where the slope is close to the river, adjacent to where the slag was removed from the riverbed in 1999.

Walkover surveys performed in 2005 confirmed that the radioactive material in these areas is limited to the area east of the Section 2 slag pile inside the chain-link fence and north of Section 1 where there is a drum containing slag material and a few large pieces of radioactive slag are scatted on the ground surface. Slag that is located below the ground surface will be excavated using heavy equipment. Wetland areas will be restored with guidance provided by the PA DEP.

4.2.6 Characterization Summary

Table 4-1 provides a summary of the waste volumes shipped off-site prior to 2006 and the expected waste volumes remaining. The 2006 estimates are based on trenching activities conducted in 2004 and previous site excavations.

TABLE 4-1
ESTIMATED SLAG WASTE VOLUMES

Location	Slag Waste Shipped Prior to 2006 (tons)	Slag Waste Remaining (tons)
Section 1	0	1000
Section 2	4,300	5,700[a]
Section 3	1,700	100
Section 4	0	0
TOTALS	**6,000**	**6,800**

Notes:
[a] 4,500 of the 5,700 tons was staged in Section 3 awaiting off-site disposal before the end of 2005 leaving approximately 2,200 tons left to be excavated in 2006.

4.3 SURFACE AND GROUNDWATER

Samples from characterization and routine site surveillance activities have not detected the presence of residual radioactivity in water samples collected from the site ponds, streams, or the Shenango River. Groundwater samples were screened against gross alpha or gross beta emitter limits of 15 picoCuries per liter (pCi/L) or 50 pCi/L respectively. The gross alpha limit was based on the EPA's maximum contamination level for drinking water and the gross beta limit was based on a resulting dose limit 4 mrem/yr. From May 2000 through June 2005, the gross alpha limit has been exceeded three times (most recently in two wells in June 2005) and the gross beta limit has been exceeded six times in four wells (most recently in April 2001). Gross alpha and gross beta concentrations in groundwater are summarized in Table 4-3.

If either the gross alpha or gross beta limit was exceeded, isotopic thorium and uranium analysis were performed on the sample. The results of these isotopic analyses are provided in Table 4-4. The data indicate that the water effluent concentration criteria in 10 CFR 20, Appendix B, Table 2, Column 2, or the EPA drinking water maximum contaminant levels (MCL) have not been exceeded.

TABLE 4-2
SITE MONITORING WELL RADIOLOGICAL DATA (pCi/L)

Well Number	May 2000		April 2001		September 2001		August 2002	
	Gross alpha	Gross beta	Gross alpha	Gross beta	Gross alpha	Gross beta	Gross alpha	Gross beta
MW-1	<MDA	29	<MDA	<MDA	<MDA	<MDA	3.2	<MDA
MW-2	15	28	<MDA	13	<MDA	<MDA	6.5	5.0
MW-3	<MDA	8.6	<MDA	3.9	<MDA	5.5	<MDA	<MDA
MW-4	9.9	48	**26**	**140**	11	5.4	4.6	18
MW-5	<MDA	18	<MDA	13	<MDA	<MDA	<MDA	6.7
MW-6	25	**85**	15	**61**	<MDA	5.7	5.2	4.7
MW-7	6.2	19	<MDA	6.7	<MDA	<MDA	<MDA	11
MW-8	8.6	**73**	<MDA	39	6.6	27	5.2	32
MW-9	<MDA	13	<MDA	4.5	<MDA	<MDA	<MDA	<MDA
MW-10	23	**95**	<MDA	**77**	11	12	<MDA	2.6

Well Number	October 2003		September 2004		April 2005		June 2005	
	Gross alpha	Gross beta	Gross alpha	Gross beta	Gross alpha	Gross beta	Gross alpha	Gross beta
MW-1	<MDA	5.6	<MDA	<MDA	<MDA	<MDA	<MDA	4.4
MW-2	4.9	9.3	<MDA	15.3	<MDA	8.3	**17.0**	17.5
MW-3	2.5	<MDA	<MDA	<MDA	<MDA	3.6	<MDA	4.4
MW-4	8.5	9.5	<MDA	6.4	6.0	4.6	<MDA	8.1
MW-5	<MDA	7.7	<MDA	4.6	<MDA	9.6	<MDA	8.2
MW-6	5.4	6.7	6.0	6.5	<MDA	7.3	**17.0**	12.0
MW-7	<MDA	4.4	<MDA	5.5	<MDA	6.4	<MDA	8.2
MW-8	5.3	22	<MDA	21.4	<MDA	18.3	<MDA	19.9
MW-9	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	<MDA	8.3
MW-10	6.6	212	9.6	30.1	<MDA	12.1	<MDA	18.5

TABLE 4-3
ISOTOPIC GROUNDWATER ANALYSIS DATA

Date	Well Number	Concentration (pCi/L)					
		Th-228	Th-230	Th-232	U-234	U-235	U-238
5/00	6	3.0 ± 1.2	1.9 ± 1.0	1.9 ± 1.0	1.1 ± 0.5	< 0.3	1.1 ± 0.6
5/00	8	< 0.3	0.4 ± 0.2	< 0.1	0.2 ± 0.2	< 0.1	0.3 ± 0.2
5/00	10	2.4 ± 0.8	1.0 ± 0.5	1.7 ± 0.6	1.4 ± 0.4	< 0.1	1.0 ± 0.3
4/01	4	3.9 ± 0.7	1.7 ± 0.5	3.3 ± 0.7	2.8 ± 0.5	< 0.1	1.9 ± 0.4
4/01	6	1.6 ± 0.4	1.0 ± 0.3	<0.09	2.4 ± 0.8	0.5 ± 0.4	1.3 ± 0.6
4/01	10	< 0.5	0.7 ± 0.4	< 0.2	0.3 ± 0.2	< 0.1	0.3 ± 0.2
6/05	2	0.52 ± 0.28	0.302 ± 0.18	0.23 ± 0.16	1.78 ± 0.50	0.22 ± 0.20	0.75 ± 0.31
6/05	6	0.69 ± 0.44	0.53 ± 0.29	0.39 ± 0.22	1.54 ± 0.48	< 0.26	1.19 ± 0.42
10 CFR 20 limit		200	100	30	300	300	300
EPA MCLs		15	15	15	20	20	20

Monitoring wells #1, #5, #6, #8, #9, and #10 and water from the Shenango River were also sampled and analyzed by the Pacific Northwest National Laboratory (PNNL) in 1999. The results of the analyses of filtered and unfiltered samples, published in NUREG/CR-6632[61], showed that the concentrations of thorium and uranium were "quite low in all samples with the thorium concentrations at or below the analytical detection limit." Uranium concentrations were also reported as low but detectable with concentrations around 1 microgram per liter. Additionally, no other individual radionuclides were detected by PNNL at concentrations greater than 1 pCi/L.

[61] NRC, February 2002, NUREG/CR-6632 (PNNL-12205), *Solubility and Leaching of Radionuclides in Site Decommissioning Management Plan (SDMP) Slags.* Prepared by Pacific Northwest National Laboratory.

5.0 DOSE MODELING EVALUATIONS

The goal for the Whittaker Site decontamination and decommissioning (D&D) project is to satisfy the criteria of 10 CFR 20, Subpart E for release for unrestricted use. 10 CFR 20.1402 allows termination of a license and release of a site for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of a critical group that does not exceed 25 mrem/yr and the residual radioactivity has been reduced to levels that are ALARA.

The dose assessment in support of the DCGL development was prepared by Scientech[62] and submitted to the NRC Region 1, Division of Nuclear Materials Safety, along with the site license renewal application in 2004. The DCGLs and the supporting dose assessment were approved as part of the 2005 license renewal. Table 5-1 provides a summary of the results of the dose assessment.

TABLE 5-1
DOSE SUMMARY (MREM/YR)

	Uranium-238	**Uranium-238+D**	**Thorium-232+D**
DCGL (pCi/g)	166.5	9.7	7.0
Peak Dose	6.30	24.9	24.9
Year of Peak Dose	0	0	0
Water Independent Pathways – Total dose			
Ground	5.43	23.6	24.3
Inhalation	0.34	0.10	0.24
Soil Ingestion	0.54	1.1	0.42
Water Dependent Pathways – Total dose	0	0	0

[62] Scientech, LLC; August 2004; *Dose Assessment in Support of Establishing Derived Concentrations Guideline Levels for the Whittaker Decommissioning Site*; Energy*Solutions* Document No. 82A9534

6.0 ALTERNATIVES CONSIDERED AND RATIONALE FOR CHOSEN ALTERNATIVE

The Whittaker Corporation has chosen to decommission and release the facility for unrestricted use based on environmental, economic, and regulatory considerations. Short-term impacts for the immediate vicinity during decommissioning activities will include increased truck traffic containing LLRW and the possibility of generating liquid or airborne effluents. As Whittaker's decommissioning contractor, Energy*Solutions* will address hazards associated with traffic by implementing site-specific work plans requiring standard traffic controls and by overseeing sub-contractors to ensure that they comply with all applicable U.S. Department of Transportations (DOT) regulations. Energy*Solutions* will prepare and implement site-specific programs and procedures in accordance with this Decommissioning Plan and NRC and Commonwealth of Pennsylvania regulations to monitor and control effluents. Due to the site's location, it will be necessary for Energy*Solutions* to interact closely with Greenville Metals to ensure that decommissioning activities will not adversely impact their operations.

The selected decommissioning alternative (remediation to a level acceptable for an industrial exposure scenario) will benefit the area by removing licensed residual radioactive material and releasing the property for unrestricted use. There are no employees at the facility to be displaced as a result of selecting this decommissioning alternative and temporary decontamination workers will be brought into the areas to perform the work. Additionally, Energy*Solutions* will try to use local contractors and vendors for goods and services need during project activities. Therefore, the decommissioning project should have only positive impact on the local economy.

A restricted release alternative was also considered. This alternative would require the design and construction of an engineered radioactive materials disposal cell on the present site. This alternative would also require stabilization of the cell and site, development of institutional controls, assurance of financial support and stability, and monitoring of groundwater, all of which have long-term implications. In accordance with 10 CFR 20, given the known contaminants, these practices and procedures would need to remain in effect for 1,000 years. This alternative was rejected because the cost is greater, there is difficulty in stabilizing the land due to the site's physical parameters, and there is uncertainty about the viability of available options for long-term institutional controls and financial assurance. In addition, there is resistance to the establishment of restricted release sites by the Commonwealth of Pennsylvania.

7.0 ALARA ANALYSIS

Energy*Solutions* must demonstrate that the decommissioning goal for this project, the criteria for release for unrestricted use in 10 CFR 20.1402, will result in doses that are ALARA. Module 7 and Appendix D of NUREG-1727 provide guidance to licensees and list methods acceptable to the NRC to demonstrate that the dose to the average member of the critical group is ALARA. These methods basically estimate and compare the desired effects of a remediation action (benefits) and the undesirable effects of that action (costs). If the calculated benefits are greater than the costs, the remedial action is considered cost-effective and should be performed. If the costs are greater than the benefits, the levels of residual radioactivity are considered ALARA and no allowable remedial action is expected.

Section 1.5 of Appendix D of NUREG-1727, "When Mathematical Analyses Are Not Necessary," states that "In certain circumstances, the results of an ALARA analysis are known on a generic basis and an analysis is not necessary. For residual radioactivity in soil in sites that will have unrestricted release, generic analyses (see NUREG-1496, the examples in this appendix, and other similar examples) show that shipping soil to a low-level waste disposal facility is unlikely to be cost effective for unrestricted release, largely due to the high costs of waste disposal. Therefore shipping soil to a low-level waste disposal facility generally does not have to be evaluated [for being ALARA] for unrestricted release." That is, due to the high costs of transportation and disposal of large volumes of soil, remediating to the DCGLs that correspond to the 25 mrem/yr dose limit, and no further, is in line with the ALARA principle.

The bulk of the activities associated with the decommissioning of the Whittaker Site involve the removal and transportation of waste slag that contains thorium, uranium, and their progeny in excess of site-specific DCGLs for off-site disposal. Further reduction of this dose would involve the removal, transport, and disposal of additional quantities of slag and soil at concentrations less than the DCGLs, which would add significant cost to the project.

In accordance with the guidance and generic analyses referenced above, a site-specific quantitative ALARA analysis is unnecessary. Remediation to the decommissioning guidelines specified in this Decommissioning Plan will be considered as a demonstration that doses meet the ALARA requirement.

8.0 PLANNED DECOMMISSIONING ACTIVITIES

8.1 PROCEDURE DEVELOPMENT

Site work plans and site-specific procedures will contain the operational details necessary to perform the D&D activities summarized in the following portions of this section. Energy*Solutions* (as Scientech) prepared the following plans and procedures specific to the Whittaker decommissioning project.

- Work Plan: Phase 1: Surface Debris Removal; Document No. 82A9537 (Complete)
- Work Plan: Site Characterization to Evaluate Type 1 and Type 2 In-Situ Radioactive Waste Volumes; Document No. 82A9549 (Complete)
- Air Sampling and Sample Counting Procedure; Document No. 82A9538
- Procedure for Surveying Large Volumes of Whittaker Slag and Slag-Like Waste Materials Using Gamma Measurements and ISOCS and Applications of the On-site and Quality Assurance Data; Document No. 82A9557
- Restoration Plan; Document No. 82A9524 (for PADEP permit waiver)
- Erosion and Sediment Pollution Control Plan for Phase 1 and 2 Activities at the Whittaker Remediation Site; Document No, 82A9519
- Sampling and Analysis Plan for Backfill Soil and Slag; Document No. 82A9573
- Section 2 Final Status Survey Plan; Document No. 82A99564

Future plans will include additional final status survey plan (FSSP) and a quality assurance project plan (QAPP) to support the final status survey efforts.

8.2 SITE MOBILIZATION

Initial site mobilization in July 2004 included set-up of the site office and health physics trailers; sanitary facilities; areas for the handling, staging, and transport of equipment and waste; and RCAs. With the permission of Greenville Metals, the field office trailer was placed on Greenville Metals property directly north of Section 3. Greenville Metals has also allowed Energy*Solutions* to use the paved areas west of the trailer as a lay-down area for non-radiological debris. A small area of the former Radioactive Materials Area adjacent to the northern property gate in Section 3 was radiologically cleared so that the health physics trailer could be placed inside the site security fence, but outside the RCA.

All personnel assigned to work in the RCA received site-specific training during this mobilization phase and received retraining in 2005. Details on personnel and training are contained in Section 9 of this Decommissioning Plan.

8.3 SITE PREPARATION

Land areas within the Whittaker Site were cleared of ground cover and small trees to facilitate access to the areas for radiological surveys and remediation activities. Care was exercised to prevent unnecessary damage to or removal of mature trees. Personnel used manually operated

equipment to prevent the spread of potential contamination and damage to the environment or site features, such as fencing and monitoring wells. Trees and brush were fed into a chipper and the debris was used on the site as mulch (primarily in Section 3). Large root balls were surveyed and placed in a clean waste dumpster outside of the RCA.

Power was hooked up to the office and health physics trailers. Water was obtained by connecting into a waterline located north of Section 3. On-site equipment includes a back-hoe/loader, a track excavator, a 4x4 utility vehicle, and a mechanical screener to separate larger debris (slag, bricks, rocks, metal, etc.) from soil. Health physics equipment includes an array of radiological survey instruments, environmental air samplers, and a high-purity germanium (HPGe) detector for on-site gamma spectroscopy analysis. At times the HPGe system is temporarily loaned out to other Energy*Solutions* projects.

8.4 CONTAMINATED STRUCTURES, SYSTEMS, AND EQUIPMENT

Following the majority of site excavation activities, the concrete pads in Sections 2 and 3 will be decontaminated to surface contamination levels in accordance with Section 14.1.2 of this Decommissioning Plan. Based on results of the characterization surveys, the evidence that the radioactive slag do not leach their radioactive constituents, and the fact that the concrete pad has had prolonged exposure to the elements, the concrete surfaces are not expected to be contaminated in excess of permitted surface contamination levels. If elevated surface contamination is detected, the concrete pads will be decontaminated.

Energy*Solutions* will break or drill through selected locations on the concrete pads to examine the soil or fill material underneath. Based on characterization data and site history, it is not expected that the material under the concrete pad in Section 3 will contain radioactive slag. If it becomes necessary or desirable to remove the concrete, the top surfaces of the concrete will be surveyed in discrete grids. The concrete will then be removed and the underside will be surveyed. The soil/fill material under the concrete will then be surveyed and sampled.

The embedded three-sided steel bins in Section 3 were all removed and released according to the release criteria described in Section 14.1.2. With only a few exceptions, the bin walls and posts were released without any decontamination efforts. Only light scrubbing with a metal wire brush was necessary to reduce residual contamination to below detectable levels. The steel walls and posts were transferred to a metal recycling facility.

Early site operations also involved the removal of several tons of scrap metal and debris that was scattered about the site. Some of the material could not be surveyed sufficiently to free release it as clean waste for disposal or recycling. This material was shipped as low level radioactive waste (LLRW) to RACE, LLC in Tennessee. Other contaminated metal debris or debris that cannot be adequately surveyed for free release will also be disposed of as LLRW at Energy*Solutions'* Clive, Utah LLRW disposal site.

Small amounts of debris (metal, wood, plastic, etc.) remain on site. This material will be surveyed and released or disposed of as LLRW according to Section 14.1.2.

8.5 RADIOACTIVE SLAG

Energy*Solutions* will address each section of the Whittaker Site differently to remove the radioactive slag materials. Because most of Section 2 contained radioactive materials, the vast majority of the site has been excavated, the material placed through the mechanical screener, and then stockpiled according to the radiological classification of the material (Type 1, 2, or 3). Through April 2006, about 90% of Section 2 had been excavated down to the native soil layer. In Section 1, there will be targeted excavations directed by the walkover survey results and exploratory trenching conducted in 2004. This material will also be mechanically screened to separate the clean soil from the slag. In Section 3, the material that was located on the pad prior to mobilization has already been screened and sorted. The radioactive slag and slag-like materials are stockpiled on the concrete pad and the soil is stockpiled just east of the concrete pad. Some radioactive materials have been excavated from the eastern portion of Section 3, but additional targeted excavations are still necessary. Energy*Solutions* does not plan on excavating any materials from Section 4.

All excavation activities will be performed in accordance with The U.S. Occupational Safety and Health Administration (OSHA) [63] standards and requirements. This will require a competent person for excavations, as defined by OSHA, to be on-site during excavation activities. Heavy equipment operators will be trained in accordance with all OSHA regulations.

When stockpiles of radioactive slag materials are large enough, dump trucks will be brought on site. The trucks will be loaded with higher-activity (> DCGLs) materials, manifested according to DOT regulations, and then the trucks will transport the slag to a transloading facility at Alaron, Inc. in Wampum, Pennsylvania. At Alaron, the material will be loaded into gondola rail cars and transported to a licensed disposal facility. Through November 2005, all radiologically contaminated slag has been transported in this manner.

8.6 CONTAMINATED SOILS

About 5,000 cubic feet of soils located in the southern area of Section 2 is apparently contaminated with low levels of uranium and thorium. The contaminated soil is located at the level of the surficial groundwater layer, more than 20 feet below the original elevation of the Section 2 slag pile. The source of the contamination is unknown, but it appears that the contaminated materials were placed in there current location as a previous disposal action.

8.7 CLEAN SOILS AND SLAGS

The stockpile of clean soils east of the concrete pad in Section 3 will be used in Section 2 as fill material following the Section 2 final status survey. The soil was radiolgicaly screened using large-volume sample survey techniques before being placed in the stockpile. Additionally, the stockpile will be sampled in a systematic statistically-based approach similar to the approach outlined in MARSSIM for a Class 2 outside area. Samples will be analyzed on-site using

[63] OSHA, 1989, 29 CFR 1926, Subpart P, *Excavations*

gamma spectroscopy with some samples also receiving off-site laboratory analysis for quality assurance. A sampling and analysis plan, *Sampling and Analysis Plan for Backfill Soil and Slag*; Energy*Solutions* Document No. 82A9573, be developed to address the release of the soil stockpile.

The stockpile of Type 3 slag will also be sampled and surveyed according to Energy*Solutions* Document No. 82A9573 to ensure that the material meets the release criteria. To release the slag stockpiles, representative large-volume (1.4 m^3) samples will be collected and analyzed on-site using *in situ* gamma spectroscopy. The number of samples will be determined using a statistically-based approach similar to the approach outlined in MARSSIM for a Class 2 outside area. The material will then be spread out on the surface of Section 2 for site stabilization purposes and a 100% walkover survey will be performed to identify any pieces of slag above DCGL concentrations. Pieces of slag that do not meet the release criteria will be removed.

8.8 CONTAMINATION CONTROL

Energy*Solutions* has installed material retention barriers at locations where sediment and debris from excavation activities could migrate to wetland areas. The design, installation, and maintenance of these barriers are conducted in accordance with the Erosion and Sediment Pollution Control Plan[64] approved by the Mercer County Conservation District.

Energy*Solutions* will enforce appropriate physical and administrative measures to ensure that cross-contamination or recontamination of a remediated area does not occur. Barriers, markers, and signs will designate areas of varying contamination or contamination potential.

Contamination surveys of dusty equipment such as the mechanical screener have shown no detectable removable contamination. On-site work area and site boundary air samples have shown no airborne contamination issues at the site. However, Energy*Solutions* will use water sprays to suppress dust migration during dusty operations.

Dirty equipment receives a thorough wash down prior to exiting the RCA. All personnel and equipment are scanned with a GM detector ("frisked") upon exiting the RCA at the RCA control point. The tires of trucks and other vehicles that enter the RCA for short periods of time are scanned prior to leaving the RCA. The main RCA control point is located inside the security fence just inside the northern gate in Section 3. To date, no personnel or equipment has become contaminated due to on-site activities.

Should areas with removable or transferable contamination be identified, these areas will be roped off and posted as "Contamination Areas." A separate RWP will be prepared for work in "Contamination Areas."

[64] Scientech, LLC; June 2004; *Erosion and Sediment Pollution Control Plan for Phase 1 and Phase 2 Activities at the Whittaker Remediation Site*, Scientech Document No. 82A9519

8.9 REMEDIAL ACTIVITIES AND SEQUENCES

This section provides an overview of the planned D&D tasks by section and describes other site-wide and off-site tasks. The D&D project schedule includes the anticipated sequences of activities. The actual activities and sequences may be modified in response to field conditions. Energy*Solutions* will continually evaluate decisions to perform tasks sequentially or simultaneously based on activity progress, field conditions, data, and resource availability.

8.9.1 Section 2

Work in Section 2 is nearly complete. Additional excavations are still necessary and radioactive material along the bottom of the slag pile slope needs to be relocated. The following sequence describes the remaining activities scheduled for Section 2:

- Complete excavation of the remainder of the Section 2 slag pile (summer 2006).
- Mechanically screen the slag and soil mixture to separate the slag and other debris from the clean soil (summer 2006).
- Stockpile slag in Section 3 according to the contaminant concentrations (summer 2006).
- Sample and release the soil stockpile for Section 2 backfill (fall 2006).
- Sample and release the Type 3 slag stock pile for use in stabilizing Section 2 (fall 2006).
- Perform the final status survey (FSS) of Section 2 (fall 2006).
- Backfill Section 2 with the stockpiled soil and Type 3 slag (fall 2006).
- Perform final grading and stabilization (2007).

8.9.2 Section 2 Pit

A small area of about 150 square meters (1,600 square feet) was identified as containing disperse radiological contamination within the soil and sand media located at a depth of more than 20 feet below the original Section 2 elevation. This is the depth of the surficial groundwater layer. The samples collected within this area in May 2006 indicate that the soil/sand matrix contains thorium-232+D concentrations of approximately 16 pCi/g and radium-226+D concentrations of approximately 5 pCi/g. Samples also indicate that the radiologically impacted soil/sand is about 3 to 4 feet deep below the groundwater elevation.

Remediation in this area will involve excavation of the impacted area to a depth of about 3 feet below ground level of the immediate elevation. The excavated material will be placed in a holding tank and the sediments will be allowed to settle to the bottom. The water will be sampled and shown to meet current groundwater sampling criteria for gross alpha and gross beta pumped out of the tank. The solids will be allowed to dry and then it will be excavated from the tank and added to the LLRW stockpile.

Once remediated, the pit area will receive a 100% walkover survey using 2-inch by 2-inch sodium iodide (2x2 NaI) detectors. The detectors will be encased in a water-tight housing such as a PVC pipe with a pipe cap on one end. Direct measurements will be recorded at various locations within and adjacent to the pit.

Soil from the pit bottom will also be sampled. As described in the NRC-approved Section 2 FSS, a minimum of eleven samples will be collected from the area. The pit will be drained as much as possible and the samples will be retrieved as quickly as possible from random locations that provide complete coverage of the pit. A sample location grid will not be used because the samples should be removed before allowing too much groundwater to seep back into the pit.

Sample will be dried and a 500-ml sample aliquot will be analyzed using an on-site gamma spectroscopy system. The system will be energy and efficiency calibrated using a NIST-traceable 500-ml multi-peak standard. A minimum of two of the samples will be sent off-site for quality assurance analysis at an independent laboratory. The on-site gamma spectroscopy will have a minimum detectable concentration (MDC) of not more than 1 pCi/g for both uranium-238+D (radium-226 daughters) and thorium-232+D.

A minimum of eleven reference area samples will also be collected in a non-impacted area, prepared, and analyzed in the same manner as the pit samples. At least two reference area samples will be sent off-site for quality assurance analysis at an independent laboratory.

8.9.3 Section 1

Energy*Solutions* will perform targeted excavations in Section 1 based on the results of intrusive and non-intrusive characterization efforts performed in 2004. D&D project tasks for Section 1 include the following:

- Excavate target areas identified during the 2004 subsurface characterization and walkover surveys and mechanically screen out the slag and other debris (fall 2006).
- Stockpile slag material in Section 3 according to the contaminant concentrations (fall 2006).
- Perform Section 1 FSS (2007).
- Perform final grading and stabilization (2007).

8.9.4 Section 3

Section 3 will be the loading point for all LLRW shipments. All slag materials bound for off-site disposal will be stockpiled on the concrete pad in Section 3 prior to loading into truck for off-site transport. Section 3 will also require additional excavations for removal of radioactive materials. D&D project tasks for Section 3 include the following:

- Load stockpiles of slag material for shipment as LLRW (fall 2005 – fall 2006).
- Sample and release the soil stockpile for Section 2 backfill (fall 2006).
- Excavate target areas and mechanically screen out the slag and other debris (2007).
- Perform FSS of the section, including the concrete pad, the soil under the concrete pad, and the areas east of the concrete pad (2007).
- Perform final grading and stabilization (2007).

8.9.5 Section 4

There has been some limited excavation on the extreme northern side of Section 4 along the boarder with Section 2 but no other excavations or remediation are expected. Remaining D&D project tasks for Section 4 include the following:

- Perform FSS of the section (fall 2006).
- Perform final grading and stabilization (2007).

8.9.6 Ravine and Floodplain Areas

The ravine and floodplain areas will be managed along with the section they are associated with. Radioactive materials in these areas are on the ground surface and will be removed from the areas and placed in the Section 3 stockpiles. Some radioactive slag material will need to be excavated from the wetland areas. These excavations and the wetland restoration will be conducted in accordance with the Restoration Plan and PADEP permit waiver. The areas will be divided into Class 2 FSS survey units and surveyed accordingly.

8.9.7 Shenango River

Energy*Solutions* will perform a FSS of the riverbed only after Section 2 has been remediated, radioactive slag has been removed from the floodplain, and the background count rate has been reduced to normal levels. For surveys conducted in the riverbed, the detector will be placed in a water-tight housing and the surveys will be conducted on contact with the river bottom. Background measurements will be made using the same detector setup in the river upstream. Energy*Solutions* will work with the Pennsylvania Department of Conservation and Natural Resources at the Pymatuning State Park dam and the COE as necessary to limit the flow of the river during the survey and sampling effort.

8.9.8 Greenville Metals' Property

There has been no radiological characterization data obtained from the Greenville Metals' property adjacent to Section 2. In 2005, while excavating material in Section 2, pockets of radioactive slag was uncovered at depths of 3 to 15 feet below grade along the

common property line with Greenville Metals. The radioactive materials were identified at the following two general locations:

- In Section 2 along the west fenceline extending from the southwestern fence corner to approximately 120 yards north.
- In Section 2 along the north fenceline for the entire distance of approximately 100 yards.

Whittaker and Greenville Metals have approved a site access agreement that will allow Energy*Solutions* to excavate materials from Greenville Metals' property along the two locations identified above. When all radioactive materials have been removed, these areas will be stabilized as necessary while awaiting final status survey of Section 2.

In May 2006, Energy*Solutions* also identified the presence of radioactive materials south of Section 1 beyond the Whittaker property line on property owned by Greenville Metals. While some radioactive material was removed by hand, other material was identified at depths down to two feet and as far as fifty feet south of the Section 1 fence line. As a result, Energy*Solutions* must perform additional walk-over surveys in the area south of Section 1 in order to fully define the extent of the area containing radioactive materials. Once the area is defined, a fence will need to be erected to control the licensed radioactive materials. The extension on the Section 1 fence to the south is not expected to impact Greenville Metals operations. After the fence is in place, the area enclosed by the fence will be remediated along with Section 1.

8.9.9 Other Off-site Areas

Energy*Solutions* will survey off-site areas that were used to stage material or equipment, or provide pathways for access and transport. Surveys on adjoining properties, including Greenville Metals property, will be conducted as necessary to demonstrate that areas beyond the Radioactive Materials Area boundary are not impacted.

8.9.10 Final Grades and Slopes

Following remediation and NRC license termination, the site must also meet requirements set by the PADEP for site stabilization. For example, embankments between the site plateau and the floodplain will be graded to a slope not to exceed 1½ : 1 (horizontal to vertical). The final slope will be covered with clean soil to a depth of not less than 0.15 meters; the soil will be compacted and seeded.

In areas outside the wetland and ravine area where there was little excavation and removal of materials, the ground surface will be graded with a slope, not to exceed 2%, toward the site embankment. A layer of clean soil will be added as a cover layer in order to provide resistance to normal wind and surface water erosion. This soil layer will be compacted and seeded.

The final cover is not intended to function as an impermeable, erosion-resistant surface to satisfy criteria or guidelines for long-term stabilization of contaminated material. An impermeable cover would be necessary to release of a uranium mill tailings site, for example, or any other area under restricted conditions. In addition, the cover was not included in the dose model used to calculate the DCGLs.

8.10 GROUND AND SURFACE WATERS

It is not anticipated that groundwater or surface waters will become contaminated with radioisotopes as a result of site D&D operations. However, an Environmental Monitoring Program will be implemented as described in Section 11 of this Decommissioning Plan. Measures will be taken to protect site groundwater monitoring wells from accidental damage by D&D activities and equipment.

8.11 FINAL SITE CLEANUP AND DEMOBILIZATION

The D&D project temporarily demobilized in the winter of 2005 and remobilized in the March 2006. During the temporary demobilizations, Energy*Solutions* secured the site and shipped survey instruments and sampling equipment off site. Other equipment was returned to the appropriate vendor or secured on site. Site personnel also demobilized from the project site. Energy*Solutions* will also demobilize again for the winter months in 2006/2007 with remobilization in Spring 2007.

Energy*Solutions* conducted a site inspection in February 2006[65]. Inspectors examined the site for erosion control, material migration, access control, and site postings. The inspection showed that the site conditions had not changed since demobilization in November 2005. A site inspection will also be conducted upon remobilization in 2007.

The final site demobilization is expected in 2007; demobilization will involve discontinuing services, removing unnecessary facilities and equipment, and returning personnel to their home locations. After the NRC terminates the license and releases the site for unrestricted use, site access controls may remain in place if continued surveillance and /or well monitoring activities are necessary to comply with PADEP land recycling regulations. Upon satisfaction of all PADEP regulatory requirements, the Whittaker Corporation will be responsible for the final disposition of the site.

[65] Energy*Solutions*, LLC. March 2006. *Whittaker Site Quarterly Inspection, First Quarter*. Letter report to Marjorie McLaughlin, US NRC, from Kevin Taylor, Energy*Solutions*.

8.12 SCHEDULE

On-site D&D activities began in July 2004 and continued through November 2005 with two temporary winter demobilizations from December to March Additional D&D activities commenced in March 2006 and will continue into 2007 following a temporary winter demobilization. Decommissioning site activities beyond the anticipated completion date are largely dependent upon the extent of contaminated material residing on the Greenville Metals' property.

Remaining project activities planned for 2006:

- Shipment of radioactive slag staged on the Section 3 pad in 2005.
- Excavation of the remaining radioactive materials in Section 2.
- Excavation of contaminated slag on Greenville Metals' property.
- Shipping of radioactive slag and contaminated metal debris.
- Final status surveys and confirmation sampling in Sections 2 and 4.
- Backfilling of Section 2.
- Excavation of radioactive materials from Section 1.
- Temporary site demobilization.

2007 site activities will likely include:

- Further remediation of Greenville Metals' property if necessary.
- Excavation of radioactive materials from Section 3.
- Final status surveys and confirmatory sampling in Sections 1 and 3.
- Site restoration of the Whittaker and Greenville Metals properties.
- Submittal of FSS report(s) to the NRC for material license termination.
- Final site demobilization.

The schedule does not include a timeline for non-radiological activities that may be necessary to satisfy site release requirements beyond those of the NRC or for the ultimate disposition of the site.

9.0 PROJECT MANAGEMENT AND ORGANIZATION

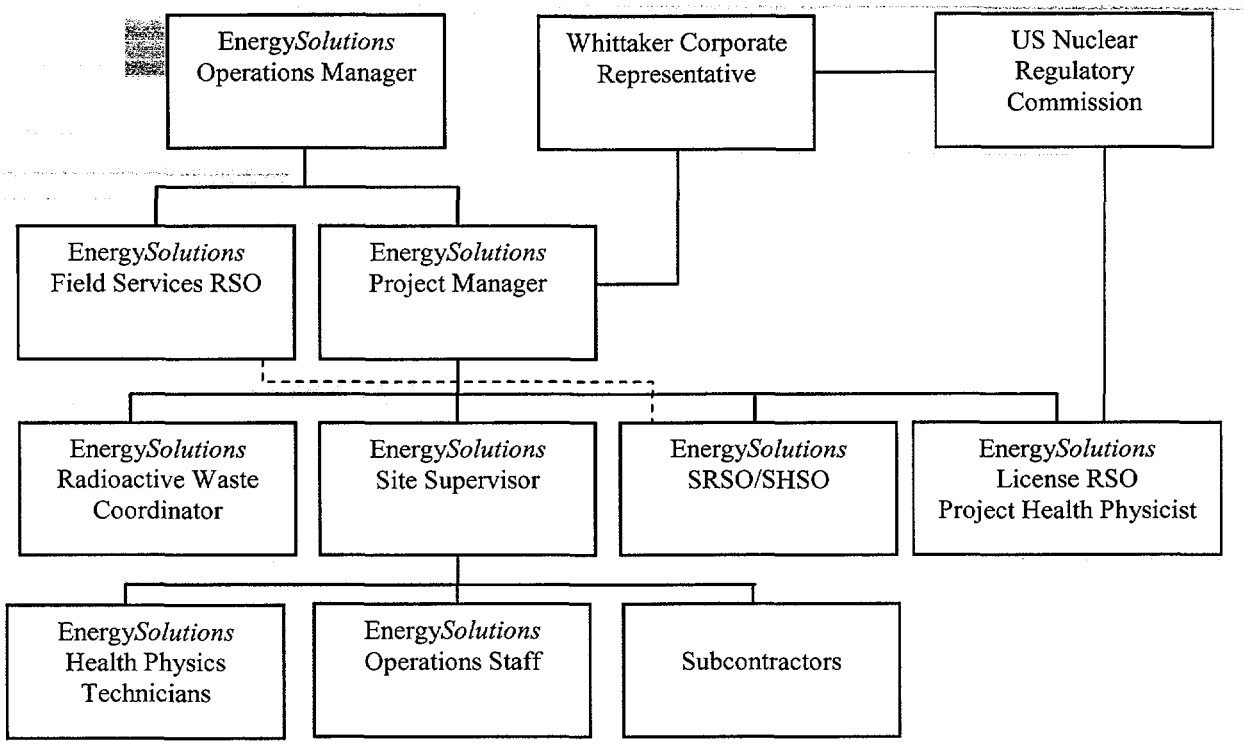
9.1 DECOMMISSIONING MANAGEMENT ORGANIZATION

Energy*Solutions* will ensure that the Whittaker D&D project is performed safely and in accordance with NRC requirements. An organization chart displaying the project management structure is provided in Figure 9-1. Energy*Solutions* will be responsible for preparing work plans and procedures; performing and radiologically monitoring the D&D work; providing engineering and health physics support; removing, packaging, and loading of radioactive materials for disposal; training workers; providing licensing and regulatory interface support on technical matters; performing FSS; and preparing a final report in support of the license termination.

The Whittaker D&D project organization will include the following management personnel:

- Whittaker Corporation's Vice-President and General Counsel - oversees the project for the Whittaker Corporation, the Licensee for the site.
- License RSO - prepares the Decommissioning Plan and FSSPs and FSS Report and directs currently licensed site surveillance activities (see Section 2.1). Coordinates document submittals and site activities with the NRC. The License RSO is currently an Energy*Solutions* Senior Health Physicist.
- Energy*Solutions* Field Services Operations Manager - provides senior management oversight of the project.
- Energy*Solutions* Project Manager (PM) - reports directly to the Energy*Solutions* Field Services Operations Manager, manages the project, and serves as the primary interface between the project and the home office. The Project Manager interacts with Whittaker's representative; coordinates office and field personnel; manages administrative requirements; ensures that quality assurance and contractual requirements are fulfilled; prepares work plans and procedures; manages the preparation and implementation of the technical approach; prepares the Final Report; and ensures that the project is completed within schedule and budget.
- Energy*Solutions* Field Services Radiation Safety Officer (FSRSO) - ensures that all activities are performed in accordance with the radiological safety requirements as established in 10 CFR 20 and the Whittaker Site NRC License. Through quality reviews and audits, the FSRSO ensures that all radiological data is complete and is maintained in accordance with procedures. The FSRSO also sets the requirements for radiological monitoring of personnel.
- Energy*Solutions* Project Health Physicist – prepares project plan and procedures; ensures that data are being collected in accordance with applicable plans and procedure.

FIGURE 9-1
WHITTAKER SITE DECOMMISSIONING
PROJECT MANAGEMENT ORGANIZATION CHART



The Whittaker D&D project organization will also include the on-site personnel listed below. A single individual may assume more than one of the following roles. For example, one person may fill the roles of the Site Health and Safety Officer and the Site Radiation Safety Officer.

- Energy*Solutions* Site Supervisor - works closely with, and reports to, the PM to ensure that on-site activities are performed in a manner that is consistent with the objectives and scope of this Decommissioning Plan. The Site Supervisor directly oversees and implements all pertinent Energy*Solutions* corporate and site specific procedures and work plans, is responsible for personnel training, coordinates the activities of field personnel and subcontractors, and prepares and maintains all required records. The Site Supervisor will have training and experience equivalent to the requirements of American National Standards Institute (ANSI) 3.1 for senior health physics technicians, as well as for OSHA HAZWOPER. The Site Supervisor may assume the daily responsibilities of the Site Health and Safety Officer (SHSO) and, in this capacity, will administer the Site-Specific Health and Safety Plan.

  The Site Supervisor has full stop-work authority and authority to make operational decisions to ensure that D&D activities are performed in an effective and economical manner while maintaining a safe work environment. In the absence of a separate SHSO,

the Site Supervisor is responsible for conducting daily safety briefings and ensuring that D&D personnel are aware of all routine or non-routine conditions and activities.

- Energy*Solutions* Site Radiation Safety Officer/Site Health and Safety Officer (SRSO/SHSO) – administers the Radiation Protection and ALARA Programs and other directives of the FSRSO. The SRSO/SHSO reports to the PM and the FSRSO and has full stop-work authority. The SRSO/SHSO implements all dose-monitoring activities as directed by the FSRSO and enforces the workplace and effluent monitoring protocols. The SRSO/SHSO also implements the site-specific health and safety plan (SSHASP) and oversees all environmental health and safety (ES&H) matters.

- Energy*Solutions* Radioactive Waste Coordinator - reports directly to the Site Supervisor and is responsible for managing LLRW logistics including manifesting and arranging transportation of waste, assisting the Site Supervisor, and providing oversight and assistance for on-site radioanalytical operations.

- Energy*Solutions* Health Physics Technicians (HPT) - monitors Energy*Solutions* and subcontractor personnel for radiation exposure during on-site activities and maintains ALARA principles to limit project personnel exposures. HPT personnel monitor the environment, ensure compliance with NRC and DOT waste packaging and shipping requirements, perform release surveys for equipment and materials, collect samples, and perform remedial and final status surveys. Senior HPTs meet the training and experience requirements of ANSI 3.1 and report directly to the Site Supervisor.

- Energy*Solutions* Geologist – oversees and assists in the groundwater sampling activities to ensure that these activities are performed in accordance with standard sampling protocols. The Energy*Solutions* Geologist receives technical direction from the Site Supervisor and the Energy*Solutions* home office and operational supervision and assistance from the HPTs.

- Energy*Solutions* Mechanics/Operators - set up and maintain site equipment, perform remediation and decontamination, package materials, and assist the subcontractors. These personnel will receive instructions from and be directly supervised by the HPTs.

9.2 DECOMMISSIONING TASK MANAGEMENT

Energy*Solutions* programs, plans, work procedures, and RWPs (see Section 7) will guide the implementation of all D&D tasks. Energy*Solutions* management and the Energy*Solutions* Field Services Radiation Safety Officer (ESFS RSO) will review and approve all plans and procedures prior to implementation. Procedures will be tracked in accordance with Energy*Solutions* document control and quality assurance (QA) procedures. Plans and procedures are in place to address the following issues: employee training, radiation safety, air monitoring, instrument calibration and maintenance, personnel monitoring, access control to work areas and the RCA, sampling procedures and laboratory analysis of samples, environmental monitoring, specific operational procedures, waste management and transportation, waste disposal, verification sampling, interim waste releasable material storage, and emergency planning and response. RWPs will be prepared by the SRSO and approved by the PM.

All personnel will be expected to read and understand all procedures and instructions pertinent to their assigned tasks. All personnel will also participate in daily safety briefings prior to commencing the day's work activities in order to ensure that they understand the scope of the work to be performed, specific hazards, precautions associated with special equipment or conditions, and changes to RWPs or procedures associated with the tasks. The Site Supervisor, or his designee (SRSO/SHSO), will be responsible for conducting the initial task familiarizations and daily safety briefings.

9.3 DECOMMISSIONING MANAGEMENT QUALIFICATIONS

Decommissioning management personnel will have the qualifications detailed in Appendix C of Energy*Solutions*' Radiation Protection Manual [66].

9.4 TRAINING

Before they can work on-site, all personnel will receive training in accordance with the requirements of 10 CFR 19.12[67], 10 CFR 20, 29 CFR 1910[68], Energy*Solutions* corporate procedures, and site-specific plans and procedures. This training will include the following topics:

- Personal responsibilities
- Site access and control
- Work scope, including special equipment or conditions
- Protective clothing and equipment
- Radiological hazards, including training on the nature of beta, gamma, and alpha radiation; external and internal radiation protection requirements; the measurement of radioactivity; and personal radiological monitoring and decontamination.
- Chemical, physical, and biological hazards

[66] Energy*Solutions*, Document No. 82A8042, Rev. No. 5, *Radiation Protection Manual*
[67] NRC, January 2001, 10 CFR 19.12, *Instruction to Workers*
[68] OSHA, 29 CFR 1910, *Occupational Safety and Health Standards*

- Emergency procedures

Personnel training will be properly documented. The Energy*Solutions* Site Supervisor will have full stop-work authority in regards to non-adherence to these training and documentation requirements. Actions in response to non-adherence may include cessation of work activities until the non-adherence can be evaluated and corrected, mandatory personnel retraining, or termination of employment of the responsible individual(s).

9.5 CONTRACTOR SUPPORT

Subcontractor personnel are expected to provide on-site services in support of LLRW and non-radioactive waste transportation, soil drilling and sub-surface sampling, heavy equipment maintenance, and fence installation and repair. Laboratories that perform radiochemistry, gamma spectroscopy, and hazardous or chemical analysis are expected to provide the only off-site subcontractor support.

The Energy*Solutions* HPT staff will provide task-level supervision of subcontractors, while overall responsibility for site operations will remain with the Energy*Solutions* Site Supervisor. The Energy*Solutions* Site Supervisor, with assistance from the Energy*Solutions* PM, will provide the interface between subcontractor management and on-site personnel.

Subcontractor personnel are not required to meet the training requirements specific in Section 9.4 as long as they are escorted or supervised by HPT staff or other site personnel trained in accordance with Section 9.4.

10.0 SAFETY AND HEALTH PROGRAM

10.1 RADIATION SAFETY CONTROLS AND MONITORING OF WORKERS

Work will be performed in accordance with the requirements of 10 CFR 20 and the Energy*Solutions* Radiation Protection and ALARA Programs. Energy*Solutions* programs include procedures for monitoring airborne radioactivity and providing respiratory protection, measuring and controlling internal and external radiation exposures, limiting contamination, performing radiological surveys, controlling and calibrating instruments, limiting access to work areas, following sampling and analysis protocols, handling emergency situations, maintaining documentation, and retaining records. Project-specific concerns will be addressed at the direction of the FSRSO in site-specific work plans, procedures, and RWPs.

10.1.1 Workplace Air Sampling Program

A routine air monitoring program has been in place since July 2004 during activities such as clearing and grubbing, slag pile excavation, and mechanical screening. The program has been conducted according to the site-specific air sampling procedure[69]. The mechanical screening operation has the greatest potential for creating airborne contamination because the soil and slag are loaded into the screener using an excavator and the tumbled through a cylindrical screen. As such, there is a significant amount of dust and fine particulate that is spread to the air and onto the surfaces of the screener. However, no work area air samples taken in the vicinity of the screener have indicated the presence of airborne contamination. Furthermore, removable contamination samples (swipes) taken on the mechanical screener during operation were also free of gross alpha or gross beta contamination.

For this project, air in the work area will be monitored during initial excavation or grading activities for compliance with 10 CFR 20, Appendix B, Table 1, Column 3[70] limits for thorium-232. These limits are 1E-12 microcuries per milliliter (μCi/ml) of air for occupational exposure derived air concentration (work zone DAC) and 6E-15 μCi/ml of air for airborne effluents (environmental DAC). Work activities that are suspected of causing the increase in airborne concentrations above 10% of the applicable limit will be suspended until the cause is determined and corrective actions have been instituted. Examples of corrective actions are moistening of materials that are being disturbed, modifying the method or equipment for a specific activity, or employing personal protective equipment. The Energy*Solutions* Field Services RSO must authorize the corrective actions and resumption of activities. The Site Supervisor will keep the Project Manager informed of any situations involving elevated airborne concentrations. Air sampling requirements may be reduce by the Field Services RSO.

D&D activities will continue to be observed and evaluated for unexpected conditions or materials that may create airborne contamination, even if it has been determined that air

[69] Energy*Solutions*, LLC; August 2, 2004; *Air Sampling and Sample Counting Procedure*; Document No. 82A9538
[70] NRC, July 1997, 10 CFR 20, *Standards for Protection Against Radiation*, Appendix B

sampling is unnecessary. The Site Supervisor will have full authority to stop work, evaluate new conditions, and implement work area air sampling.

10.1.2 Respiratory Protection Program

If it becomes necessary, respiratory protection equipment will be used as specified by the Energy*Solutions* Radiological Respiratory Protection Manual[71] and the RWP. The Energy*Solutions* program is in compliance with ANSI Z-88.2[72], NRC Regulatory Guide 8.15[73], 10 CFR 20.1701 through 20.1704[74], and OSHA requirements. The Energy*Solutions* Respiratory Protection Program includes the following components:

- Written procedures governing the use of respirators
- Assignment of responsibilities
- Types of records
- Training of employees and supervisors
- Quantitative and qualitative fit testing
- Selection of appropriate respirators
- Work area surveillance
- Medical surveillance
- Special respirator-use problems and limitations
- Maintenance and repair of respirators

10.1.3 Internal and External Exposure Determination

Energy*Solutions* has and will continue to implement an external dose monitoring program during on-site D&D project operations. Energy*Solutions* personnel, both full-time and visiting project team members, have been issued optically-stimulated luminescent (OSL) radiation monitoring badges to monitor deep dose equivalent (DDE), eye/lenses dose equivalent (LDE), and shallow dose equivalent (SDE). OSL badges are returned for processing each month.

The first month with reportable doses greater than 1 mrem was April 2005. During this month, site personnel spent more time in Section 2 excavating, mechanically screening, and stockpiling higher activity materials. Through June 2005, the maximum cumulative annual doses to a single site workers were 10 mrem DDE, 10 mrem LDE, and 10 mrem SDE. The annual regulatory dose limits are 5,000 mrem TEDE, 15,000 mrem LDE, and 50,000 mrem SDE. (TEDE = DDE + CEDE [CEDE = committed effective dose equivalent = 0]).

[71] Energy*Solutions*. LLC; *Radiological Respiratory Protection Manual*; Document No. 82A8044
[72] ANSI, 1992, ANSI Z-88.2, *Practices for Respiratory Protection*
[73] NRC, October 1999, Regulatory Guide 8.15, *Acceptable Programs for Respiratory Protection*
[74] NRC, October 1999, 10 CFR 20.1701-.1704, *Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas*

Since air sampling data and swipe samples indicate that there is no routine airborne contamination threat, there will be no routine monitoring for internal exposures (thus CEDE to date is equal to 0). If at any time, air-sampling results exceed 10% of the 10 CFR Appendix B limits (see Section 10.1.1), the ESFS RSO will be notified and will develop an internal exposure assessment/dose assessment protocol. The protocol will be implemented on site by the SRSO/SHSO.

10.1.4 Contamination Control Program

The RCA will be defined as the present property boundaries of the Whittaker Site. A chain-link fence primarily bounds this area, with eastern and northeastern portions consisting of older, barbed wire fencing. Initially, the north gate will serve as the primary access and control point to the RCA. Due to the size, shape, and topography of the site, it will be necessary to use other existing gates or to install new gates, as site access and material logistics dictate, in order to complete D&D activities. Appropriate radiological monitoring and controls will be established when access or egress is necessary at any alternate gate. The perimeter fencing of the RCA will be properly posted for the presence of radioactive material. During the D&D project all access to the RCA and work areas will be limited to those personnel required and trained to perform work. Each work area entrance will be posted to keep unauthorized personnel from inadvertently entering the RCA or work areas. The fenced/gated RCA and work/storage areas will be secured during off hours with locks. A trained radiation worker must escort visitors, sub-contractors, and non-radiation workers whenever they are in the RCA. No minors will be allowed in the RCA.

Personnel exiting the RCA shall be surveyed with a Ludlum Model 44-9 G-M detector, or equivalent, for beta/gamma contamination. Affected areas of clothing or skin will be decontaminated according to the procedures in Energy*Solutions'* Radiation Protection Manual[75] until levels are indistinguishable from background levels. Contamination of personnel will be documented as required by Energy*Solutions* procedures and investigated to determine if corrective actions are warranted. These actions may involve increasing the amount or type of personal protective equipment required, retraining personnel in radiological safety and controls, or modifying procedures.

All material or equipment exiting the RCA will be swipe-surveyed and direct-frisked with a Ludlum Model 44-9 G-M detector, or equivalent, for beta/gamma contamination. Any material with detectable activity above background levels will be surveyed with a Ludlum Model 43-5 scintillation detector, or equivalent, for alpha contamination. No material or equipment will be released if contamination levels exceed the limits specified in NRC Policy and Guidance Directive FC 83-23 (Regulatory Guide 1.86). These limits are presented in Table 14-2 of this Decommissioning Plan.

To date, no residual contamination has been identified on site personnel or any equipment leaving the RCA.

[75] Energy*Solutions*. LLC; *Radiation Protection Manual*; Document No. 82A8042

10.1.5 Instrumentation Program

Energy*Solutions* will calibrate, maintain, and operationally check instruments according to Energy*Solutions* procedures. Records will be maintained in accordance with 10 CFR 20 Subpart F and established Energy*Solutions* procedures. Records will include frequencies, methods, dates, and source traceability.

Energy*Solutions* will select survey instruments based on the known contaminants, type of material contaminated, and instrument capabilities. Instruments will be tested and calibrated in accordance with the specifications contained in ANSI N323-1978 [76] and will be capable of measuring activity at the decommissioning guideline levels established in this Decommissioning Plan, to an acceptable degree of confidence. Specific types of remedial and final survey instruments and detection capabilities are discussed in greater detail in Section 15 of this Decommissioning Plan.

10.2 NUCLEAR CRITICALITY SAFETY

The Whittaker D&D project does not require a Nuclear Criticality Safety Program due to the physical nature of the site and the on-site slag and soil.

10.3 INSPECTIONS AND RECORD-KEEPING PROGRAM

Energy*Solutions* will conduct on-site surveillances and/or inspections according to the procedures outlined in Energy*Solutions'* Radiological Control, Safety and Quality Assurance Program Manual[77]. The ESFS RSO or designee will review the records during the D&D project. The reviews will focus on data quality, instrumentation usage, site radiation safety.

Site records, including training, survey, calibration, and other records, will be maintained on-site by the SRSO/SHSO according to the requirements of Energy*Solutions'* Radiation Protection Manual and Radiological Control, Safety and Quality Assurance Program Manual. The records are subject to audit or review by Whittaker, the ESFS RSO, or the NRC at any time. Following the D&D project, the records will be archived by Energy*Solutions* and copies will be transferred to Whittaker management personnel.

[76] ANSI, 1978, *Radiation Protection Instrumentation Test and Calibration*, ANSI N323-1978
[77] Energy*Solutions*, LLC. *Radiological Control, Safety and Quality Assurance Program Manual.* Document No. 82A8041

10.4 INDUSTRIAL SAFETY PROGRAM

Project activities will be performed in accordance with the standards outlined in the Energy*Solutions'* Decommissioning and Radiological Services Health and Safety Plan[78] and other corporate and site-specific procedures.

The SRSO/SHSO, who is responsible for ensuring that the project meets OSHA requirements for project personnel and the general public, will perform the following specific duties:

- Instruct employees in general safe work practices
- Review project procedures to verify adequate coverage of industrial safety and hygiene concerns
- Perform periodic inspections of work areas and activities to identify and correct any unsafe conditions or work practices
- Provide industrial hygiene services as required
- Advise upper management on safety matters and on the results of periodic inspections

OSHA standards[79] applicable to anticipated site operations include, but are not limited to:

- Eye, face, head, foot, hand, respiratory, and noise protection
- Flammable and combustible liquids, arc cutting, portable fire extinguishers, electrical, and slings and materials handling
- Operation and safety for machines, portable powered tools, hand tools, and other equipment
- Medical services and first aid
- Trench safety

[78] Energy*Solutions*, LLC. *Decommissioning and Radiological Services Health and Safety Plan*. Document No. 82A8049.
[79] OSHA, 29 CFR 1910, *Occupational Safety and Health Standards*

11.0 ENVIRONMENTAL MONITORING PROGRAM

11.1 ENVIRONMENTAL ALARA EVALUATION PROGRAM

It is the policy of Energy*Solutions* to maintain radiation exposures to the general public ALARA during the course of any D&D project. At the Whittaker Site, this will be accomplished through the implementation of, and adherence to, the Energy*Solutions* Radiation Protection programs, this Decommissioning Plan, and project-specific procedures developed in accordance with the requirements of 10 CFR 20. Energy*Solutions* will periodically sample site effluents to ensure that the decommissioning activities do not increase exposure to the general public and comply with 10 CFR 20, Appendix B, Table 2 limits for beta and alpha emitters in air and water. The project SRSO/SHSO has the responsibility for administering the Radiation Protection Program.

11.2 EFFLUENT MONITORING PROGRAM

Due to the location and physical configuration of the site and environs, workers at the adjoining Greenville Metals or Reynolds Development Corporation Water Plant facilities comprise the target off-site population for particulate airborne contaminants. This population would conceivably receive the greatest impact if dust was generated from the excavation, handling, or storage of contaminated slag or soil. Airborne-effluent sampling stations will be set up and operated during activities that might generate dust. These stations will be located along the site property boundary at the nearest point to the location of the work being performed. If monitoring shows that the D&D activities are not contributing to increased airborne effluent concentrations at the property boundary, the FSRSO may determine that the monitoring program should be discontinued. Conversely, in response to changing conditions or safety concerns, the FSRSO may increase the monitoring frequency or locations at their discretion.

If the site perimeter monitoring is discontinued, the primary mechanism of controlling off-site airborne radioactive concentrations will be to control work zone concentrations. CAP-88[80] (Version 2.0) dispersion modeling predicts that controlling the work zone airborne concentration to 1 occupational DAC will limit concentrations to less than 1 environmental DAC at distance greater than 20 meters from the source. There are not any full-time off-site receptors located less than 20 meters from any site boundary.

Energy*Solutions* will also monitor surface water and groundwater to ensure that D&D activities are not contributing to liquid releases to the environment. Routine monitoring will consist of quarterly water sampling and analysis from the ten site groundwater monitoring wells, the North and South Ponds, the Section 3 floodplain wetlands discharge point to the Shenango River, and the Shenango River. If dry weather or other conditions create a situation where there is no water to sample at a routine location, the sampling will not be required for the affected calendar quarter. Non-routine monitoring may be implemented at the discretion of D&D project

[80] CAP88 input parameters: midpoint distance = 1m; wind file directory from Youngstown, Ohio (1988-1992); annual precipitation = 103 cm/yr (Mercer County Soil Survey - USDA 1992); annual ambient temperature = 26 °C (Mercer County Soil Survey - USDA 1992); height of lid = 1000m (default); source height = 0m; source area = 50 m^2; plume rise = 0; default agricultural data for urban scenario; thorium-232 release of 3.4 E-05 Ci/yr.

management if weather-related or other events that contribute to the discharge of water and possible effluents from the site at points other than the routinely monitored locations. The effluent monitoring program is also described in the site Restoration Plan approved by the PADEP.

Samples will be analyzed for gross alpha- and gross beta-emitting radionuclides that comprise the site contaminants. If gross alpha results are greater than 15 pCi/L or gross beta results are greater than 50 pCi/L the sample shall be analyzed for isotopic thorium, isotopic uranium, and progeny.

Table 11-1 provides a summary of requirements for the radiological environmental monitoring program.

TABLE 11-1
RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

Exposure Pathway	Sample Location	Sample Collection Frequency	Type of Sample	Analysis
Airborne	Nearest point of the north, west, or south property boundary to the work location	As ordered by RSO	Particulate	Gross Alpha and Beta Emitters
Airborne	Work zone	Daily	Particulate	Gross Alpha and Beta Emitters
Groundwater	MWs #1-#10	Quarterly	Low-flow well	Gross Alpha and Gross Beta Emitters*
Surface Water	North and South Ponds	Quarterly	Grab	Gross Alpha and Gross Beta Emitters*
Surface Water	Section 3 Discharge Stream	Quarterly	Grab	Gross Alpha and Gross Beta Emitters*
Surface Water	Shenango River	Quarterly	Grab	Gross Alpha and Gross Beta Emitters*

* Isotopic thorium, isotopic uranium, and progeny radioanalyses if results are greater than guidelines

11.3 EFFLUENT CONTROL PROGRAM

Controls will be implemented to limit the generation and migration of dust during handling activities. Water sprays will also be used to during material handling activities such as loading slag/soil mixtures into the mechanical screener or loading slag into trucks. Stockpiles may also be sprayed with water during dry periods.

To control the flow of liquid effluents, Energy*Solutions* will comply with the site Erosion and Sediment Pollution Control Plan as approved by the Mercer County Conservation District.

12.0 RADIOACTIVE WASTE MANAGEMENT PROGRAM

Energy*Solutions* will handle, store, ship, and dispose of radioactive materials in accordance with 10 CFR 20.2006[81], 49 CFR 100-177[82], 10 CFR 61[83], and other applicable guidelines for processing and disposal of LLRW.

Waste classification criteria for disposal of LLRW are contained in 10 CFR 61.55. Based on the various site characterizations, the radionuclides present at the site are natural thorium, natural uranium, and progeny in approximate secular equilibrium. The waste generated from the D&D activities will be classified as Class A (low level) radioactive waste. Radioactive waste generated from the D&D is expected to meet the stability criteria and, therefore, not need to be segregated per 10 CFR 61.56.

To reduce the overall volume of waste generated, Energy*Solutions* will adhere strictly to a policy of waste minimization during the D&D project unless minimization methods will compromise overall safety on site and inhibit efficient and cost-effective completion of the project. Waste minimization techniques include limiting the generation of waste; cleaning, decontaminating, or otherwise removing material from the waste stream; and reducing the volume of space that the generated waste occupies. Energy*Solutions* personnel will follow the rules listed below to minimize the waste generated during this project:

- Take only the material absolutely necessary to perform the task into the RCA
- Minimize the use of consumable materials such as wrapping, plastic, protective clothing, and wood by using only the amount needed for the job. Conserve and re-use whenever possible.
- Do not knowingly mix hazardous and radioactively contaminated materials
- Observe waste packaging procedures and minimize voids or wasted space in containers
- Minimize the use of liquids and activities that will generate potentially contaminated liquids
- Use engineering controls to minimize the spread of contamination to land areas, containers, or equipment
- Stress radioactive waste reduction in site-specific training
- Limit the number of access points to the RCA
- Use equipment and materials that can be decontaminated

When a storage container that also serves as a shipping container is full, it will be surveyed, labeled, and manifested prior to shipment off site. Energy*Solutions* will ensure that containers of contaminated materials are properly sealed and labeled for transportation to the proper facility. Each shipment of radioactive waste must be accompanied by a shipment manifest as specified in 10 CFR 61, Section I of Appendix F, *Requirements for Low-Level Waste Transfer for Disposal at Land Facilities and Manifest to 10 CFR 20.1001 through 20.2401.*

[81] NRC; September 1998; 10 CFR 20.2006; *Transfer for Disposal and Manifests*
[82] DOT; October 2000; 49 CFR 100-177; *Transportation of Hazardous Materials*
[83] NRC; January 1998; 10 CFR 61; *Licensing Requirements for Land Disposal of Radioactive Waste*

Solid waste that is stored in stockpiles may be loaded into trucks at the site and transported to a transfer facility in Wampum, Pennsylvania, operated by Alaron, Inc. There, material will be transferred to railcars for shipment to its final disposal destination at Energy*Solutions* in Clive, Utah.

Slag materials are expected to be shipped from the Whittaker site as exempt consignments according to 49 CFR 173.401(b)(4). The DOT has ruled that similar non-ore materials containing natural uranium and thorium that will not be processed for the uranium and thorium in the material and are being transported as waste, meet the intent of the exemption.

Alaron will prepare the waste shipments and all shipping documents for rail shipments from Wampum to Clive. Energy*Solutions* will monitor all shipments to ensure proper control and handling of the radioactive material.

12.1 SOLID RADIOACTIVE WASTE

It was originally estimated that approximately 4,000 m^3 (~8,000 dry weight tons) of dry active waste (DAW) would be generated for disposal as LLRW over the course of the D&D project, with the vast majority of solid LLRW being slag and slag-like materials from Section 2. The total slag volume that was to require off-site transportation and disposal was estimated at 3,700 m^3.

Through November 2005, about 3,300 m^3 (more than 6,000 tons) of slag was shipped to Clive, UT and about 3,000 tons of LLRW scrap metal was shipped to RACE. Currently, about 2,200 m^3 (4,500 tons) of slag is staged and ready to be shipped beginning in April 2006. An estimated 1,100 m^3 (2,300 tons) of LLRW slag is still unexcavated in Sections 1, 2, and 3 (see Table 4-1).

An additional 3,000 tons of LLRW scrap metal and debris also will be disposed of in 2006. This material either has measurable residual contamination or it cannot be adequately surveyed for free-release.

The non-radiological waste slag has been characterized in accordance with Pennsylvania Land Recycling Regulations[84]. Initial evaluations of the characterization data by PADEP personnel indicate that slag may remain on site as clean fill if it satisfies the radiological criteria for release for unrestricted use. During the D&D activities, Energy*Solutions* will continue to evaluate the slag in regards to land recycling requirements in order to ensure that the current data accurately reflects the characteristics of the on-site waste material. If material does not comply with Pennsylvania regulations, it will be disposed of at an off-site disposal facility.

[84] Commonwealth of Pennsylvania, August 1997, Pennsylvania Code, Title 25, Chapter 250, *Administration of Land Recycling Program*

12.2 LIQUID RADIOACTIVE WASTE

Efforts will be made throughout the D&D project to minimize the generation of liquid radioactive waste. Liquid waste that is generated during D&D activities will be sampled and assayed to determine the proper disposal pathway in accordance with 10 CFR 20, Appendix B, Table 2, Column 2 limits[85] and PADEP regulations. Liquid waste that does not meet the specified criteria will be filtered and re-sampled or solidified for shipment to an approved disposal site. The treatment and disposition method selected for the liquid waste will depend on the type of radionuclides present, its forms, and total volume of liquids.

Currently water is used on site primarily for dust control and to rinse non-contaminated equipment. To ensure that the equipment is not contaminated prior to rinsing, the equipment is surveyed and swipe samples are taken and analyzed for removable contamination. To date, no equipment has become contaminated and no liquid radioactive wastes have been generated.

12.3 MIXED/HAZARDOUS WASTE

Several radiologically contaminated items that also contained asbestos-containing material (ACM) were identified among the debris in Section 3. The contaminated ACM was segregated, packaged, and transported to RACE. If additional contaminated ACM if identified, it will be handled in the same manner.

There are approximately 70 drums containing soil or other debris that are not radioactively contaminated but may be contaminated with non-radiological hazardous constituents. These drums are left over from the 1991 site drum removal project. These drums will be managed and disposed of by a hazardous materials contractor. Prior to releasing the drums for hazardous waste disposal, the drums will be scanned using a 2x2 NaI detector and surveyed using *in situ* gamma spectroscopy to verify that the contents meet the site DCGLs.

[85] NRC, July 1997, 10 CFR 20, *Standards for Protection Against Radiation*, Appendix B

13.0 QUALITY ASSURANCE PROGRAM

Work at the Whittaker site will conform to written and approved corporate guidelines and site-specific procedures. This decommissioning project will also comply with the requirements and procedures outlined in Energy*Solutions*' Radiological Control, Safety and Quality Assurance Program Manual. Site-specific quality requirements will be integrated into existing Energy*Solutions* QA documents through preparation of a QAPP.

13.1 ORGANIZATION

Energy*Solutions* will be responsible for implementing its own QA and radiological control program and ensuring that its personnel adhere to the written procedures. Energy*Solutions*' Project Manager, ESFS RSO, Site Supervisor, the Whittaker license RSO, and SRSO/SHSO will each have the authority to stop the work activities if QA procedures are not being followed. The Energy*Solutions* Project Manager or designee will oversee the QA and radiological programs to ensure that the work is performed in a safe and controlled manner. The ESFS RSO will also audit the implementation of designated field survey techniques, data management practices, and radiation safety procedures at least once per calendar year. The project management personnel shown in the organization chart in Figure 9-1 are responsible for the D&D of the facility.

13.2 QUALITY ASSURANCE PROGRAM PLAN

The QAPP will be the site-specific QA document implemented during the course of the FSSs. The QAPP will address such topics as instrument calibration and operational checks, radiation protection, document control, off-site analysis QA checks, data review requirements, statistical analysis and acceptable error rates, and QA measurements (duplicate measurements, split samples, etc.). The QAPP will be prepared according to Energy*Solutions'* QAPP procedure[86].

The QAPP will provide description and detailed directions on specific quality issues such as:

- Data quality objectives
- Collection, handling, chain of custody preparation, packaging, and shipping of samples
- QA sample requirements
- Data review and approval procedures

13.3 DOCUMENT CONTROL

All site-specific documents, including this Decommissioning Plan, will be controlled in accordance with Energy*Solutions'* procedures[87] and the Energy*Solutions* D&D project team will maintain copies on-site. Off-site management personnel such as the Energy*Solutions* Project Manager, Energy*Solutions* Field Services Operations Manager, and the Whittaker License RSO will also maintain controlled copies of most project documents.

[86] Energy*Solutions* ,LLC. *Procedure for Preparing a Quality Assurance Program Plan.* Document No. 82A8054.
[87] Energy*Solutions* ,LLC. *Document Control Procedure.* Document No. 82A8001.

Changes to controlled documents that reflect desired policy or procedure changes will require various levels of approvals before implementation. The level of approval depends on the document. For substantive changes, Energy*Solutions* management, Whittaker corporate management, and the NRC must approve amendments to this Decommissioning Plan. For more minor changes or variations from this Decommissioning Plan, description of the change in the Final Status Survey Report will be sufficient. Changes or revision to a RWP require only the approval of the Whittaker License RSO.

13.4 CONTROL OF MEASURING AND TEST EQUIPMENT

Proper use and maintenance of the instruments according to written procedures will ensure instrumentation quality control. During on-site activities, Energy*Solutions* will develop and enforce storage and security measures to ensure that only authorized personnel have access to the instruments. Instruments will be response-checked according to written procedures to ensure that they are functioning properly on a day-today basis.

13.5 SURVEILLANCES AND INSPECTIONS

Energy*Solutions* may perform periodic surveillances and/or inspections prior to, during, and after decommissioning activities to ensure compliance with the requirements of this plan and written decommissioning activity procedures. Whittaker's project manager or designee may also perform independent audits or inspections. Depending on the scope of the surveillance or inspection, the Energy*Solutions* Project Manager and the ESFS RSO, or designee, will conduct Energy*Solutions*' internal reviews. These reviews will likely include the following:

- Health and safety training program (Project Manager)
- Radiological control program including instrument usage and calibration, and personnel and area monitoring procedures (ESFS RSO)
- Work procedures with regard to public health and safety and the principles of ALARA (ESFS RSO)
- Records for training, radiation surveys, instrument calibration, and waste shipments (Project Manager)

14.0 FACILITY RADIATION SURVEYS

Final Status Survey Plans (FSSP) will be prepared by Energy*Solutions* using guidance provided in NUREG-1575 (MARSSIM) and NUREG-1727. The final status survey will be designed to ensure that the final condition of the site satisfies the release criteria defined in Section 5.4.2. MARSSIM methodologies will be employed to the extent practical based on the nature and configuration of the residual radioactivity. The MARSSIM guidance may not be directly applicable to some tasks, such as the evaluation of sub-surface contamination, included in the final status survey. Energy*Solutions* may use other guidance documents in conjunction with MARSSIM to design the survey so it meets the applicable data quality objectives (DQO). The DQOs will be specifically defined in the FSSP. Final surveys will be performed incrementally as D&D work progresses and at the conclusion of work activities, depending on the portion of the site undergoing remediation and the remediation method employed in a particular area. Areas in which the final status survey has been completed will be cordoned off to ensure that it remains clean. Following all final status surveys, a Final Status Survey Report (FSSR) will be prepared in accordance with current NRC guidance on format and content. This report will include an overview of the site radiological conditions as a result of D&D activities, explanations of the survey design methodologies, descriptions of and justifications for deviations from the final survey design proposed in the FSSPs or decommissioning tasks proposed in this Decommissioning Plan, and a detailed presentation of all final survey data and conclusions. The original final survey data will be transferred to Whittaker upon completion of the project.

14.1 RELEASE CRITERIA

14.1.1 Slag and Soil

Table 14-1 summarizes the radionuclide DCGLs developed in Section 5 of this Decommissioning Plan.

14.1.2 Equipment and Materials

It will not be possible to distinguish between radioactivity from thorium or uranium using conventional field instruments. Therefore, Energy*Solutions* will use the more restrictive levels for natural thorium (Th-nat) in Table 1 of NRC Policy and Guidance Directive FC-83-23 as the acceptable surface contamination level for release of the object. The natural thorium release criteria are 1,000 and 3,000 dpm/100 cm^2 (average and maximum respectively) and 200 dpm/100 cm^2 removable. The FC 83-23 levels for thorium and uranium are presented in Table 14-2. These limits apply independently to either alpha or beta/gamma contamination levels.

TABLE 14-1
DERIVED CONCENTRATION GUIDELING LEVEL

Radionuclide	$DCGL_W$[a] (pCi/g)
Natural Thorium (Th-232+D)	7.0
Natural Uranium (U-238+D)	9.7
Uranium-238 (U-238)	166.5

Note:
[a] Discussion on the development of the DCGLs is provided in Section 5.0 of this Decommissioning Plan.

TABLE 14-2
ACCEPTABLE SURFACE CONTAMINATION LEVELS

Radionuclide [a]	Average [b c f]	Maximum [b d f]	Removable [b e f]
Natural uranium (U-nat)	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2
Natural thorium (Th-nat)	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2

Notes:
[a] Where surface contamination by both alpha-and beta-gamma-emitting nuclides exists, the limits established for alpha-and-beta-gamma-emitting nuclides should apply independently.
[b] As used in this table, dpm (disintegrations per minute) means the rate of emissions by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.
[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
[d] The maximum contamination level applies to an area of not more than 100 cm^2.
[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects with less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.
[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 m and 1.0 mrad/hr at 1 cm respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

In the event that a surface does not meet the natural thorium level, but is less than the natural uranium level, and further decontamination is impractical, an analysis of the surface contamination may be performed to determine the thorium-to-uranium ratio. The unity rule may then be applied to determine if the surface may be released. The Site Supervisor will consult with the SRSO and make the decision to implement this approach based on an evaluation of the time and cost necessary to perform this analysis compared to the cost of including the equipment or material into the waste stream as LLRW. Items that would be impractical or cost-prohibitive to adequately survey due to their physical condition, geometry, inaccessibility, or media will be disposed of as LLRW.

14.2 CHARACTERIZATION SURVEYS

Section 4 of this Decommissioning Plan provides data and a detailed discussion of the radiological conditions at the site based on the previous characterization performed by ORAU and Energy*Solutions* (and its predecessor companies). No further characterization surveys are expected.

14.3 REMEDIAL ACTION SUPPORT SURVEYS

Energy*Solutions* will conduct remedial action surveys of the scrap metal and other debris located in Section 3 and other areas of the site after it has been segregated by radiological status (*i.e.* less than or greater than the release criteria) and decontaminated as necessary. Material with post-decontamination activity levels that exceed the criteria described in Section 14.1.2 will be designated as LLRW. Other materials will be considered free of residual contamination and acceptable for disposal as clean waste.

During excavation of the slag area, Energy*Solutions* will perform remedial action surveys, including surface scans and large-volume composite sampling and analysis, as described in Section 8.5. Additional methodology details will be provided in the D&D work plans.

14.4 FINAL STATUS SURVEYS

Due to the diverse nature, distribution, and configuration of the site contaminants, final status surveys will be designed and performed utilizing a combination of methodologies from MARSSIM and other appropriate guidance documents. These documents provide detailed guidance on the classification, selection, and size of areas to be surveyed; survey instrument requirements; quantity and quality of data to be collected; unbiased sampling methods; and methods for evaluating survey results. The following is a summary of the key tasks for the final status surveys.

14.4.1 Stating the Data Quality Objectives

In order to release the Whittaker site for unrestricted use, the final status survey must show that residual contamination levels do not exceed the release criteria within an acceptable degree of confidence. Energy*Solutions* will do this by establishing DQOs that identify data needs for the survey, data quality indicators, and the statistical tests used to demonstrate compliance with the release criteria. Specifically, data will include the following:

- Type of samples/measurements
- Necessary quantity of samples/measurements
- Necessary quality of samples/measurements (quantitative or qualitative)
- Minimum detection concentration (MDC)
- Necessary quantity of background samples/measurements
- Measurement documentation requirements

14.4.2 Classifying Areas

The site will be divided into impacted and non-impacted areas based on information on previous use and contamination potential, site characterizations, and past routine and non-routine site surveys. Areas that are known or suspected to contain residual radioactive material will be classified as Class 1, 2, or 3 impacted areas. Areas that were not used for storage or disposal of radioactive slag will be classified as non-impacted. Classifications for the site and surrounding areas based on current radiological information are discussed below. These classifications may change prior to the final status survey as a result of additional information generated by D&D remedial action support surveys. A description of the Class 1, 2, and 3 areas, as established with current site information, follows:

<u>Impacted - Class 1: areas with known radioactivity significantly greater than the DCGL prior to site remediation; areas may have localized post-remediation levels greater than the DCGL but less than the DCGL for elevated measurement comparisons ($DCGL_{EMC}$)</u>

- All of Section 1.
- All of Section 2.
- All of Section 3.
- The river floodplain between the base of the eastern Section 2 embankment and the Shenango River, including a portion of the riverbed. The north-south limit of this impacted area will be from perimeter fence post #213 (at the north termination of the chain link fencing) to fence post #185 at the southern termination of the Section 2 embankment, a distance of approximately 200 feet.

Impacted - Class 2: areas with only localized areas of radioactivity slightly greater than the DCGL prior to site remediation; no post-remediation levels expected to be greater than the DCGL

- The wetland/floodplain area east of Section 3.
- The floodplain and ravine area south of Section 2 to the northern creek.
- All of Section 4.
- Soil under the concrete pad in Section 3.

Impacted - Class 3: not expected to contain any residual radioactivity or residual radioactivity of approximately 10% or less of the DCGL

- The ravine area between the southern and northern creeks that flow from Section 4 to the river.
- The floodplain area south of the southern creek and east of Section 1.

14.4.3 Identifying Survey Units

Site areas will be divided into individual soil survey units with the size of each unit based on its classification. Class 1 survey units will be limited to 2,000 m^2 and Class 2 and Class 3 survey units will be limited to 10,000 m^2.

14.4.4 Establishing a Reference Coordinate System

Energy*Solutions* will establish a reference grid system for the land areas to be surveyed. The grid size and pattern will be based on the classification of the area. The grid system will facilitate systematic selection of measuring and sampling locations, provide a mechanism for referencing a measurement/sample back to a specific location, and provide a convenient means for determining average activity levels.

Alternatively, Energy*Solutions* may use GPS to locate and record the position and elevation of each soil sample location. The FSSP will identify sample locations by easting and northing coordinates.

14.4.5 Selecting Instrumentation

Energy*Solutions* will select survey instruments based on their capabilities for detection of alpha, beta, and gamma emissions from natural thorium and natural uranium and their decay progeny. Instruments will be tested and calibrated in accordance with Energy*Solutions* procedures. Table 14-3 lists the applications and detection capabilities of various types of instruments that may be used for the project.

TABLE 14-3
D&D INSTRUMENTATION

Instrument/Detector	Application
MicroRem meter	Area dose rate measurements
MicroR meter	Area exposure rate measurements
"Pancake" GM detector	Beta/gamma surface contamination surveys; personnel frisking
Alpha/Beta Scaler with Alpha/Beta Sample Counter	Swipe and air sample counting
2x2 NaI gamma scintillation detector	Area gamma radiation scans
High-Purity Germanium detector	Qualitative and quantitative gamma analysis (*in situ* and field laboratory sample analysis)

14.4.6 Conducting Surveys

14.4.6.1 Background Reference Measurements

The MARSSIM approach to the release of a survey unit relies on the ability of the survey and sampling effort to demonstrate that the contaminant concentrations in the survey unit are not statistically greater that the concentrations in a background reference area by more than the DCGLs. The Wilcoxon Rank Sum (WRS) test is the preferred statistical test because the site contaminants are also present naturally in background. Because there are several types of survey units to be considered (soil, wetlands, river bed, etc.), there will be as several corresponding reference areas to provide an accurate measurement of the applicable background.

The reference areas sample/data sets will likely include the following:

- Dry soil sampling
- Wetland soil sampling
- River sediment sampling

Reference areas should be selected at off-site locations with similar characteristics to the on-site locations. Samples and surveys should be conducted using the same techniques as applied to the survey units. The number of reference area samples will be determined using MARSSIM protocols. Preliminary analysis suggests that nine samples will be required from each soil/sediment background reference area.

14.4.6.2 Surface Radioactivity Survey Methods

Energy*Solutions* will take direct measurements and material samples from survey unit locations specified in the FSSP. The sampling locations will follow a random

start systematic pattern with dimensions determined according to the methodology in Section 5 of MARSSIM.

Surface scans will be performed with instruments that have adequate scan MDCs as determined by the radionuclide of concern, grid pattern, grid dimensions, and outdoor area factors for the designated survey area in accordance with Section 5 of MARSSIM. Areas of elevated measurements will be evaluated and a $DCGL_{EMC}$ developed in accordance with MARSSIM. Additional measurements and sampling may be performed at locations and frequencies based on professional judgment. Table 14-4 presents guidance for the type of scans and sampling surveys expected on affected land areas in accordance with MARSSIM.

TABLE 14-4
SURVEY COVERAGE FOR LAND AREAS

Area Classification	Land Areas	
	Surface Scans	**Soil Samples**
Class 1	100%	Number of data points from statistical tests; additional measurements for small areas of elevated activity; triangular grid
Class 2	10 to 100% - systematic and judgmental	Number of data points from statistical tests; triangular grid
Class 3	Judgmental/Random	Number of data points from statistical tests; biased locations

14.4.6.3 Survey Methods in Excavated Areas

Section 2 will be almost completely excavated to segregate material that must be disposed as LLRW from material that meets the DCGLs and may remain on-site. Excavations have revealed that the underlying non-waste material is sand similar to beach sand mixed with some soil. The FSS and the survey methods in Section 2 will be designed to initially survey and sample this sand/soil layer. Survey and sampling methods in this area will involve walk-over surveys and shallow soil sampling. *In situ* gamma spectroscopy surveys may also be conducted at the sampling locations.

If the GPS system is used to log the gamma count rates in gross cpm along with the position of the detector, the survey data will be downloaded by the survey technician and stored on a computer hard drive and a removable storage device (diskette, CD, USB drive, etc.). Survey maps will be produced from the electronic data.

If a GPS system is not used for logging a walkover survey, the data from surveys will be recorded as follows:

- The number of walkover sections will be equal to the number of fixed measurement data points in the survey unit.
- Each survey section within a survey unit should be approximately the same size.
- For each survey section, the average and maximum count rates will be recorded in gross cpm on a survey sheet.
- A survey map will show each scanning section.

Sand/soil samples will be analyzed on-site using a HPGe detector and gamma spectroscopy analysis software. Samples will be dried and placed in a 500 ml Marinelli sample container or a smaller "tuna can" for analysis. The sample containers will be sealed with electrical tape and labeled with the sample identification number, sample mass, the time and date the sample was collected, and the initials of the sampling technician. If a calibration standard is used (rather than a modeled geometry calibration), the sample mass should be not more than 10% greater than the mass of the calibration standard.

Excavated materials, slag and sand/soil mixtures, with residual radioactive material concentrations less than the DCGLs will be used as fill material in excavated areas. As a results, this material will also be subject to FSS procedures.

Slag material will be sampled using large-volume composite samples randomly selected from the clean slag stockpile and analyzed on-site using *in situ* gamma spectroscopy. Once the samples have been analyzed, the material will be spread throughout Section 2 in a single layer. Once in place, the material layer will receive a 100% walkover scan.

Once the walkover survey of the slag is complete, the clean soil/sand will be placed in Section 2 and graded as necessary to limit erosion and runoff while awaiting final stabilization. The soil/sand layer will then receive a 10% to 25% walkover survey (previous samples of the soil/sand pile suggest that survey units containing the material should be Class 2 survey units). Samples will be collected using the same number of samples and sample point locations (different elevation) that were used previously on the bottom soil/sand layer in Section 2.

14.4.6.4 Survey Methods in Non-Excavated Areas

Based on characterization data concerning the concentrations and distribution of contaminants in Sections 1 and 3, these sections will only receive targeted excavations. As a result, the underlying soil/sand will not be exposed throughout the section. Therefore, final surveys will consist of a combination of surface surveys, surface and subsurface sampling, and qualitative down-hole gamma surveys.

Sampling locations will be determined using a random-start systematic pattern with dimensions determined in accordance with the methodology in Section 5 of MARSSIM. The locations will be the same for the surface and subsurface sampling. In this manner the random-start systematic pattern will remain consistent for all sampling elevations. This consistency will assist in recreating and confirming volumetric calculations of the remaining source term.

Composite sampling of the subsurface material will be performed at each surface sample location located on the slag pile. Borings will be advanced through the slag pile to the native soil layer. The material collected from between the surface and the native soil will be collected into one or more large-volume (about 5 gallons) composite samples and the samples will be analyzed using on-site gamma spectroscopy.

If the boring bit hits a subsurface obstruction (called a boring refusal), the refusal will be documented as to location, depth, and description of material. A new boring location will be selected within a one-meter radius of the original location. If the second location results in a refusal, boring will stop and the conditions will be documented. Project management will evaluate the information to determine if the refusals indicate a subsurface condition or presence of a dissimilar material that would compromise the final status survey design or the dose modeling parameters used to derive the DCGL for the survey unit. Additional investigation may be warranted and may include excavation of the location of the refusal.

Each bore hole will also receive a gamma radiation profile. Using a 2x2 NaI detector, net gamma count rates will be logged along the depth of the bore hole at 1-foot increments. The count rate data will be compared against gamma radiation profiles of borings in a background reference area. While this survey will not be used to quantify activity levels of the surrounding materials, a statistical comparison will be performed to determine if count rate data from the survey unit boreholes are statistically elevated above the background data.

Statistically elevated measurements, or outliers, may be an indicator that material at or near that location may exceed the DCGLs. These measurements will be investigated further with targeted excavations and material sampling to quantify the activity and compare it against the DCGLs.

14.4.6.5 Bounding Contamination

Excavating, surveying, sampling, and final classifying of material from the site will continue until it is determined that residual radioactivity has been bounded both vertically and horizontally. There is the possibility that remediation activities will involve off-site areas such as Greenville Metals property. This involvement may range from disturbing portions of property to achieving required sloping for excavation safety to the remediation of contaminated material on or

below adjoining grounds. Prior to or during D&D activities, Energy*Solutions* will address access, remediation, or final survey issues with adjoining property owners to ensure residual radioactivity has been adequately bounded.

14.4.6.6 Documenting Survey Activities

Energy*Solutions* will document all survey activities including sample and measurement locations, survey data, survey unit reclassifications, survey unit remediation and re-survey efforts, unusual findings during survey activities, and instrument MDCs in the FSSR.

14.4.6.7 Evaluating Survey Results and Data Analysis

Energy*Solutions* will evaluate the survey results beginning with a data-quality assessment. The original DQOs presented in the FSSP will be reviewed to determine if they are still applicable. The DQOs will be re-evaluated for deviations from the original FSSP such as an insufficient number of data points or use of instruments with insufficient sensitivities.

Survey results and data will be analyzed and evaluated according to the guidance provided in Section 8.0 of MARSSIM and will include:

- A preliminary data review and calculation of summary statistics
- A graphical data review to identify patterns and outliers
- Selection of the statistical test(s)
- Verification of the assumptions of the test(s)
- Drawing conclusions from the data

14.4.6.8 Sample Analysis

Sample collection and laboratory analysis will be performed in accordance with established Energy*Solutions* and site-specific procedures for solid media. Based on the radionuclides of concern, laboratory analyses will include on-site and off-site laboratory gamma spectroscopy, on-site net gamma-activity counting, outside laboratory alpha spectroscopy (isotopic), and hazardous material profiling. The MDC for the on-site gamma spectroscopy analysis will be less than 50% of the DCGLs.

To evaluate the precision of the on-site analytical methods, Energy*Solutions* will collect and analyze duplicate samples and perform replicate analyses on the same sample.

To prepare a duplicate sample, a sufficient sample volume at a single sample point will be collected. Once dried, the sample volume will be divided into 2 separate 500 ml Marinelli samples. Each sample will be analyzed independently.

A duplicate sample will be collected from at least one sample location in each of the six Section 2 survey units and each background reference area. The analytical results of the sample pairs will be compared.

Replicate analyses will be made on at least 10% of the samples collected. The replicate analysis will involve recounting a single sample to collect a second gamma spectra and performing an identical analysis on the second spectra.

No less than 5% of the on-site samples will be sent to an off-site laboratory for gamma spectroscopy analysis. The MDC for the off-site gamma spectroscopy analysis will be less than 50% of the DCGLs. The off-site analysis results will be compared to the on-site analysis results to evaluate the accuracy of the on-site analysis methods

14.4.6.9 Compare Results to Release Limits

To determine if a given survey unit meets the release criteria, data, reported in gross pCi/g, will be analyzed and compared to the release limits according to the MARSSIM protocols.

14.4.6.10 Confirmatory Surveys

The NRC or the PADEP may perform surveys and collect samples for confirmatory purposes. The survey and sample locations will be at the discretion of the regulatory agencies and will be coordinated with Energy*Solutions* D&D management to ensure adequate on-site support, oversight, and documentation.

14.5 FINAL STATUS SURVEY REPORT

The site FSSR will be prepared and submitted at the conclusion of D&D activities. The FSSR will include:

- An overview of the D&D activities
- An overview of the results of the final status survey
- A discussion of changes made in the final status survey from what was proposed in the Decommissioning Plan, the detailed final status survey plan, or any other prior submittals, including changes in initial survey unit assumptions relative to the extent of residual radioactivity
- A description of the method by which the number of samples was determined for each survey unit, as well as a summary of and justification for the values used to determine these numbers
- The survey results for each survey unit including:
  - numbers of samples or *in situ* measurements per survey unit

- maps or drawings of survey units showing the reference system and systematic or random sample/measurement location, and random locations for reference areas and Class 1, 2, and 3 survey units
- measured concentrations and a statistical evaluation of these concentrations
- judgmental and miscellaneous sample data
- discussion of anomalous data, including a statement that a survey unit containing anomalous data satisfies the release criteria

- A description and discussion of the statistical tests that are used to show compliance with the DCGLs and release of the site and the errors associated with the tests

15.0 FINANCIAL ASSURANCE

15.1 COST ESTIMATE

Since the initial approval of Whittaker site decommissioning financial assurance in March 2005, project costs have increased due primarily to the discovery of additional radioactive materials; however, much of the project costs have been incurred. As such, a balance-of-project (BOP) cost estimate was developed based on the decommissioning tasks remaining prior to Energy*Solutions* mobilizing to the site in April 2006. The BOP activities in the approximate order of execution include:

- Transportation and disposal of the radioactive slag staged in Section 3 excavated prior to 2006.
- Excavation of the remaining radioactive slag from Section 2 and in the wetland areas.
- Excavation of radioactive materials from Greenville Metals property.
- Excavation of radioactive slag from Section 1.
- Final status surveys of all impacted areas (excluding Section 3).
- Replacement of the Section 3 clean soil/sand stockpile into Section 2.
- Excavation of radioactive materials from Section 3.
- Transportation and disposal of radioactive slag excavated during 2006.
- Final status survey of Section 3.
- Site demobilization.

This cost estimate utilized actual Energy*Solutions* cost factors, subcontractor price quotes, waste volumes estimated in this Decommissioning Plan, estimated equipment and supply costs, and estimates based on Energy*Solutions*' relevant past and current experience in regard to D&D costs. Costs include all expenses associated with project management, engineering, site operations, waste transportation & disposal, travel & living, vendors and subcontractors. Costs also include assumed contractor overheads, mark ups, and profits. For cost estimating purposes, LLRW volume estimate was 6,800 tons (see Sections 4.2.1 through 4.2.8).

Actual total project expenditures through 2005, including LLRW transportation and disposal, were approximately $6 million. The BOP cost is estimated at about $4.8 million. This estimate has **not** been adjusted for costs already incurred in 2006 and does **not** include the 25% contingency needed for financial assurance funding. The BOP cost estimate is provided in Table 15-1 and again with added detail in Table 15-2. Since the size of the on-site work crew and the level of off-site support will remain essentially constant for the BOP and many of the activities will overlap, the costs for each of the BOP activities listed above is not provided individually. All costs are expected to be incurred prior to the end of 2006. However, the completion date is highly dependent on the extent of radioactive materials discovered on the Greenville Metals' property.

TABLE 15-1
PREVIOUS YEARS COSTS AND BALANCE OF PROJECT ESTIMATE

	2004	2005	Balance of Project (BOP)	Total Project
Off-Site Labor	$ 115,640	$ 337,806	$ 216,168	**$ 669,614**
Site Labor	$ 598,017	$ 1,040,053	$ 1,202,743	**$ 2,840,816**
ODCs	$ 217,415	$ 397,374	$ 411,075	**$ 1,025,864**
Travel and Living Exp.	$ 111,000	$ 202,918	$ 212,336	**$ 526,254**
Fixed Fee Items	$ 175,219	$ 241,807	$ 243,644	**$ 660,670**
Other Site Activities	$ 20,549	NA	NA	**$ 20,549**
Total Operations	$1,238,000	$2,220,000	$2,286,000	**$5,744,000**
LLRW Disposal Costs	$360,000	$2,163,000	$2,499,000	**$5,022,000**
Sub-total Project	$1,598,000	$4,383,000	$4,785,000	**$10,766,000**
25% Contingency			$1,196,000	**$1,196,000**
Total Project Estimate			*$5,981,000*	***$11,962,000***

Note: Costs that may be imposed by regulatory agencies to perform verification surveys associated with License Termination are not included in the above table

15.2 FINANCIAL ASSURANCE MECHANISM AND CERTIFICATION STATEMENT

In accordance with Subpart E of 10 CFR 20 and 10 CFR 40, Whittaker Corporation, as the licensee for the site, has demonstrated through previous documentation and the BOP cost estimate that sufficient funds are available to complete the site decommissioning. The current BOP cost estimate, including a 25% contingency, is $5,981,000 and the committed decommissioning funding through the Parent Company Guarantee is $6,670,000. This financial assurance commitment exceeds the estimated BOP costs by $689,000.

The NRC approved Whittaker's financial assurance on March 15, 2005. A Certification Statement is provided as Appendix A.

TABLE 15-2
DECOMMISSIONING FUNDING PLAN COST
ESTIMATE FOR BALANCE OF PROJECT

TABLE WITHHELD FROM PUBLIC DISCLOSURE UNDER 10 CFR 2.390 - PROPRIETARY FINANCIAL INFORMATION

APPENDIX A

DECOMMISSIONING FINANCIAL ASSURANCE CERTIFICATION

CERTIFICATION OF FINANCIAL ASSURANCE

Principal: Whittaker Corporation (Meggitt-USA, Inc.)
1955 N. Surveyor Avenue, Simi Valley, California 93063

NRC License No.: SMA-1018
Whittaker Corporation Waste and Slag Storage Area
99 Crestview Drive Extension, Transfer, Pennsylvania 16154

Issued to: U.S. Nuclear Regulatory Commission

I certify that the Whittaker Corporation is license to store, package, and prepare for shipment the following types of source material licensed under 10 CFR Part 40 in the following amounts:

Type of Material	Amount of Material
Source Material (material containing > 0.05% by weight thorium or uranium or any combination of thorium and uranium)	Contaminated materials present at the site as of June 1, 1985

I also certify that financial assurance in the amount of $6,670,000 in the form of a Parent Company Guarantee has been obtained for the purpose of decommissioning as prescribed by 10 CFR Part 40.

Eric G. Lardiere
Vice President and General Counsel

6/21/06
Date

[*Corporate Seal*]

This is to acknowledge the receipt of your letter/application dated 12/15/2006 (ENERGYSOLUTIONS), and to inform you that the initial processing which includes an administrative review has been performed.

AMEND. SMA - 1018

☑ There were no administrative omissions. Your application was assigned to a technical reviewer. Please note that the technical review may identify additional omissions or require additional information.

☐ Please provide to this office within 30 days of your receipt of this card

_____.

A copy of your action has been forwarded to our License Fee & Accounts Receivable Branch, who will contact you separately if there is a fee issue involved.

Your action has been assigned **Mail Control Number** 139943.
When calling to inquire about this action, please refer to this control number.
You may call us on (610) 337-5398, or 337-5260.

NRC FORM 532 (RI)
(8-96)

Sincerely,
Licensing Assistance Team Leader