RECORD OF DECISION

SCRAPYARD SITE

NASA Wallops Flight Facility

Wallops Island, Virginia

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility

JANUARY 2008

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NUMBER

1.0 DECLARATION

1.1 SITE NAME AND LOCATION

Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia 23337
CERCLIS ID No. VA8800010763

1.2 STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the Scrapyard Site (Scrapyard or Site) at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center (GSFC) Wallops Flight Facility (WFF) in Accomack County, Virginia. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record file for this Site.

NASA and the United States Environmental Protection Agency (EPA) jointly selected the remedy, and the Virginia Department of Environmental Quality (DEQ) concurs with the Selected Remedy.

1.3 DESCRIPTION OF SELECTED REMEDY

The Site is one of the sites currently subject to the EPA/NASA Administrative Agreement on Consent (AAOC) (EPA Docket No. RCRA-03-2004-0201TH). This Record of Decision (ROD) only applies to the Scrapyard. Separate investigations and assessments are being conducted for the other sites in accordance with the AAOC and CERCLA.

The Selected Remedy for the Site is No Action.

1.4 STATUTORY DETERMINATIONS

NASA and EPA have determined, and DEQ concurred, that no remedial action is necessary at the Site to ensure protection of public health or welfare or the environment. A Removal Action, conducted at the Site in 2003, removed the contaminated soil thereby eliminating the need to conduct further remedial action. Post-Removal Action sampling and studies conducted from 2003 through 2006, confirmed that no action is required.

The No Action remedy will not result in hazardous substances, pollutants, or contaminants remaining on Site above levels that allow for unlimited use and unrestricted exposure. Therefore, a five-year review will not be required for the Site.

1.5 AUTHORIZING SIGNATURES

1/7/08

Dr. John H. Campbell, Director
Wallops Flight Facility

Date

2/12/08

Abraham Ferdas, Director
Waste Chemicals Management Division
U.S. EPA Region 3

Date

2/11/08

James Burke, Director
Hazardous Site Cleanup Division
U.S. EPA Region 3

Date

2.0 DECISION SUMMARY

2.1 SITE NAME, LOCATION, AND DESCRIPTION

WFF is located in Accomack County on the eastern shore of Virginia (Figure 1). The facility is comprised of three separate areas: the Main Base, the Mainland, and Wallops Island. The Main Base is the most heavily developed area. The Main Base is bordered to the east by extensive marshland and creeks that drain to the Chincoteague Bay and inlet. Little Mosquito Creek, which eventually flows east into the inlet and the Atlantic Ocean, borders the Main Base to the north and west. State Routes 175 and 798 form the southern and southeastern borders of the facility (Figure 2). The Mainland and Wallops Island are located several miles south of and are not contiguous with the Main Base. The EPA identification number for the WFF Main Base is VA8800010763.

NASA is the lead agency for site activities at the WFF. EPA is the lead regulatory agency, and DEQ is the support agency. Funding is provided by NASA.

The Scrapyard Site, the Site for which this ROD is being issued, is located on the west side of the WFF Main Base, near the main entrance gate to the facility (Figure 2). The area is currently an operating "scrapyard" used to temporarily store scrap metal and surplus items awaiting offsite disposition. The Site is surrounded by a fence with a locked gate and gently slopes to southwest.

2.2 SITE HISTORY AND ENFORCEMENT ACTIONS

2.2.1 Site History

It is unknown when operations at the Site first began. NASA developed the Scrapyard after 1959 when WFF was transferred from the Navy. NASA used the Scrapyard to store scrap metal, empty drums, out-of-service transformers, used batteries, and surplus office and scientific equipment until 1992. The Site was closed at that time when surface soil contamination was documented. Access was restricted by maintaining an existing fence, locking the only gate, and erecting signs.

2.2.2 Previous Investigations, Removal Actions, and Enforcement Actions

Environmental investigations began at the Site in 1988 when a Preliminary Assessment (PA) of WFF identified the Site as an Area of Concern (Ebasco, 1988). A Site Investigation (SI) was conducted in 1989 and included limited surface soil sampling and the collection of one groundwater sample from a nearby monitoring well (Ebasco, 1990a).

A Preliminary Field Investigation (PI) was conducted in 1990 to provide additional data for scoping a Remedial Investigation (Ebasco, 1990b). Field activities included a soil-gas survey, the collection of surface and subsurface soil samples, and the resampling of the monitoring well. Supplemental surface soil sampling was conducted in 1992 to support the final revision to the SI Report (Metcalf & Eddy, 1992).

A Limited Remedial Investigation (RI) was conducted in 1994 and 1995 (Metcalf & Eddy, 1995). Field activities included the collection of surface and subsurface soil samples, wipe sampling of metal debris stored on site, and a radiological field survey.

An RI Addendum investigation was conducted in 1997. This field effort included the performance of a more detailed radiological survey, scrap material characterization and removal, and soil sampling (Metcalf & Eddy, 1997).

A Pre-Removal Investigation was conducted in 2002. The field activities included surface and subsurface soil sampling (Weiss and Associates, 2003).

A Notification and Certification of removal activities under the Self-Implementing On-Site Cleanup Rule was issued by NASA in 2003 (NASA, 2003).

A Removal Action was conducted in 2003 (FWEC, 2004). The removal action included the collection of surface and subsurface soil samples during and after removal actions.

A Groundwater Characterization Study was conducted in 2005 (Weiss and Associates, 2005). The study included the installation of monitoring wells and the collection of two rounds of groundwater samples.

A Summary Site Status Report, compiling sample data from all previous investigations and presenting an evaluation of current and future site risks, was prepared in 2006 (TtNUS, 2006).

No other enforcement activities or remediation activities have been initiated at the Site.

2.3 COMMUNITY PARTICIPATION

The RI Report, Feasibility Study (FS) Report, Post-RI investigation reports, Removal Action Completion Report, Groundwater Characterization Report, Summary Site Status Report, and the Proposed Remedial Action Plan (PRAP) for the Scrapyard were made available to the public. The Removal Action Completion Report was made available in June 2004, the Groundwater Characterization Report was made available in December 2005, the Summary Site Status Report was made available in August 2006,

and the PRAP was made available in February 2007. These documents can be found in the Administrative Record file and the Information Repositories maintained at the Eastern Shore Public Library and Island Library. The notice of availability of these documents was placed in the Chincoteague Beacon and Eastern Shore News on February 8 and 14, 2007, respectively. A public comment period on the PRAP was held from February 14, 2007 to March 15, 2007. In addition, a public meeting was held on March 1, 2007 to present the PRAP to a broader community audience than those who had already been involved at the Site. At this meeting, representatives from NASA, EPA, and DEQ were present to answer questions about the Site and the proposed remedial decision. No comments were received during the comment period as noted in the Responsiveness Summary section of this ROD.

2.4 SCOPE AND ROLE OF RESPONSE ACTION

The Scrapyard is one of the sites subject to the NASA/EPA AAOC. The Selected Remedy is the final remedial action for the Scrapyard under CERCLA. The function of the remedy is to return the Scrapyard to unrestricted use. There were no unacceptable risks to human health or the environment associated with exposure to environmental media at the Scrapyard.

This ROD applies only to the Scrapyard. Separate investigations and assessments are being conducted for the other sites at the WFF in accordance with CERCLA and the AAOC. Separate RODs or other CERCLA decision documents have been or will be prepared for the other sites subject to the AAOC.

2.5 SITE CHARACTERISTICS

2.5.1 Physical Setting

Site features are shown on Figure 3. The Site is located on the west side of the Main Base, near the main access gate to the facility and adjacent to Building N-222. The Site consists of an approximately 3,500 square yard fenced storage yard used by NASA for the temporary storage of surplus items awaiting offsite disposition. The Site is paved with recycled crushed concrete and is relatively level with a slight grade to the southwest to allow for surface drainage. The adjacent area to the east consists of a paved parking lot and office building. The areas immediately north, west and south of the Site are undeveloped land supporting a growth of mixed conifer and deciduous trees and shrubs. Overland drainage is southwest and west where a series of vegetated open drainage swales within the wooded area direct surface runoff into low lying areas. There is no direct runoff into storm drains or water bodies.

The Columbia Formation lithologic unit underlies the Site and consists predominately of fine- to medium-grained sand with lesser amounts of silt and clay. The Columbia Formation is approximately 50 feet thick

beneath the Site. A silty clay layer approximately 3 feet thick exists within the Columbia Formation at a depth of approximately 25 feet below ground surface (bgs). This clay lens functions as a leaky aquitard that hydraulically divides the Columbia Aquifer into upper and lower units. The lower Columbia unit is underlain by the upper Yorktown Aquitard. This aquitard separates the Columbia Aquifer from the deeper Yorktown Aquifer.

The depth to groundwater at the Site is approximately 15 feet bgs. Groundwater in the upper unit of the Columbia Aquifer flows to the northeast. Groundwater measurements at the Site revealed a consistent pattern of a low northeasterly gradient (0.3 feet over 400 feet distance). Groundwater from the Columbia Aquifer in the vicinity of the Site is not currently used as a potable water supply. The Town of Chincoteague maintains three water supply wells screened in the Columbia aquifer. These wells are located about 1.5 miles to the northeast and are operated on an as-needed seasonal basis. Drinking water at the WFF is obtained from the Yorktown Aquifer. There is no known hydrogeologic connection or communication between the surficial Columbia Aquifer and the deeper Yorktown Aquifer.

There are no known areas of archeological or historical importance at the Site.

2.5.2 Conceptual Site Model

Previously completed response actions conducted by NASA removed contaminant source materials and contaminated soils from the Scrapyard, and placed clean fill material and compacted surface paving over the entire Site. Post-Removal sampling of the soil, collected prior to backfilling, and groundwater samples collected from Site monitoring wells confirmed that Site-related contaminants are not present at levels that pose a threat to human health or the environment. The current potential exposure to Site contaminants, if present, would be through an industrial or construction worker scenario. Workers could come in contact with Site soils and incidentally ingest soil during excavation activities. Additionally, if the area were to be developed for residential use, which is unlikely since the Site is currently used as a scrapyard, residents could be exposed to residual contamination in the soils. The shallow groundwater, present at a depth of about 15 feet bgs, is currently not used and use of or exposure to the groundwater is highly unlikely. Therefore there is no current exposure pathway for the shallow groundwater. However, the assessment of Post-Removal site data assumed that the Site would be developed for residential use and therefore assumed a residential ingestion pathway or exposures for soil and groundwater. The Site is currently paved and offers no significant habitat for ecological receptors.

2.5.3 Sampling Strategy

The release of contaminants, primarily polychlorinated biphenyls (PCBs) and low-order radiological residues (radium-226 and Thorium-222), resulted from the handling and storage of surplus equipment and scientific instruments at the Site.

The 1989 SI included the collection of seven surface soil samples and one groundwater sample that were analyzed for full target compound list (TCL) organics and Target Analyte List (TAL) metals (Ebasco, 1990a). The soil samples were collected along the eastern and western perimeter fence. The groundwater sample was collected from a monitoring well located about 400 feet to the northeast of the Site. This initial sampling indicated the presence of PCBs and several metals above expected background levels in soils. Chromium was identified in the groundwater sample at levels above the human health screening criteria.

Additional sampling programs were conducted in 1990 and 1992 (Ebasco, 1990a; Ebasco 1990b; Metcalf & Eddy, 1992). The sampling investigation included a soil-gas survey and soil and groundwater sampling. Forty seven soil-gas samples were collected and analyzed for volatile organic compounds (VOCs) in a field laboratory equipped with a gas chromatogram. Fifty-two soil samples, spaced on 100 foot, 50 foot and 25 foot grids throughout the Site and the surrounding wooded area, were collected and analyzed in the field laboratory for PCBs. Field laboratory results indicated high levels of PCB contamination within the fence line (up to 430,000 micrograms per kilogram (ug/kg)) and evidence of migration (up to 86,000 ug/kg) immediately outside of the southwestern corner of the fence at the Site. In addition, 13 soil samples were collected and submitted to a fixed based laboratory; 10 for TCL organics and TAL metals analysis, and three for PCBs only. One groundwater sample was collected from the nearby monitoring well and analyzed for total and dissolved chromium. Chromium was not detected in the ground water sample.

Table 2-1 presents a summary of the fixed base laboratory results for soil samples collected during the three SI-related sampling events (Ebasco, 1990a; Ebasco 1990b; Metcalf & Eddy, 1992). The analytical results indicated a similar pattern but lower concentration of PCB contamination as was reported using field testing methods. The highest concentrations of PCBs were detected in surface soil samples collected from within the fence line with decreasing concentrations detected in samples along drainage pathways leading outside the fence line to the southwest of the Site. PCBs were detected in one sample (1,600 ug/kg) collected immediately outside the fence line to the southwest. The analytical results for other parameters indicated a similar pattern of contamination and the SI identified potentially elevated mercury and pesticide concentrations in discrete locations within the fence line as a potential concern.

NASA conducted an RI from 1994 to 1995 to evaluate the nature and extent of PCB and localized mercury contamination (Metcalf & Eddy, 1995). Using a 20 foot grid spacing, a rectangular sampling grid of 124 sampling locations was established that included areas within the Scrapyard and adjacent areas west and south of the perimeter fence (see Figure 4). Surface soil samples at a depth of zero (0) to 10 inches and wipe samples of Scrapyard debris were collected for field screening analysis for total PCBs via immunoassay. The qualitative PCB immunoassay screening reported individual sample results as a concentration range instead of as a single numeric value, with the low end of the detected range reported as 4,000 ug/kg to 15,000 ug/kg. At surface soil locations where PCBs were detected in the 4,000 ug/kg to 15,000 ug/kg range or greater, subsurface samples were collected from an expanded depth range of 10 to 20 inches bgs. For those locations displaying elevated PCB concentrations at this depth, a third sample was collected at a depth from 20 to 30 inches bgs.

Split samples were collected for PCB and mercury confirmation analysis by an offsite laboratory for 10 percent of the field screening soil samples. Two of 20 wipe samples were submitted for confirmation PCB analysis. Analytical data from confirmation samples were validated following EPA Region 3 guidelines. Confirmatory analysis was performed on samples collected from the surface and the two subsurface zones within the fence line, and on surface soil samples collected immediately outside the fence line to the east and southwest. Table 2-2 presents a summary of the PCB and mercury analytical laboratory results. The results confirmed previous findings regarding PCB contamination. The highest PCB concentrations (470,000 ug/kg) were identified in surface soil samples collected from the northeast corner of the Scrapyard. The remainder of the samples indicated the presence of hotspots primarily extending from the northeast corner toward the southwest corner of the Scrapyard. Samples in the drainage pathway to the southwest indicated that PCBs had not migrated off Site at significant concentrations (110 ug/kg). Mercury was detected only in soil samples collected from within the fence line.

During the RI, a radioactivity field survey was conducted for health and safety purposes because according to a NASA employee, radioactive material may have been temporarily stored and handled at the Scrapyard. Using a portable scintillation probe, a walk through screening was conducted for sources emitting x-rays or gamma rays. Locations displaying radioactivity readings greater than Site-specific background measurements were further surveyed with a Geiger Mueller probe to evaluate radiation exposure intensities. Three areas associated with elevated readings above background were detected during the survey. One source of radioactivity was found to be a direct current (DC) ampere gauge with a painted radium dial face. A second hot spot was identified as emanating from four small pieces of light-weight material, which were suspected to be thorium-aluminum debris. Both of these potential sources were removed from the Site during the survey. No source was identified in the third area exhibiting readings above background levels.

The RI concluded that exposure to the concentrations of PCBs present in Scrapyard soil could yield potentially unacceptable human health risks, exceeding the upper limit of the acceptable risk range for cancer risk (1×10^{-4}), and exceeding the non-cancer hazard quotient (HQ) benchmark of 1.0, a threshold above which adverse non-cancer risks cannot be ruled out. It was estimated that cancer (1.96×10^{-4}) and non-cancer risks (HI of 3.6) could occur as a result of incidental ingestion or dermal contact with PCB-contaminated soil from exposures to an occupational worker with an exposure of 50 days per year for a period of 25 years. The cancer and non-cancer risks to a hypothetical future resident with an exposure of 6 years as a child and 24 years as an adult were estimated as 2.2×10^{-3} and 33, respectively. The residential exposure scenario was not anticipated to occur, and would only be possible if land use were to change.

The RI eliminated mercury as a possible chemical of concern for human health risks at the Scrapyard, since the maximum detected mercury concentration in soil was less than the EPA Region 3 risk-based concentration (RBC) for mercuric chloride of 23 mg/kg (Metcalf & Eddy, 1995). The RBC value used in the RI represents the current (October 2006) EPA residential screening criterion used to evaluate exposure to inorganic forms of mercury. The RBC represents a threshold below which adverse non-cancer toxicity effects would not be expected to occur from residential exposure via incidental ingestion of soil.

An ecological risk assessment (ERA) was also conducted by NASA for the limited RI. The ERA was based on soil exposure, since no permanent aquatic habitats were found to exist at the Scrapyard, and all runoff was expected to settle in the woodland to the west of the Site, based on the existing topography. The terrestrial indicator species selected for the Scrapyard ERA were grass (primary producer), meadow voles (burrowing primary consumer), and owls (secondary consumer). The levels of PCBs and mercury were used to estimate intakes for ecological receptors. The ecological risk assessment concluded that mercury levels did not present a significant ecological risk. The maximum exposure concentration of PCB Aroclor 1242 in surface soil was estimated to present a potential risk to terrestrial receptors, but the second highest exposure location was not estimated to be associated with adverse ecological risk. The ecological risks to a secondary consumer (the owl) were not expected to be significant.

Based on the sampling data and risk evaluations presented in the limited RI, the report concluded that further actions to address PCB contamination were required to protect human health and the environment. The RI report also presented several potential options for further action, ranging from capping the Scrapyard with clean soil, capping with an asphalt or concrete sealed cap, and/or excavating and backfilling contaminated areas.

NASA conducted a supplemental investigation, or RI addendum investigation, in 1997. The field work, which included a radiological survey and scrap removal, focused primarily on radiological contamination with limited sampling for PCBs (Metcalf & Eddy, 1997). Within each grid interval established from the 1995 RI, field screening for radioactivity was performed and PCB wipe sampling and radiological testing were conducted on scrap objects. Grid locations for this initial screening are shown in Figure 5.

Material was classified for disposal based on PCB wipe samples analyzed using a PCB field immunoassay kit. Scrap was classified as PCB-contaminated based on wipe readings greater than 10 micrograms (ug) of PCBs per 100 centimeters squared (cm^2). This material was segregated from the other scrap before being removed and disposed off Site. Scrap items were tested for radiological concerns by first surveying the area using an Eberline ASP-1 (microRad) meter with a Sodium Iodide (NaI) detector and a Victorine 450P pressurized ion chamber. Scrap materials exhibiting gamma radiation levels greater than 5 microRads per hour (uR/hr) above background levels were further surveyed with an Eberline E-600 equipped with a Geiger-Mueller pancake detector and a scintillation detector to determine beta/alpha contamination. Radiological contaminated scrap materials that exceeded Department of Energy (DOE) and Atomic Energy Commission (AEC) disposal guidelines were double bagged, placed into a 20 gallon plastic drum, and disposed off Site. No mixed (radiologically and PCB) contaminated waste was found at the Site.

After scrap removal, a revised 10 meter (M) square grid system was established to define grid intervals for further testing, which consisted of a walkover direct radiation survey and soil sampling for radiological and PCB analysis. Based on the findings from the walkover survey, 35 soil samples were screened for radiological contamination using an Eberline portable NAI detector. Eleven of these samples were sent to a fixed based laboratory for PCB analysis and radiological testing using a multi-channel analyzer to identify and quantify radionuclides. The results of the survey identified four small areas within the Site that contained potential radiological emitting sources, see Figure 6. These areas were roped off to prevent accidental entry by Site workers. Laboratory analysis for PCBs, in general, confirmed previous findings that PCB contamination existed within the fence line in hot spot areas.

In 2002, NASA conducted a follow-up radiological survey and collected additional soil samples at the Scrapyard (Weiss and Associates, 2003). The purpose of the survey was to identify areas of maximum radiological activity to collect samples for offsite analysis, to further define the lateral extent of contamination of hot spots found during the 1997 survey, and to use survey methods, instrumentation, and statistical methods consistent with NUREG 1575 (MARSSIM) (NRC, 1997a), NUREG 1505 (NRC, 1997b), and 10 CFR 20.1403. A field survey, using an 8-M square grid system, was conducted throughout the Site. Gamma readings were recorded at 1 M height using NaI scintillation and pressurized ion chamber instruments. The walkover survey did not identify any gamma radiation readings

significantly above background levels. Ground level scanning was then used to attempt to relocate the same soil areas that showed residual radioactivity after scrap removal during the 1997 survey. Elevated gamma readings were noted in three grid areas which were an order of magnitude lower and covered a more limited area than those identified during the 1997 investigation. Soil samples were collected for radionuclide analysis from locations exhibiting the highest current radiological survey readings. As a result of the survey and sample analysis, four discrete areas containing radium (Ra-226 and its daughter products) and/or thorium (Th-232) above background levels were identified. These areas are shown in Figure 7.

During the 2002 field investigation, 23 samples were collected for PCB analysis to help define the vertical and lateral extent of contamination at depth intervals representing 6 to 12 inches bgs or 12 to 18 inches bgs. The analytical results were consistent with previous findings, indicating the presence of PCB hot spots within the fence line with the highest concentrations occurring in surface soils, and evidence of migration just outside the fence line to the southwest. PCBs were detected in samples collected from 6 to 12 inches bgs at levels up to 12,000 ug/kg, and in samples collected at 12 to 18 inches bgs at levels up to 760 ug/kg, indicating that most of the PCB contamination was confined to the top 12 inches of soil. Surface soils collected at the 6 to 12 inch depth from outside the fence line contained PCBs ranging from 510 ug/kg to 3,400 ug/kg. Figure 8 depicts the sample locations and presents the estimated location of the PCB hot spots (areas with soil concentrations in excess of 10,000 ug/kg) as defined by previous analytical results.

In 2003, a comprehensive soil Removal Action and pre- and post-removal sampling were conducted at the Scrapyard (FWEC, 2004). The Removal Action was performed to remove soil contaminated with PCBs across the entire Site and isolated areas of soil exhibiting elevating readings for Ra-226 and Th-222. The removal action objectives (cleanup goals) were to achieve PCB levels of less than 1,000 ug/kg and Ra-226 and Th-222 activity of levels less than 5 picocurie per gram (pCi/g). The PCB action levels were based on the guidelines in the Toxic Substances Control Act ("TSCA"), 15 U.S.C. Sections 2601 to 2692, for self-implemented cleanups and the radiological cleanup goals were established using previously approved EPA cleanup goals. The removal action cleanup goals were presented in a work plan which was reviewed and approved by EPA and DEQ (FWEC, 2003).

The Removal Action was conducted in two phases: removal of the radiologically impacted soils and removal of PCB-contaminated soil. Removal of radiologically contaminated soil occurred on April 9 and 10, 2003. Soil removal was conducted to a depth of 18 inches bgs within the four soil excavation areas shown in Figure 7 and based on the boundaries of lateral and vertical extent of contamination determined by the 2002 soil radiological survey. Fourteen 55-gallon steel drums of soil were removed during this portion of the Removal Action and were shipped offsite for disposal at the U.S. Army Joint

Munitions Command Barnwell, South Carolina. After the removal action was completed, one five-point composite sample was collected from the bottom and sidewalls of each excavation area to confirm that radiological cleanup goals were achieved. Confirmation samples were analyzed for the radioactivity parameters gamma (EPA method 901.1), alpha (ASTM D3972-90M), and gross alpha/beta (EPA method 9310). Analytical results indicated that the clean up goals were achieved; maximum Post-Removal concentrations of Ra-226 and Th-232 were 1.44 pCi/g and 0.315 pCi/g, respectively (FWEC, 2004).

To support the PCB-contaminated soil removal, a square grid system was established with a grid interval of 9.45 meters, which was a modified grid spacing, deviating from the recommended value of 3 meter intervals to make an allowance for the moderately large area of the Site, as noted in 40 C.F.R., Part 761.62. A total of 12 composite samples were collected at a depth of zero (0) to 3 inches from the individual sampling points within the composite zones. In addition, as specified in the work plan, discrete rather than composite sampling was conducted within the "hot spot" identified in the northeast corner of the Site, see Figure 8. Analytical results for the 16 characterization surface soil samples revealed PCBs at levels ranging from 52 ug/kg to 65,000 ug/kg.

Initial PCB-contaminated soil removal occurred from April 30 to May 12, 2003 and consisted of the removal of the top 12 inches of soil from the entire Site (FWEC, 2004). During this phase, a buried metal object, initially identified as a possible ordnance shaped item, but later determined not to be ordnance related, was encountered. Based on this finding, a geophysical survey of the Site was conducted from June 25 to 28, 2003. The survey identified 69 subsurface anomalies. A subsequent investigation revealed that sixty-one of these anomalies were found to be debris relatively close to the surface. The additional eight anomalies were identified as buried construction debris (FWEC, 2004). After completion of the geophysical anomaly investigation, soil removal actions resumed and were conducted from August 11, 2003 to November 7, 2003. After removal of the top 12 inches of soil, the Site was resampled for PCBs in the same manner described above, except the grid spacing was set at one-half the distance as was used for initial characterization. Those areas that contained PCBs above the cleanup goal were further excavated and sampled until all sample results were at or below the cleanup goal of 1,000 ug/kg (FWEC, 2004). The excavation for PCB-contaminated soil extended to variable depths ranging from 12 inches to 48 inches bgs. Figure 9 illustrates the depths of the excavation and shows the Post-Removal sampling locations. Further excavation was conducted in two areas identified during the geophysical survey as containing buried construction debris and scrap. These areas were excavated to a depth of 6.5 and 11 feet, respectively, at which point no further debris or evidence of potential contamination was observed. After completing the excavation samples from each side wall and the floor of the excavations were collected and screened for PCBs. PCBs were not identified as being present in these screening samples. Five additional soil samples were collected from the deeper excavations to confirm attainment of the cleanup goal. These five samples were analyzed for full TCL organics, TAL metals, and total petroleum hydrocarbons (TPH- Diesel Range

Organics and Gasoline Range Organics). A total of 49 Post-Removal soil samples were collected and analyzed from the Site. The sample locations are shown on Figure 10 and analytical results for these samples are summarized in Table 2-3.

Approximately 4,000 tons of soil and scrap were removed from the Site and disposed of at Waste Managements Big Bethel Landfill located in Hampton, Virginia. The Site was restored by backfilling with clean fill and the final surface grade was achieved by placing and compacting a layer of crushed recycled concrete (FWEC, 2004).

In 2005, a Groundwater Characterization Study was performed at the Scrapyard. The study included the installation of 4 monitoring wells, the redevelopment of the existing nearby monitoring well, and two rounds of groundwater sampling. The groundwater samples were analyzed for full TCL organics, TAL metals, and perchlorate (Weiss and Associates, 2005). The well locations are depicted on Figure 10 and the analytical results are summarized in Table 2-4.

2.5.4 Nature and Extent of Contamination

Contaminants of Potential Concern (COPCs) were identified based on the analytical data, risk drivers from the risk assessment (discussed in Section 2.7), and exceedances of regulatory standards and criteria. COPCs were identified by comparing the maximum detected sample analytical results for Post-Removal Action samples to EPA Region 3 RBCs for residential exposure. The concentrations of the soil COPCs are provided in Table 2-2. The COPCs include three metals (arsenic, chromium, and vanadium) and PCBs (aroclor-1016 and aroclor-1254). The concentrations of the groundwater COPCs are provided in Table 2-3. The COPCs include two metals (manganese and vanadium) and two VOCs (chloroform and tetrachloroethene).

Arsenic was detected in Site soils ranging from 1.9 mg/kg to 13.9 mg/kg. The maximum concentration was found in a sample collected from the floor of an excavation, eight feet bgs. The same sample contained the maximum chromium (30.6 mg/kg) and vanadium (25 mg/kg) concentrations. Other samples contained arsenic concentrations ranging from 1.9 mg/kg to 2.8 mg/kg. The range of chromium and vanadium concentrations in the other Site samples were 6.2 mg/kg to 11.1 mg/kg and 7 mg/kg to 15 mg/kg, respectively. Total PCBs were detected in 34 of the post-removal samples in concentrations ranging from 0.03 mg/kg (33 ug/kg) to 1 mg/kg (1,000 ug/kg). The maximum PCB concentration detected, equal to the cleanup goal of 1 mg/kg, was found in a sample collected at a depth of 2 feet bgs. All other concentrations of PCBs detected were below the cleanup goal.

Manganese was detected in all Site groundwater samples and ranged from 18.5 ug/L to 92.3 ug/L. The maximum concentration was found in a downgradient well sample collected in February 2005. The same well was sampled in May 2005 and manganese was detected at 23.2 ug/L. Manganese concentrations in all other groundwater samples, including both rounds of sampling, were below the Region 3 tap water RBC. Vanadium was detected in three Site groundwater samples collected in May 2005 ranging from 1.6 ug/L to 4.4 ug/L. The maximum concentration, the only concentration above the Region 3 tap water RBC, was detected in a downgradient well. Analysis of the sample collected from this well in the earlier sampling round did not detect vanadium. Chloroform was detected in all groundwater samples collected from the three downgradient wells at concentrations ranging from 0.73 ug/L to 4.4 ug/L. Tetrachloroethene was detected in one sample collected from a downgradient well at an estimated concentration of 0.27 ug/L. The other sample collected from this well did not contain tetrachloroethene.

Additional information on the spatial distribution and concentrations of chemicals detected in all site media and post-removal sampling conducted to date are contained in the Removal Action Completion Report (FWEC, 2004), Groundwater Characterization Report (Weiss and Associates, 2005), and Summary Site Status Report (TtNUS, 2006).

2.6 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

The Site is currently used as a storage yard for the temporary storage of surplus equipment, scrap, and supplies awaiting offsite disposition. During the Removal Action, the top 1 to 2 feet of soil were removed from the entire Site. Other areas of the Site were excavated to depths of 4 to 11 feet and potentially contaminated soil and waste were removed. The Site was brought back to original grade with clean backfill material imported from offsite and covered with a final grade of crushed and compacted recycled concrete. The Site is fenced and is located adjacent to a paved parking lot at Building N-222. The other areas adjacent to the Scrapyard Site consist of a narrow strip of undeveloped woods separating the Site from roadways, the WFF's main entrance gate and security office, and administrative office buildings. No change in the use of the Site is likely or planned. Shallow groundwater is not used by NASA for any purpose, and NASA has no plans to develop this resource in the future. Drinking water for the WFF is obtained from the deeper Yorktown Aquifer. The shallow Columbia Aquifer is not as productive as, or hydraulically connected to, the Yorktown Aquifer. The Town of Chincoteague relies primarily on the Yorktown Aquifer for its source of potable water. However, the town operates two Columbia Aquifer wells, located about 1.5 miles northeast of the Site, to augment water supplies on an as-needed seasonal basis. The town owns a third well adjacent to the operating wells which is currently in disrepair and non-operational.

2.7 SUMMARY OF SITE RISKS

As described above in Sections 2.5.2 and 2.6, the Site is an active paved storage yard and offers no significant habitat for ecological receptors. In addition, as described Section 2.5.3, an ecological risk assessment conducted before removal actions concluded that contamination at the Site did not present a significant risk to ecological receptors. Therefore, no Post-Removal ecological risk assessment was conducted.

2.7.1 Summary of Human Health Risk Assessment

The human health risk assessment (HHRA) estimates the risks that the Site would pose if no further action is taken. It provides the basis for taking no action and identifies the contaminants and exposure pathways. This section of the ROD summarizes the results of the HHRA that was included in the Summary Site Status Report (TtNUS, 2006). Given that a removal action was previously completed at the Site, a streamlined and abbreviated HHRA was conducted to establish whether soil and groundwater concentrations at the Site have been adequately remediated to the point where potential exposures would not result in unacceptable risk. The HHRA assessed the levels of residual soil contamination and current groundwater contaminants to determine whether there could be significant potential human health risks to current or future receptors. The most sensitive receptor for future exposure to soil and groundwater would be a hypothetical future resident. The primary focus of this summary is on the exposure pathways and chemicals identified as COPCs. The HHRA in the Summary Site Status Report contains an evaluation of all chemicals identified at the Site. COPCs are those chemicals that are identified as potential threats to human health and are evaluated further in the risk evaluation. Chemicals of Concern (COCs) are a subset of COPCs that are identified as needing to be addressed to remediate unacceptable risks. No COCs were identified at the Site.

2.7.1.1 Identification of Chemicals of Potential Concern

For all media, the HHRA assumed that the maximum detected concentrations of each substance were equal to the presumed concentrations for year-round continuous exposure. A preliminary risk-based screening step was employed to select COPCs and rule out substances present at concentrations below thresholds of potential significance. The maximum detected soil concentrations from soil locations remaining after the Removal Action and the maximum detected ground water concentrations identified in Site samples were compared to RBCs for residential exposure (soil and tap water). RBC benchmarks were adjusted to correspond to a lifetime cancer risk of 1×10^{-6} or a non-cancer hazard quotient HQ of 0.1. Based on this screening step, any substance present at levels above its RBCs for soil or groundwater

was then assumed to be a COPC and was carried through a risk ratio analysis to estimate cancer and non-cancer risks to future residents.

Tables 2-3 and 2-5 presents the exposure point concentrations (EPC) for each of the COPCs detected in on-Site soils based on the HHRA. The maximum detected concentration was selected as the EPC for each substance detected in Post-Removal Action soil samples collected at the Site. Soil COPCs are arsenic, chromium, vanadium and PCBs.

Tables 2-4 and 2-5 presents the EPC for each of the COPCs detected in groundwater based on the HHRA. The maximum detected concentration was selected as the EPC for each substance detected in groundwater samples collected at the Site. Groundwater COPCs are manganese, vanadium, chloroform and tetrachloroethene.

2.7.1.2 Exposure Assessment

This section presents a summary of the exposure assessment detailed in the Summary Site Status Report. The exposure assessment defines and evaluates the type and magnitude of human exposure to the chemicals present at or migrating from a site. The exposure assessment is designed to depict the physical setting of the site, to identify potentially exposed populations, and to estimate chemical intakes under the identified exposure scenarios. Actual or potential exposures are based on the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has the following three components: a source of chemicals that can be released into the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor.

The compilation of contaminant sources, likely exposure pathways, and receptors at the Site are discussed in Section 2.5.2. Potential receptors include current and future industrial workers, future construction workers, and hypothetical future residents. Examples of activities for the industrial worker include groundskeeping and maintenance of the Scrapyard, and utility or road work. Construction workers can be involved with any type of excavation activity. Future residential use is not a reasonably anticipated land use but was evaluated to determine whether unrestricted land use could be permitted. Because future residential use presents the greatest potential exposure, it was assumed that this exposure scenario would result in the greatest potential risk.

Major assumptions about exposure frequency (days per year), exposure duration (years), and other exposure factors that were included in the exposure assessment were based on exposure factors used to develop the RBCs and can be found in the Summary Site Status Report (TtNUS, 2006).

2.7.1.3 Toxicity Assessment

Carcinogenic and noncarcinogenic risk information was based on RBCs for Site COPCs which are presented in Table 2-5. For substances that potentially presented carcinogenic and noncarcinogenic risks, two RBCs were developed using the toxicity data published with the EPA Region 3 RBCs and presented in the footnotes on Table 2-5.

2.7.1.4 Risk Characterization

In the risk ratio evaluation, the EPC represents an estimated chemical concentration to which a receptor is assumed to be continuously exposed while in contact with an environmental media. Using all the analytical results for residual soil samples for COPCs, the maximum detected concentration was selected as the EPC for each substance detected in Post-Removal Scrapyard soil samples and in groundwater samples. While this risk evaluation is not typical of a rigorous statistical exposure assessment, this approach is properly conservative when utilizing RBCs as toxicity screening benchmarks.

For carcinogenic effects, the incremental cancer risk (ICR) for lifetime exposure by a future resident to one substance was represented by the following equation:

$$ICR_i = \left(EPC_i / RBC_i\right) \times 10^{-6}$$

Where:

ICRi	=	Incremental Cancer Risk for lifetime exposure to a future resident
i	=	The i^{th} Carcinogenic COPC
EPC	=	Exposure Point Concentration
RBC	=	Risk-Based Concentration

For carcinogenic effects, the total cancer risk (TCR) was represented by the following equation:

$$TCR = \sum_i ICR_i$$

Where:

TCR	=	Total Cancer Risk
ICRi	=	The i^{th} Carcinogenic Incremental Cancer Risk

The TCR represents a probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. These risks are probabilities that are usually expressed in scientific notation (e.g. 1.0E-06). An excess lifetime cancer risk of 1.0E-06 indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This risk is referred to as an "excess lifetime cancer risk", because it would be in addition to the risks of cancer individual's face from other causes such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable risk range for site-related exposure is 1.0E-04 to 1.0E-06, or an excess lifetime cancer risk of 1 in 10,000 to 1 in 1,000,000.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. For this risk evaluation the ratio of exposure to toxicity is called a hazard ratio (HR). An HR of less than one indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. For non-carcinogenic effects, the HR for one substance was represented by the following equation, which estimates the potential for risk to a future residential child, the most sensitive receptor:

$$HR_j = \left(EPC_j / RBC_j\right) \text{ x } CF_w$$

Where:

HRj	=	Hazard Ratio for Systemic Toxic Effects
j	=	j^{th} Systemic Toxicant COPC
EPC	=	Exposure Point Concentration
RBC	=	Risk-Based Concentration based on a hazard quotient (HQ) of 1.0 for exposure to soil or groundwater.
CF_w	=	Correction Factor, if needed to adjust the RBC for the most sensitive receptor. For residential exposure to tap water, the following CF is used: CF_w = 0.306 = (2 Liters per day [L/day]) / (1.4 L/day) x (15 kg) / (70kg) The adjustment of the RBC by the factor CF_w is necessary because RBCs for tap water consumption are based upon an adult receptor, whereas the most sensitive receptor for non-carcinogenic toxicity is a residential child. To be protective for non-cancer effects to the residential child, tap water RBCs should be adjusted by a factor equal to the ingestion rate ratio of the adult/child times the body weight ratio of the child/adult.

For non-carcinogenic effects, the total hazard ratio (THR) was represented by the following equation:

$$THR = \sum_i HR_i$$

Where:

THR	=	Total Hazard Ratio from all Systemic Toxicants
HRi	=	The i^{th} Hazard Ratio for Systemic Toxic Effects

If the THR exceeds one (1.0), there exists a potential for noncarcinogenic effects to occur. The THR should not be construed as a probability in the manner of the TCR but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than the substance's RfD. The RfD is the threshold concentration below which systemic effects are not likely to occur.

If the THR for a receptor exceeds 1.0, the organs potentially affected by each contaminant, referred to as target organs, were identified and a target organ-specific THR was calculated for the receptor by summing the HQs for similar target organs. A target organ-specific THR greater than 1.0 is an indication that exposures may present a risk to human health and that further evaluation and/or investigation is warranted.

Carcinogenic Risks

No unacceptable cancer risks for potential future residential exposure to Scrapyard soils and groundwater were identified. The cancer risk, assuming residential lifetime exposure to soils and use of the untreated shallow groundwater as drinking water, is 7.09×10^{-5}. This risk is within EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4}. As presented in Table 2-5 and discussed below, soil and groundwater exposure contributed equally to this overall site risk.

Table 2-5 presents the estimated ICRs for exposure to all COPCs present in residual soil and the TCR for combined exposure to all COPCs via incidental ingestion of soil by a hypothetical lifetime future resident at the Site. The TCR is 3.55×10^{-5}, which is within EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4}. This indicates that unacceptable cancer risks would not be expected to occur as a result of exposure to substances in residual soil at the Scrapyard by a hypothetical future lifetime resident. Arsenic (ICR = 3.2×10^{-5}) was the major contributor to cancer risk via ingestion of soil, along with a lesser contribution by PCBs (ICR = 3.1×10^{-6}). Since other receptors, such as an occupational worker or a construction worker, would be expected to have less contact with soil compared to a future resident, it can be concluded that exposures to substances in soil by any current or future receptor at the Site would not be expected to result in unacceptable cancer risks.

Table 2-5 also presents the estimated ICRs for exposure to all COPCs present in groundwater and the TCR for combined exposure to all COPCs via household contact with tap water by a hypothetical lifetime future resident at the Site. The TCR is 3.54×10^{-5}, which is within EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4}. Therefore unacceptable cancer risks would not be expected to occur as a result of exposure to substances in groundwater at the Scrapyard by a hypothetical future lifetime resident. Chloroform (ICR = 3.3×10^{-5}) was the major contributor to cancer risk via ingestion of tap water, along with a lesser contribution by tetrachloroethene (ICR = 2.7×10^{-6}). Since other receptors, such as an occupational worker or a construction worker, would be expected to have less contact with tap water or groundwater compared to a future resident, it can be concluded that exposures to substances in groundwater by any current or future receptor at the Site would not be expected to result in unacceptable cancer risks.

Noncarcinogenic Risks

No unacceptable non-cancer risks for potential future residential exposure to Scrapyard soils and groundwater were identified. Target organ-specific THRs from exposure to soil and groundwater by a future resident range from a low of 0.042 to a high of 0.71, which are below the target value of 1. Therefore adverse non-cancer health effects would not be expected to occur as a result of exposures to substances in soil and groundwater at the Scrapyard. The kidney was the only target organ identified that could be potentially impacted by residential exposure to both soil and groundwater at the Scrapyard. Vanadium, detected in both soil and groundwater, contributed to a non-cancer THR of 0.71 for the kidney. Table 2-5 presents the non-cancer risks associated soil and groundwater exposure and each are discussed below.

Table 2-5 presents the estimated HRs for exposure to individual COPCs present in residual soil and the THR for combined exposure to all COPCs via incidental ingestion of soil by a hypothetical future child resident at the Site. The THR is expressed as the sum of all HRs for each substance, with the summations grouped according to further toxicological considerations of target organs. The various target organ THRs from exposure to soil by a future resident range from a low of 0.042 for contaminants that could potentially adversely effect a baby's birth weight to a high of 0.68 for those that could potentially impact the skin, which are all less than the target HR of 1.0, a threshold above which adverse non-carcinogenic effects cannot be ruled out. Therefore adverse non-carcinogenic health effects would not be expected to occur as a result of exposures to substances in residual soil at the Scrapyard by a hypothetical future child resident. Since other receptors would be expected to have less contact with soil compared to a future residential child, it can be concluded that exposures to substances in soil by any current or future receptor at the Site would not be expected to result in unacceptable non-cancer risk.

Table 2-5 also presents the estimated HRs for exposure to individual COPCs present in groundwater and the THR for combined exposure to all COPCs via household contact with tap water by a hypothetical future

child resident at the Site. The THR is expressed as the sum of all HRs for each substance, with the summations grouped according to further toxicological considerations of target organs. The various target organ THRs from exposure to groundwater by a future resident range from a low of 0.046 for the target organ liver to a high of 0.41 for the target organ central nervous system (CNS), which are all less than the target HR of 1.0, a threshold above which adverse non-carcinogenic effects cannot be ruled out. Therefore adverse non-carcinogenic health effects would not be expected to occur as a result of exposures to substances in groundwater at the Scrapyard by a hypothetical future child resident. Since other receptors would be expected to have less contact with tap water or groundwater compared to a future residential child, it can be concluded that exposures to substances in groundwater by any current or future receptor at the Site would not be expected to result in unacceptable non-cancer risk.

Uncertainty Analysis

There is uncertainty associated with aspects of the streamlined/screening risk evaluations. Uncertainty in the EPC is associated with the use of the maximum concentration instead of an upper confidence limit (UCL) to estimate the upper range of exposure to an affected receptor population. Use of the maximum concentration is generally more conservative than using the 95 percent UCL with a large data set; therefore, this imparts an additional conservatism to the risk-ratio assessment.

In this risk ratio evaluation, a primary source of uncertainty regarding potential soil exposure is the assumption that future residents would be exposed to subsurface soil at the Scrapyard. The existence of a minimum of 12 inches to 48 inches of clean fill at the Site, including crushed and compacted material, reduces the likelihood that that subsurface soil may eventually be disturbed and redistributed at the ground surface in conjunction with any future land development or project involving grading, re-landscaping, or foundation excavation. Several of the confirmation samples were collected at the bottom of excavation pits at depths of 6 to 11 feet bgs. While future residential development at the Site is not anticipated, even if such a scenario were to occur, it would be unlikely that any soil disturbance would result in the mixing of subsurface soil at depths below 5 or 6 feet bgs. Furthermore, any future land development that involved soil excavation or regrading would also reduce the effective concentrations in contaminated soil by dilution with clean fill surface soil which currently exists at the Scrapyard.

Another uncertainty in this risk ratio toxicity assessment includes the assumptions used in the derivation of RBCs, especially the assumption that only ingestion exposures are significant. For soil exposure to PCBs and many common metals, the absorbed dose from the ingestion exposure pathway is estimated to be more significant than that from dermal contact exposure to a great extent. However, there are tremendous uncertainties in estimating dermal contact exposure, and so this assumption may not always be true. Hence, total risks may be underestimated to an extent as a result of including only the ingestion pathway

and not dermal contact exposure. However, by using the maximum value in place of the 95 % UCL for the EPC, this is expected to lend additional conservatism to the risk ratio assessment, to an extent which may offset the tendency to underestimate risks as a result of not considering dermal contact exposure when using RBC-based toxicity evaluation.

2.8 DOCUMENTATION OF SIGNIFICANT CHANGES FROM THE PRAP

The PRAP for the Scrapyard at NASA WFF, Wallops Island, Virginia was released for public comments on February 14, 2007. The PRAP identified No Action as the preferred alternative for the Scrapyard. No written or verbal comments were submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the PRAP, were necessary or appropriate based on public comments.

3.0 RESPONSIVENESS SUMMARY

In accordance with Sections 113 and 117 of CERCLA, NASA provided a public comment period from February 14, 2007 to March 15, 2007 for the proposed remedial action as described in the PRAP for the Site. Public input is a key element in the decision-making process.

The PRAP remains available to the public in the Administrative Record. The RI, Removal Action Completion Report, Groundwater Characterization Report, and Summary Site Status Reports are also available in the Administrative Record. The Information Repositories for the Administrative Record are maintained by the Eastern Shore Public Library (23610 Front Street, Accomack, Virginia 23301) and the Island Library (4077 Main Street, Chincoteague, Virginia 23336).

A public meeting to discuss the PRAP for the Site was held at the NASA WFF Visitor Center on March 1, 2007. Details concerning the public meeting and availability of documents were placed in the Chincoteague Beacon and Eastern Shore News on February 8 and 14, 2007, respectively.

No comments were received by NASA, EPA, or DEQ during the public comment period. Representatives of NASA, EPA, and DEQ were available at the public meeting to present the PRAP for the Site and to answer questions on the proposed remedy.

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TABLES

Table 2-1
Pre-Remedial Investigation Soil Sample Results[(1)]
Scrapyard Site
NASA Wallops Flight facility
Wallops Island, Virginia

Chemical	Units	Minimum Concentration *	Minimum Qualifier	Maximum Concentration *	Maximum Qualifier	Detection Frequency
Aluminum	mg/kg	3,140	JB	27,400	JB	17/17
Arsenic	mg/kg	2.3		6		6/17
Barium	mg/kg	70		154		4/17
Beryllium	mg/kg	1.3		2	J	2/17
Cadmium	mg/kg	1.2		79		11/17
Chromium	mg/kg	3.8	J	37		16/17
Copper	mg/kg	7.7		282		11/17
Iron	mg/kg	2,780	JB	23,100	JB	17/17
Lead	mg/kg	4.1	J	353	J	17/17
Magnesium	mg/kg	2,180		2,180		1/17
Manganese	mg/kg	59	JB	747		8/17
Mercury	mg/kg	0.28		5		6/17
Nickel	mg/kg	11		94		9/17
Silver	mg/kg	3.4		3		1/17
Vanadium	mg/kg	12	J	210	J	13/17
Zinc	mg/kg	9.6		1,170		17/17
Acetone	ug/kg	19		380		14/17
Benzene	ug/kg	28		28		1/17
2-Butanone	ug/kg	22		22		1/17
Chlorobenzene	ug/kg	37		37		1/17
Ethyl Benzene	ug/kg	13		13		1/17
O & P Xylene	ug/kg	8	J	8	J	1/17
Xylenes (total)	ug/kg	70		70		1/17
M-Xylene	ug/kg	71		71		1/17
Carbon Tetrachloride	ug/kg	110		110		1/17
1, 1-Dichloroethane	ug/kg	13		13		1/17
1, 1-Dichloroethene	ug/kg	7		7		1/17
2-Hexanone	ug/kg	220		220		1/17
4-Methyl - 2-Pentanone	ug/kg	150		150		1/17
Methylene Chloride	ug/kg	4	J	150		15/17
1, 1, 2, 2-Tetrachloroetha	ug/kg	14		14		1/17
1,1,1-Trichloroethane	ug/kg	5		550		13/17
Toluene	ug/kg	2	J	51		2/17
Trichlorofluoromethane	ug/kg	6	J	19		5/17
Tetrachloroethene	ug/kg	8		9	J	2/17
Trichloroethane	ug/kg	1	J	31		4/17
Vinyl Acetate	ug/kg	22		22		1/17

Table 2-1
Pre-Remedial Investigation Soil Sample Results[(1)]
Scrapyard Site
NASA Wallops Flight facility
Wallops Island, Virginia

Chemical	Units	Minimum Concentration *	Minimum Qualifier	Maximum Concentration *	Maximum Qualifier	Detection Frequency
Anthracene	ug/kg	240	J	240	J	1/17
Benzo(a)anthracene	ug/kg	140	J	1,400	J	4/17
Benzo(a)pyrene	ug/kg	290	J	2,600	J	3/11
Benzo(b)fluoranthene	ug/kg	510	J	2,600	J	3/17
Benzo(k)fluoranthene	ug/kg	1,100		1,100		1/11
Benzo (g,h,i) Perylene	ug/kg	480	J	480	J	1/11
bis (2-Ethylhexyl) Phthalate	ug/kg	130	J	18,000	J	8/17
Chrysene	ug/kg	660	J	2,300	J	3/11
Dimethyl Phthalate	ug/kg	710	J	710	J	1/17
Dibenzo (a,h) Anthracene	ug/kg	100	J	100	J	1/11
Fluoranthene	ug/kg	430	J	5,900		3/17
Ideno (1,2,3-cd) Pyrene	ug/kg	740		740		1/11
Phenanthene	ug/kg	130	J	1,000		2/11
Pyrene	ug/kg	190	J	1,500	J	3/17
DI-N-Octyl Phthalate	ug/kg	20		20		1/17
4,4'-DDD	ug/kg	12		21,000		5/17
4,4'-DDE	ug/kg	15		12,000		11/17
4,4'-DDT	ug/kg	23		2,800		10/17
Dieldrin	ug/kg	38		38		1/11
Endosulfan II	ug/kg	35		35		1/11
Endosulfan Sulfate	ug/kg	9.8		10		1/11
Aroclor-1242	ug/kg	130		980		2/13
Aroclor-1254	ug/kg	980		980		1/13
Aroclor-1260	ug/kg	160		72,000		4/20
PCBs, Total++	ug/kg	130		72,000		6/20

(1) Sample Results from Site Investigation and Preliminary Field Investigation Sampling Programs (Ebasco, 1990a, Ebasco 1990b, and Metcalf & Eddy 1992). Only parameters with 1 or more detections are listed.

*--Minimum/maximum detected concentration.

J = estimated value

JB = Estimated value detected at similar concnetration in blank sample.

Table 2-2
Remedial Investigation PCB and Mercury Soil Sample Results
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Chemical	Minimum * Concentration	Minimum Qualifier	Maximum * Concentration	Maximum Qualifier	Units	Detection Frequency	Human Health Screening Values (1) (µg/kg)	Ecological Screening Values (2) (µg/kg)
Aroclor-1016	--		--		µk/kg		--	
Aroclor-1221	--		--		µk/kg		--	
Aroclor-1232	--		--		µk/kg		--	
Aroclor-1242	470,000	J	470,000	J	µk/kg	1/13	--	
Aroclor-1248	--		--		µk/kg		--	
Aroclor-1254	150	J	23,000	J	µk/kg	6/13	--	
Aroclor-1260	16	J	26,000	J	µk/kg	10/13	--	
PCB**	16	J	470,000		µk/kg	13/13	83	100
Mercury	1.2		6		mg/kg	6/13	23	30

* Minimum/maximum detected concentration.

(1) Human Health screening values were derived from EPA Region III Risk Based Concentration Screening Values (1/31/1995). Limited Remedial Investigation Report for the Scrapyard Area by Metcalf & Eddy; 1995.

(2) Ecological Screening Values were derived using National Oceanic and Atmospheric Association Screening Guidance. Inorganics values based on US soils and organics based on Canadian target values.Limited Remedial Investigation Report for the Scrapyard Area by Metcalf & Eddy; 1995.

RBC values are based on 1E-06 cancer risk or a Hazard Quotient of 1.

J = Estimated Value

Table 2-3
Post Removal Soil Samples Results and Selection of COPCs
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Chemical	Minimum * Concentration	Minimum Qualifier	Maximum * Concentration	Maximum Qualifier	Units	Detection Frequency	Concentration Used for Screening	(1) Background Value (95% UTL)	(2) Screening Toxicity Value		COPC Flag	(3) Rationale for Contaminant Deletion or Selection	PCB Clean-Up Goal (µg/kg)
Aluminum	6220		11200		mg/kg	5/5	11200	29600	N/A	N	N	NoSCR**	
Antimony	0.49	J	2.2		mg/kg	4/5	2.2	N.D.	3.1	N	N	BSL	
Arsenic	**1.9**		**13.9**		**mg/kg**	**5/5**	**13.9**	**6**	**0.43**	**C**	**Y**	**ASL**	
Barium	17.9		38.4		mg/kg	5/5	38.4	49.1	1600	N	N	BSL	
Beryllium	0.14		0.31		mg/kg	3/5	0.31	N/A	16	N	N	BSL	
Cadmium	0.055	J	1.3		mg/kg	5/5	1.3	N/A	7.8	N	N	BSL	
Calcium	141	J	444		mg/kg	5/5	444	306	N/A		N	NUT	
Chromium	**6.2**	**J**	**30.6**		**mg/kg**	**5/5**	**30.6**	**18.2**	**23**	**N**	**Y**	**ASL**	
Cobalt	0.69		1.9	J	mg/kg	5/5	1.9	N/A	N/A	N	N	NoSCR**	
Copper	6.7		46.8		mg/kg	5/5	46.8	N/A	310	N	N	BSL	
Iron	3710		6590		mg/kg	5/5	6590	17000	2300	N	N	BKG	
Lead	3.7		49.5		mg/kg	5/5	49.5	13.3	400	N	N	BSL	
Magnesium	288	J	732	J	mg/kg	5/5	732	8000	N/A		N	NUT	
Manganese	20.7		96.2	J	mg/kg	5/5	96.2	158	160	N	N	BSL	
Mercury	0.016	J	0.19		mg/kg	3/5	0.19	N/A	2.3	N	N	BSL	
Nickel	4.8	J	10.2		mg/kg	5/5	10.2	N/A	160	N	N	BSL	
Potassium	283		400	J	mg/kg	5/5	400	N/A	N/A		N	NUT	
Selenium	0.3	J	0.57	J	mg/kg	4/5	0.57	N/A	39	N	N	BSL	
Silver	0.083	J	0.2	J	mg/kg	3/5	0.2	N/A	39	N	N	BSL	
Sodium	48.4	J	196	J	mg/kg	5/5	196	85.9	N/A		N	NUT	
Vanadium	**7**		**25**		**mg/kg**	**5/5**	**25**	**N/A**	**7.8**	**N**	**Y**	**ASL**	
Zinc	29.7		168		mg/kg	5/5	168	N/A	2300	N	N	BSL	
Benzo(a)anthracene	91	J	91	J	ug/kg	1/1	91	N/A	870	C	N	BSL	
Benzo(a)pyrene	66	J	66	J	ug/kg	1/1	66	N/A	87	C	N	BSL	
Benzo(b)fluoranthene	84	J	84	J	ug/kg	1/1	84	N/A	870	C	N	BSL	
Chrysene	50	J	50	J	ug/kg	1/1	50	N/A	87000	C	N	BSL	
Fluoranthene	170	J	170	J	ug/kg	1/1	170	N/A	310000	N	N	BSL	
Phenanthene	90	J	90	J	ug/kg	1/1	90	N/A	230000***	N	N	BSL	
Pyrene	130	J	130	J	ug/kg	1/1	130	N/A	230000	N	N	BSL	

Table 2-3
Post Removal Soil Samples Results and Selection of COPCs
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Chemical	Minimum * Concentration	Minimum Qualifier	Maximum * Concentration	Maximum Qualifier	Units	Detection Frequency	Concentration Used for Screening	(1) Background Value (95% UTL)	(2) Screening Toxicity Value		COPC Flag	(3) Rationale for Contaminant Deletion or Selection	PCB Clean-Up Goal (µg/kg)
4,4'-DDD	1.7	J	18	J	ug/kg	4/5	18	N/A	2700	C	N	BSL	
4,4'-DDE	1.2	J	9.7	J	ug/kg	4/5	9.7	N/A	1900	C	N	BSL	
4,4'-DDT	3.5	J	57	J	ug/kg	5/5	57	N/A	1900	C	N	BSL	
Dieldrin	1.3	J	8.3	J	ug/kg	5/5	8.3	N/A	40	C	N	BSL	
Endosulfan II	2.4	J	2.4	J	ug/kg	1/5	2.4	N/A	47000	N	N	BSL	
Endrin	0.57	J	0.57	J	ug/kg	1/5	0.57	N/A	2300	N	N	BSL	
Endrin Aldehyde	2.7	J	20	J	ug/kg	3/5	20	N/A	2300	N	N	BSL	
Methoxychlor	0.71	J	0.71	J	ug/kg	1/5	0.71	N/A	39000	N	N	BSL	
Aroclor-1016	**160**		**230**		**ug/kg**	**3/46**	**230**	**N/A**	**550**		**Y**	**(4)**	
Aroclor-1248	**160**		**630**		**ug/kg**	**5/46**	**630**	**N/A**	**320**		**Y**	**(4)**	
Aroclor-1254	**130**		**130**		**ug/kg**	**1/46**	**130**	**N/A**	**156**		**Y**	**(4)**	
Aroclor-1260	**33**		**1000**		**ug/kg**	**32/46**	**1000**	**N/A**	**320**		**Y**	**(4)**	
PCBs, Total++	**33**		**1000**		**ug/kg**	**34/46**	**1000**	**N/A**	**320**		**Y**	**(4)**	**1,000**

This screening is valid for Residential Adult, Residential Child, and Lifetime Resident.

* Minimum/maximum detected concentration.

** -- PPTRVs were retired for aluminum and cobalt, so no RBCs are available.

*** -- No RBC available for phenanthrene, so RBC surrogate based on pyrene.

++ -- Total PCBs represents the sum of all detected PCB Aroclors and is used to evaluate the cumulative cancer risk ratio from exposure to all Aroclors.

(1) Background results for 95% UTL for bojac subsurface soil (METALS ONLY)

(2) EPA Region III Risk Based Concentration Screening Values (10/2005).

(3) Rationale Codes Selection Reason:

Rationale Codes Deletion Reasons:

Above Screening Level (ASL)
No Screening Value (NoSCR)
Below Background Level (BKG)
Essential Nutrient (NUT)
Below Screening Level (BSL)

Definitions: N/A = Not Applicable
COPC = Chemical of Potential Concern
N = Non-Carcinogenic
J = Estimated Value

RBC values are based on 1E-06 cancer risk or a Hazard Quotient of 0.1.

RBCs are based upon a hierarchy of toxicity values obtained from (1) - EPA, 2006 - Integrated Risk Information System (IRIS), (2) - Provisional Peer Reviewed Toxicity Values (PPRTVs, from EPA National Center for Environmental Assessment), or (3) - Health Effects Assessment Summary Tables (HEAST, EPA, 1997).

(4) Retained all PCBs.

Table 2-4
Post Removal Groundwater Sample Results and Selection of COPCs
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Chemical	Minimum * Concentration	Minimum Qualifier	Maximum * Concentration	Maximum Qualifier	Units	Detection Frequency	Concentration Used for Screening	Screening Toxicity Value (1)		COPC Flag	Rationale for Contaminant Deletion or Selection (2)	Primary (3) EPA MCLs	VDEQ (4) Groundwater Quality Standards
Aluminum	96		900		ug/L	6/6	900	N/A**	N	N	NoSCR	N/A	N/A
Barium	15		45		ug/L	6/6	45	730	N	N	BSL	2,000	1,000
Calcium	3,240		8,440	J	ug/L	6/6	8,440		N	N	NUT	N/A	N/A
Chromium	1		2		ug/L	2/3	2	11	N	N	BSL	100	50
Cobalt	1		1		ug/L	1/5	1	N/A**	N	N	NoSCR	N/A	N/A
Iron	59	L	565		ug/L	5/5	565	1,100	N	N	BSL	N/A	N/A
Lead	3	L	3	L	ug/L	2/6	3	15	C	N	BSL	15	50
Magnesium	3,880		9,190		ug/L	6/6	9,190		N	N	NUT	N/A	N/A
Manganese	**19**		**92**		**ug/L**	**6/6**	**92**	**73**	**N**	**Y**	**ASL**	**N/A**	**N/A**
Potassium	826	J	2,210		ug/L	5/5	2,210		N	N	NUT	N/A	N/A
Sodium	6,470		20,400	J	ug/L	5/5	20,400		N	N	NUT	N/A	270,000
Vanadium	**2**		**4**		**ug/L**	**3/4**	**4**	**4**	**N**	**Y**	**ASL**	**N/A**	**N/A**
Zinc	8		11		ug/L	3/3	11	1,100	N	N	BSL	N/A	50
Perchlorate	0		1		ug/L	6/6	1	2.56***	N	N	BSL	N/A	N/A
4,4'-DDT	0	J	0	J	ug/L	2/6	0	0	C	N	BSL	N/A	0.001
Bis(2-ethylhexyl) Phthalate	2	J	4	J	ug/L	2/6	4	5	C	N	BSL	N/A	N/A
Butyl Benzyl Phthalate	0	J	0	J	ug/L	1/6	0	35	C	N	BSL	N/A	N/A
Caprolactam	5	J	8	J	ug/L	3/6	8	1,800	N	N	BSL	N/A	N/A
Phenol	1	J	2	J	ug/L	3/6	2	1,100	N	N	BSL	N/A	1
1,1,1-Trichloroethane	1	J	1	J	ug/L	1/6	1	170	N	N	BSL	200	N/A
Acetone	4	J	4	J	ug/L	1/6	4	550	N	N	BSL	N/A	N/A
Chloroform	**1**	**J**	**5**		**ug/L**	**6/6**	**5**	**0**	**C**	**Y**	**ASL**	**N/A**	**N/A**
Tetrachloroethene	**0**	**J**	**0**	**J**	**ug/L**	**1/6**	**0**	**0**	**C**	**Y**	**ASL**	**5**	**N/A**

Table 2-4
Post Removal Groundwater Sample Results and Selection of COPCs
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

This screening is valid for Residential Adult, Residential Child, and Lifetime Resident.

* -- Minimum/maximum detected concentration.

** -- PPTRVs were retired for aluminum and cobalt, so no RBCs are available.

*** --Perchlorate RBC assumes RfD of 0.0007 mg/kg/day (EPA, 2006b), given Region 3 tap water RBC equation (EPA, 2006a). RBC = 25.6ug/L = (HQ of 1)/(350days/yr)*(70kg)/(30yrs)*(365days*30yrs)*(1000ug/mg)/(2L/day)*(0.0007mg/kg/day)

(1) EPA Region III Risk Based Concentration Screening Values (10/2005).

(2) Rationale Codes Selection Reason: Above Screening Level (ASL)

'Rationale Codes Deletion Reasons: No Screening Value (NoSCR)
Essential Nutrient (NUT)
Below Screening Level (BSL)

(3) National Primary Drinking Water Regulations from EPA website; http://www.epa.gov/safewater/contaminants/index.html

(4) VDEQ Groundwater Quality Standards State water Control Board 9 VAC 25-280-40.

RBC values are based on 1E-06 cancer risk or a Hazard Quotient of 0.1.

RBCs are based upon a hierarchy of toxicity values obtained from (1) - EPA, 2006c - Integrated Risk Information System (IRIS), (2) - Provisional Peer Reviewed Toxicity Values (PPRTVs, from EPA National Center for Environmental Assessment), or (3) - Health Effects Assessment Summary Tables (HEAST, EPA, 1997).

Definitions:
N/A = Not Applicable
COPC = Chemical of Potential Concern
N = Non-Carcinogenic
J = Estimated Value

Table 2-5
Soil and Groundwater COPC Occurrence and
Risk Evaluation of Contact with COPCs Present in Soil and Groundwater
Exposure to Future Resident
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil
Exposure Point: Contact with Soil

CAS Number	Chemical	(1) Minimum Concentration	Minimum Qualifier	(1) Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Target Organs	Concentration Used for Risk Ratio (3)	Adjusted RBC (2) Based on Type of Risk N - Noncancer risk C - Cancer Risk		Risk Ratio = ICR if Carcinogen or = HR if Noncancer Toxicity
7440-38-2	Arsenic	1.9		13.9		mg/kg	N-222-GEOD18	5/5		13.9	0.43	C	3.23E-05
7440-38-2	Arsenic	1.9		13.9		mg/kg	N-222-GEOD18	5/5	Skin/Vascular	13.9	23.5++	N**	0.60
7440-47-3	Chromium	6.2	J	30.6		mg/kg	N-222-GEOD18	5/5	Fetotoxicity/GI Tract/Bone	30.6	230	N**	0.13
7440-62-2	Vanadium	7		25		mg/kg	N-222-GEOD18	5/5	Kidney	25	78	N**	0.32
12674-11-2	Aroclor-1016	160		230		ug/kg	N222WFFCF1001	3/46	Birth Weight	230	5500	N**	0.042
11097-69-1	Aroclor-1254	130		130		ug/kg	N222WFFCF1011-A	1/46	Skin/Eye	130	1560	N**	0.083
	PCBs, Total***	33		1000		ug/kg	N222WFFCF1014-A	34/46		1000	320	C	3.13E-06

Total Cancer Risk (TCR) from all COPCs =	3.55E-05
Total Hazard Ratio (THR) from all COPCs =	1.2

This risk ratio evaluation is valid for Residential Adult, Residential Child, and Lifetime Resident. Cancer risk applies to lifetime resident and noncancer risk applies to residential child.

* -- Soil represents hypothetical disturbed soil that has been mixed as a result of landscaping or construction and resdistributed at the surface.

** -- Noncancer risks are only additive when they affect the same target organ. Total Hazard Ratio (THR) is summed separately for each target organ.

*** -- Total PCBs represents the sum of all detected PCB Aroclors and is used to evaluate the cumulative cancer risk ratio from exposure to all Aroclors.

(1) Minimum/maximum detected concentration.

(2) EPA Region III Risk Based Concentration (RBC) Screening Values (10/2005).

RBC values are based on 1E-06 cancer risk or a Hazard Quotient of 1.0.

(3) EPC = Maximum Detection

Total Hazard Ratio (THR) for each target organ:

Birth Weight THR =	0.042
Bone THR =	0.13
Eye THR =	0.083
Fetotoxicity THR =	0.13
GI Tract THR =	0.13
Kidney THR =	0.32
Skin THR =	0.68
Vascular THR =	0.60

++ -- Arsenic RBC assumes RfD = 0.0003mg/kg/day (EPA,2006b), and Region 3 soil RBC equation (EPA,2006a). RBC = 23.5mg/kg = (HQ of 1)/(350days/yr)*(15kg)/(6yrs)*(365days/yr*6yrs)/(200mg/day)*(10^6mg/kg)*(0.0003mg/kg/day)

Table 2-5
Soil and Groundwater COPC Occurrence and
Risk Evaluation of Contact with COPCs Present in Soil and Groundwater
Exposure to Future Resident
Scrapyard Site
NASA Wallops Flight Facility
Wallops Island, Virginia

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater
Exposure Point: Tap Water Contact with Groundwater

CAS Number	Chemical	(1) Minimum Concentration	Minimum Qualifier	(1) Maximum Concentration	Maximum Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Target Organs	Concentration Used for Risk Ratio (3)	Adjusted RBC = RBC if Carcinogen or = RBC x 0.306 if Noncancer Toxicity (2)		Risk Ratio = ICR if Carcinogen or = HR if Noncancer Toxicity
7439-96-5	Manganese	18.5		92.3		ug/L	N222-MW003-20050208	6/6	CNS	92.3	223	N**	0.41
7440-62-2	Vanadium	1.6		4.4		ug/L	N222-MW004-20050510	3/4	Kidney	4.4	11	N**	0.39
67-66-3	Chloroform	0.73	J	4.9		ug/L	N222-MW004-20050208	6/6	Liver	4.9	112+	N**	0.044
67-66-3	Chloroform	0.73	J	4.9		ug/L	N222-MW004-20050208	6/6		4.9	0.15	C	3.3E-05
127-18-4	Tetrachloroethene	0.27	J	0.27	J	ug/L	N222-MW004-20050510	1/6	Liver	0.27	112++	N**	0.0024
127-18-4	Tetrachloroethene	0.27	J	0.27	J	ug/L	N222-MW004-20050510	1/6		0.27	0.1	C	2.7E-06

Total Cancer Risk (TCR) for all COPCs = 3.54E-05
Total Hazard Ratio (THR) for all COPCs = 0.85

This risk ratio evaluation is valid for Residential Adult, Residential Child, and Lifetime Resident. Cancer risk applies to lifetime resident and noncancer risk applies to residential child.
** -- Noncancer risks are only additive when they affect the same target organ. Total Hazard Ratio (THR) is summed separately for each target organ.

Total Hazard Ratio (THR) for each target organ:
Central Nervous System (CNS) THR = 0.41
Kidney THR = 0.39
Liver THR = 0.046

(1) Minimum/maximum detected concentration.
(3) EPC = Maximum Detection
(2) EPA Region III Risk Based Concentration (RBC) Screening Values (10/2005) for cancer (C) or noncancer toxicity (N). Based on 1E-06 cancer risk for a lifetime resident or a Hazard Index of 1 for a residential child.
+ -- Chloroform noncancer RfD=0.01 mg/kg/day (EPA,2006b). Region 3 tap water equation (EPA,2006a). RBC = 112 ug/L = (HQ of 1)/(350days/yr)*(70kg)/(30yrs)*(365days*30yrs)*(1000ug/mg)/(2L/day)*(0.01mg/kg/day)*0.306
++ -- Tetrachloroethene noncancer RfD=0.01 mg/kg/day (EPA,2006b). Region 3 tap water equation (EPA,2006a). RBC = 112ug/L = (HQ of 1)/(350days/yr)*(70kg)/(30yrs)*(365days*30yrs)*(1000ug/mg)/(2L/day)*(0.01mg/kg/day)*0.306

TOTAL CANCER RISK AND HAZARD RATIO ALL MEDIA

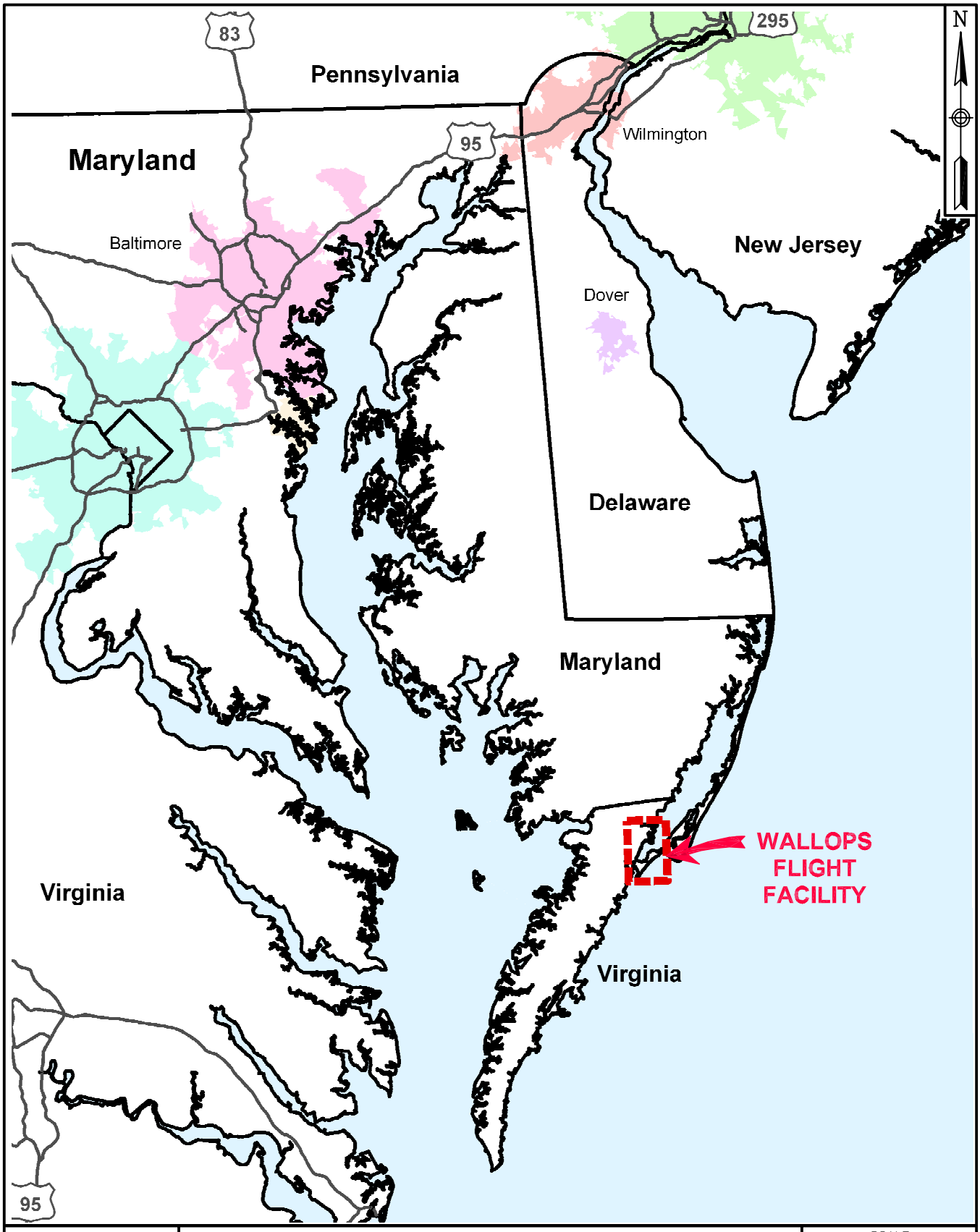
Scenario Timeframe: Future
Medium: Soil and Groundwater
Exposure Medium: Soil and Groundwater
Exposure Point: Contact with Soil and Groundwater as Tap Water

Total Cancer Risk (TCR) from Soils = 3.55E-05
Total Cancer Risk (TCR) from Groundwater = 3.54E-05
TOTAL COMBINED PATHWAY CANCER RISK = 7.09E-05

Total Hazard Ratio (THR) for each target organ Soil and Groundwater:
Birth Weight THR = **0.042**
Bone THR = **0.13**
Eye THR = **0.083**
Fetotoxicity THR = **0.13**
GI Tract THR = **0.13**
Kidney THR = **0.71**
Skin THR = **0.68**
Vascular THR = **0.60**
Central Nervous System (CNS) THR = **0.41**
Liver THR = **0.046**

FIGURES

112G00198\0213\112G00198BM01.DWG 05/08/07 MKB



TETRA TECH NUS, INC.

SITE LOCATION MAP OF NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

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REV	0
DATE	05/08/07
FIGURE NUMBER	FIGURE 1

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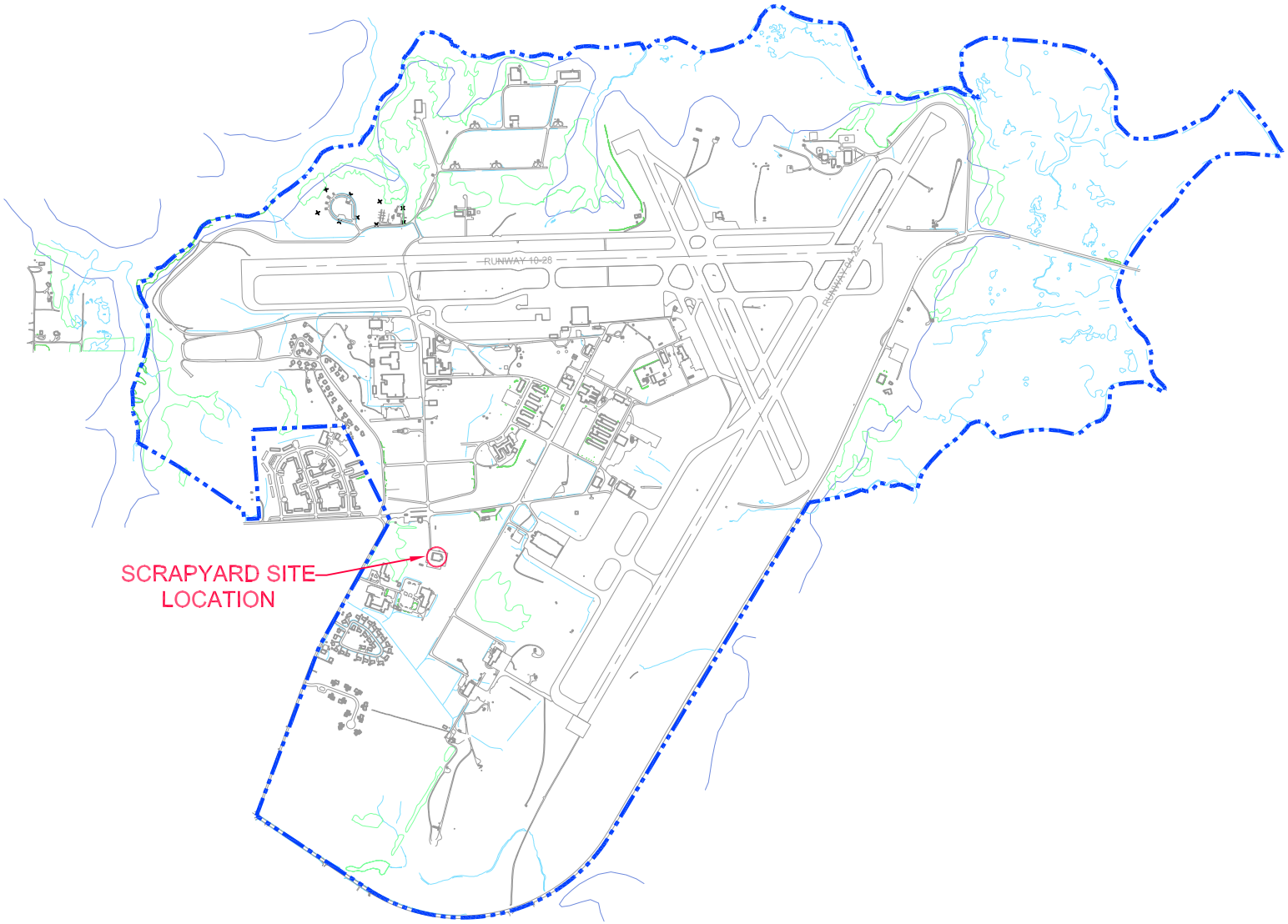

0 2000 4000

SCALE IN FEET

TETRA TECHNUS, INC.

SCRAPYARD SITE LOCATION
NASA WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

SCALE	AS NOTED
FILE	112G00198GM01
REV	0
DATE	05/08/07
FIGURE NUMBER	FIGURE 2

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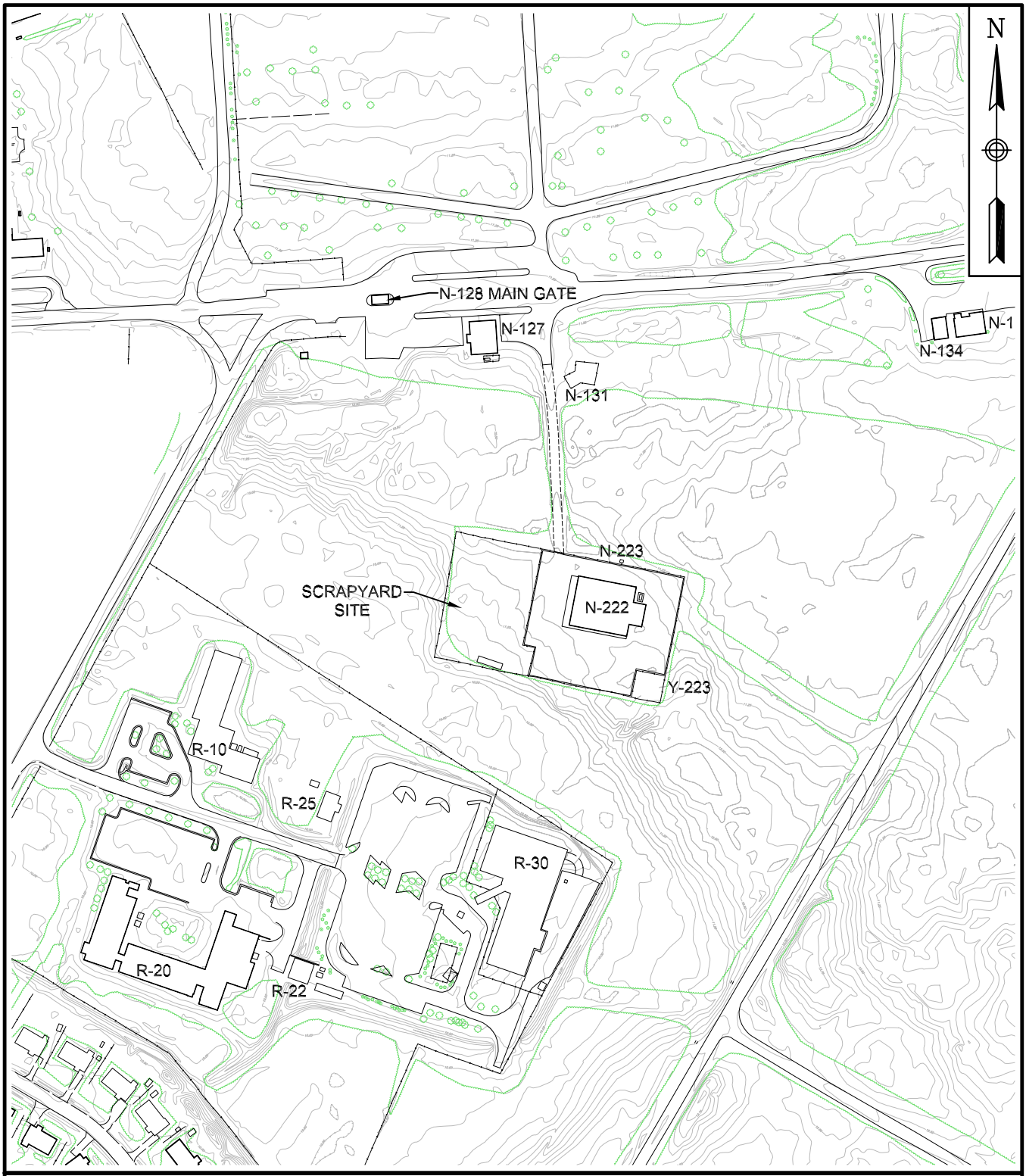

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SCALE IN FEET

TETRA TECH NUS, INC.

SCRAPYARD SITE AREA
NASA WALLOPS FLIGHT FACILITY
WLLOPS ISLAND, VIRGINIA

SCALE	AS NOTED
FILE	112G00198GM02
REV	0
DATE	05/07/07
FIGURE NUMBER	FIGURE 3

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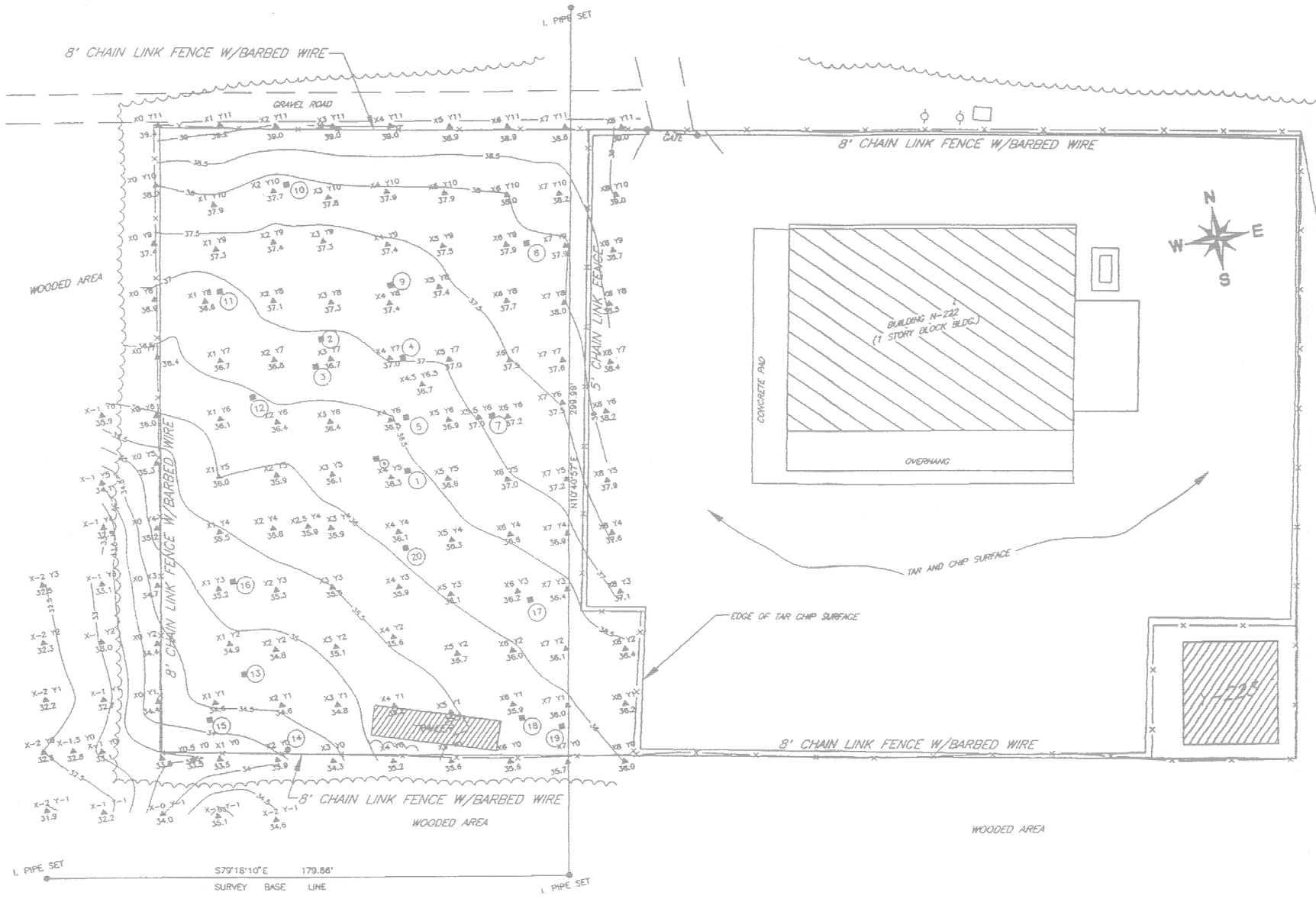


LEGEND

- ● CONTROL MONUMENTATION SET
- X3 Y8 ▲ 36.5 FIELD SAMPLE LOCATION WITH IDENTIFICATION NUMBER AND ELEVATION
- ■ (5) PCB WIPE SAMPLE LOCATION WITH IDENTIFICATION NUMBER
- ~35~ SURVEYED 0.5 FT. CONTOUR INTERVAL

GENERAL NOTES:

1. HORIZONTAL AND VERTICAL CONTROL IS TIED TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM NAD83. REFERENCE STATION NUMBERS WFF-01,WFF-02,WFF-03, AND WFF-04.
2. FIELD SURVEY LOCATIONS WERE PERFORMED BY GILMORE & ASSOCIATES, INC. ON FEBRUARY 21, 1995.
3. PCB WIPE SAMPLE LOCATIONS PROVIDED BY METCALF & EDDY, INC.
4. SCREENED AERIAL WAS PROVIDED BY METCALF & EDDY, INC. AND CONVERTED FROM METRIC TO FEET.

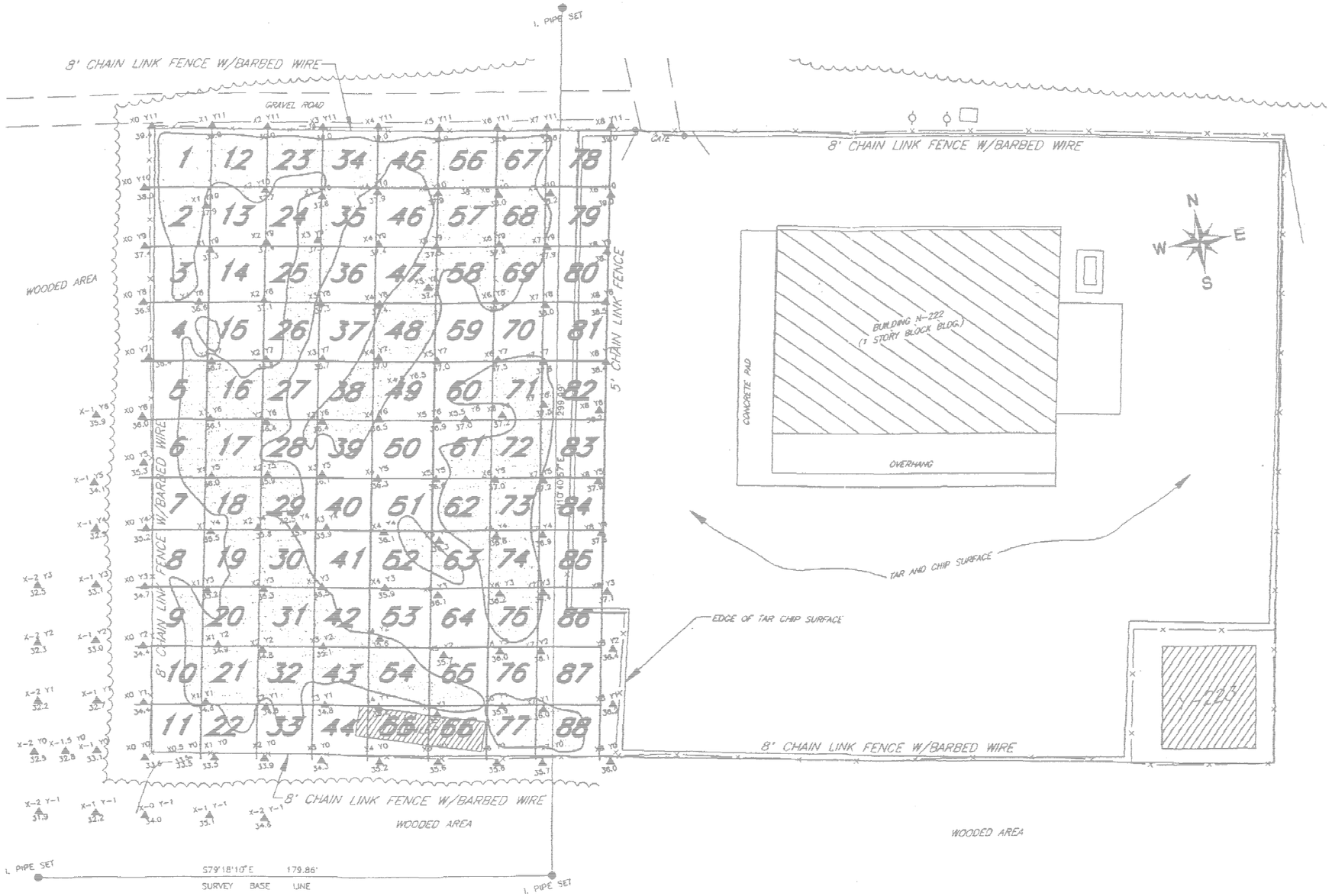
SOURCE:
FIGURE 2-4 PCB FIELD SAMPLING LOCATIONS AND AS-BUILT GRID LOCATION, LIMITED REMEDIAL INVESTIGATION REPORT FOR THE SCRAPYARD AREA, PREPARED BY METCALF & EDDY, AUGUST 1995

TETRA TECH NUS, INC.

1995 LIMITED REMEDIAL INVESTIGATION SAMPLE LOCATIONS SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

FILE	SCALE
112G00198CM01-1	AS NOTED
FIGURE NUMBER: FIGURE 4	REV: 0 — DATE: 05/08/07

112G00198/0213/112G00198CM01-2.DWG 05/08/07 MKB



LEGEND

- CONTROL MONUMENTATION SET
- X3 Y8 / 36.5 — FIELD SAMPLE LOCATION WITH IDENTIFICATION NUMBER AND ELEVATION
- ⑤ — PCB WIPE SAMPLE LOCATION WITH IDENTIFICATION NUMBER
- SCRAP AND DEBRIS COVERAGE

GENERAL NOTES:

1. HORIZONTAL AND VERTICAL CONTROL IS TIED TO THE VIRGINIA STATE PLANE COORDINATE SYSTEM NAD83. REFERENCE STATION NUMBERS WFF-01,WFF-02,WFF-03, AND WFF-04.
2. FIELD SURVEY LOCATIONS WERE PERFORMED BY GILMORE & ASSOCIATES, INC. ON FEBRUARY 21, 1995.
3. PCB WIPE SAMPLE LOCATIONS PROVIDED BY METCALF & EDDY, INC.
4. SCREENED AERIAL WAS PROVIDED BY METCALF & EDDY, INC. AND CONVERTED FROM METRIC TO FEET.
5. SCRAP METAL COVERAGE OF SCRAP YARD ESTIMATED FROM NASA PHOTOGRAPHS TAKEN FEBRUARY 16, 1994 1"=300'
6. GRID INTERVALS ARE BASED ON PCB SOIL SAMPLE STAKE LOCATIONS FROM THE FEBRUARY 21, 1995 FIELD SURVEY.

SOURCE:
FIGURE 2-4 GRID INTERVAL NUMBERING, SCRAPYARD AREA RADIOLOGICAL SURVEY REPORT, PREPARED BY METCALF & EDDY, OCTOBER 1997

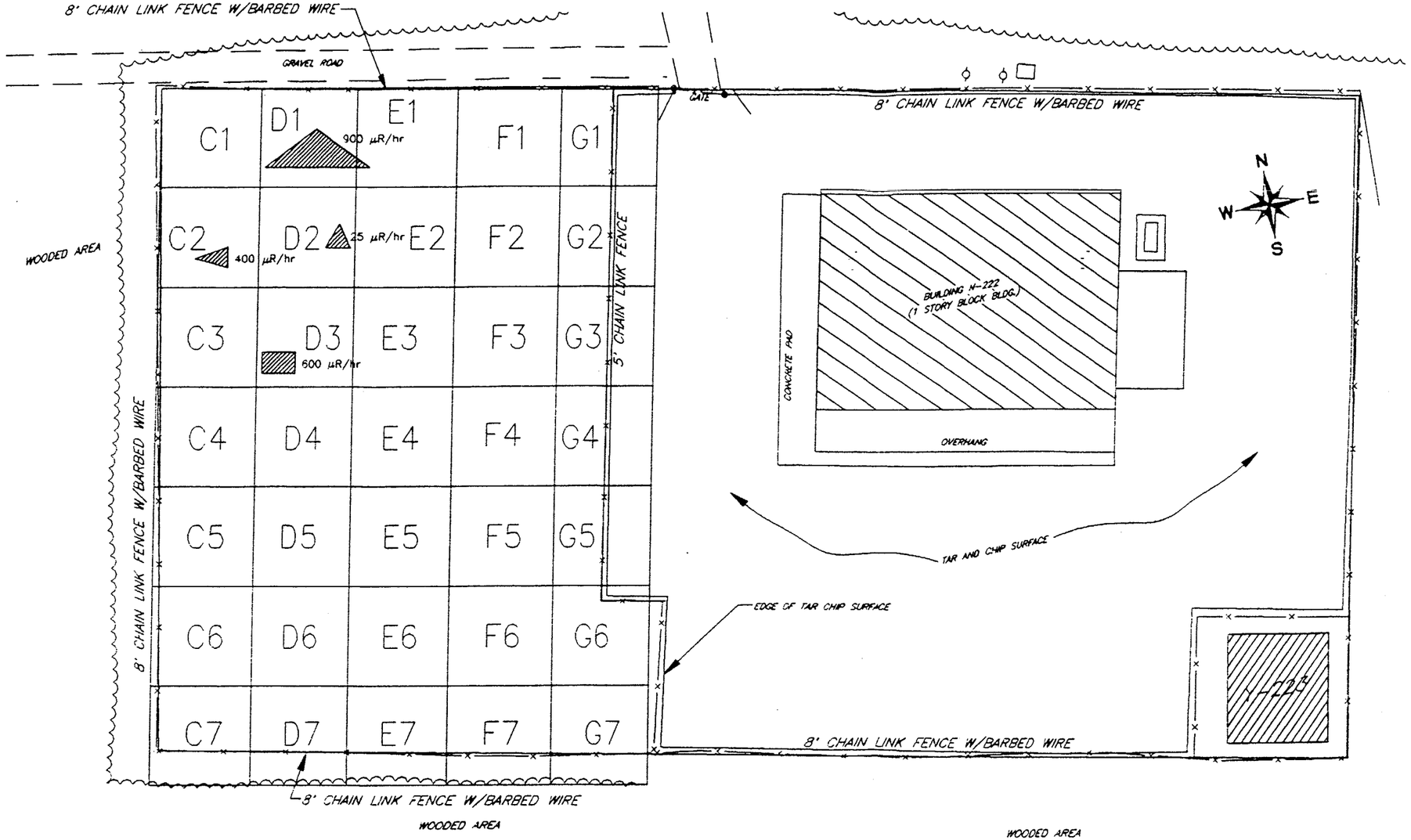
0 40 80
APPROXIMATE SCALE IN FEET

TETRA TECH NUS, INC.

1997 SCRAPYARD AREA RADIOLOGICAL SURVEY GRID AND SAMPLE LOCATIONS SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

FILE	SCALE
112G00198CM01-2	AS NOTED
FIGURE NUMBER: FIGURE 5	REV: 0 — DATE: 05/08/07

112G00198/0213/112G00198CM01-3.DWG 05/08/07 MKB



LEGEND

- LOCATION OF REMAINING "AFFECTED" AREAS WITH MAXIMUM DIRECT RADIATION MEASUREMENTS
- C4 LOCATION OF 10M X 10M GRID INTERVAL FOR THE FINAL DIRECT RADIATION SURVEY.

NOTE:

1. 10M X 10M (32.81' X 32.81') GRID INTRVAL USED FOR THIS SURVEY.

SOURCE:
FIGURE 3-2 SCRAPYARD – FINAL DIRECT RADIATION SURVEY – LOCATIONS OF REMAINING AFFECTED AREAS, SCRAPYARD AREA RADIOLOGICAL SURVEY REPORT, PREPARED BY METCALF & EDDY, OCTOBER 1997

0 40 80

APPROXIMATE SCALE IN FEET

TETRA TECH NUS, INC.

1997 SCRAPYARD AREA RADIOLOGICAL SURVEY – FINAL DIRECT RADIATION SURVEY RESULTS SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

FILE	SCALE
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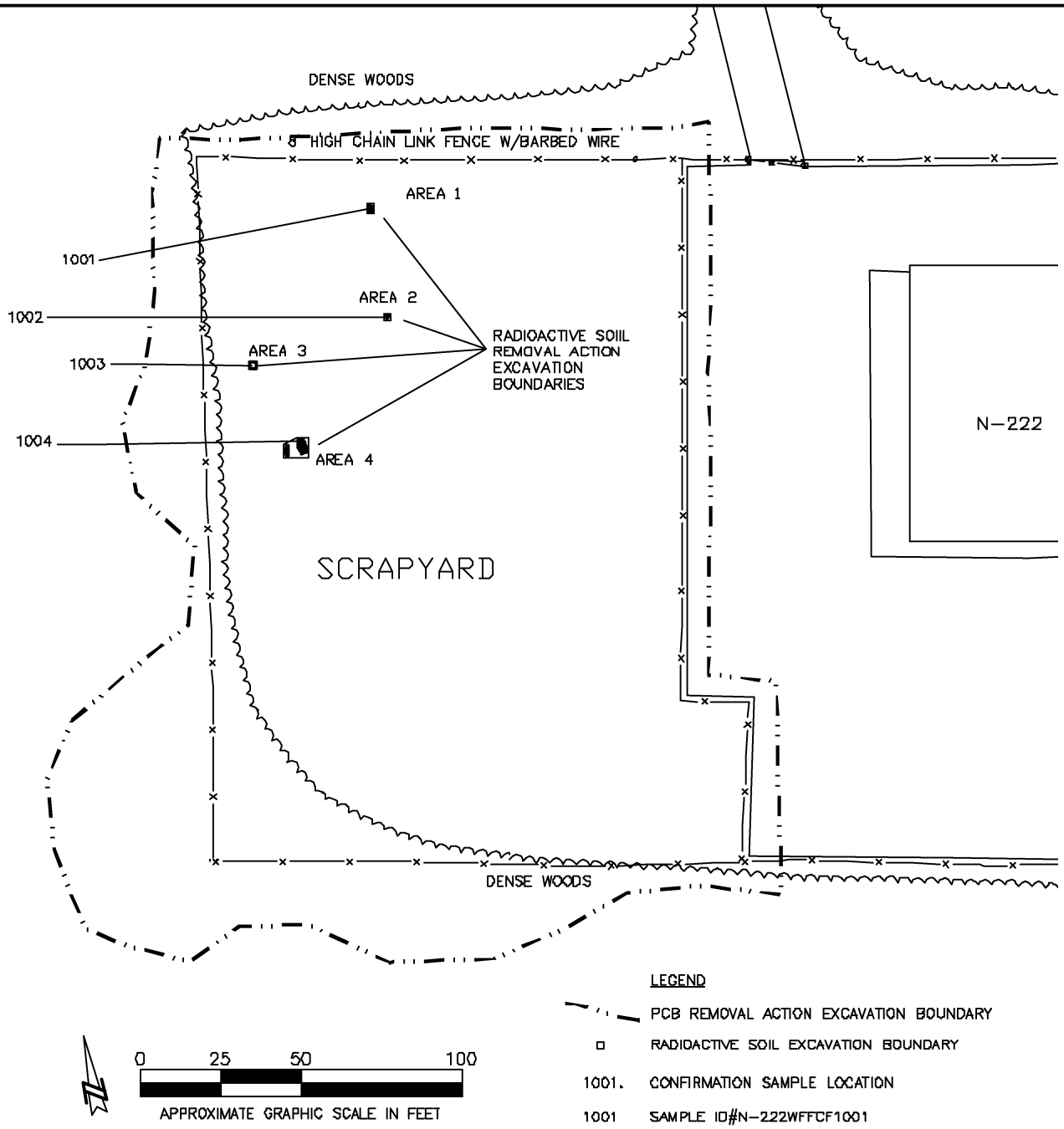


NOTES:

THIS FIGURE WAS EXCERPTED FROM AN AUTOCAD FILE PROVIDED BY WEISS ASSOCIATES.

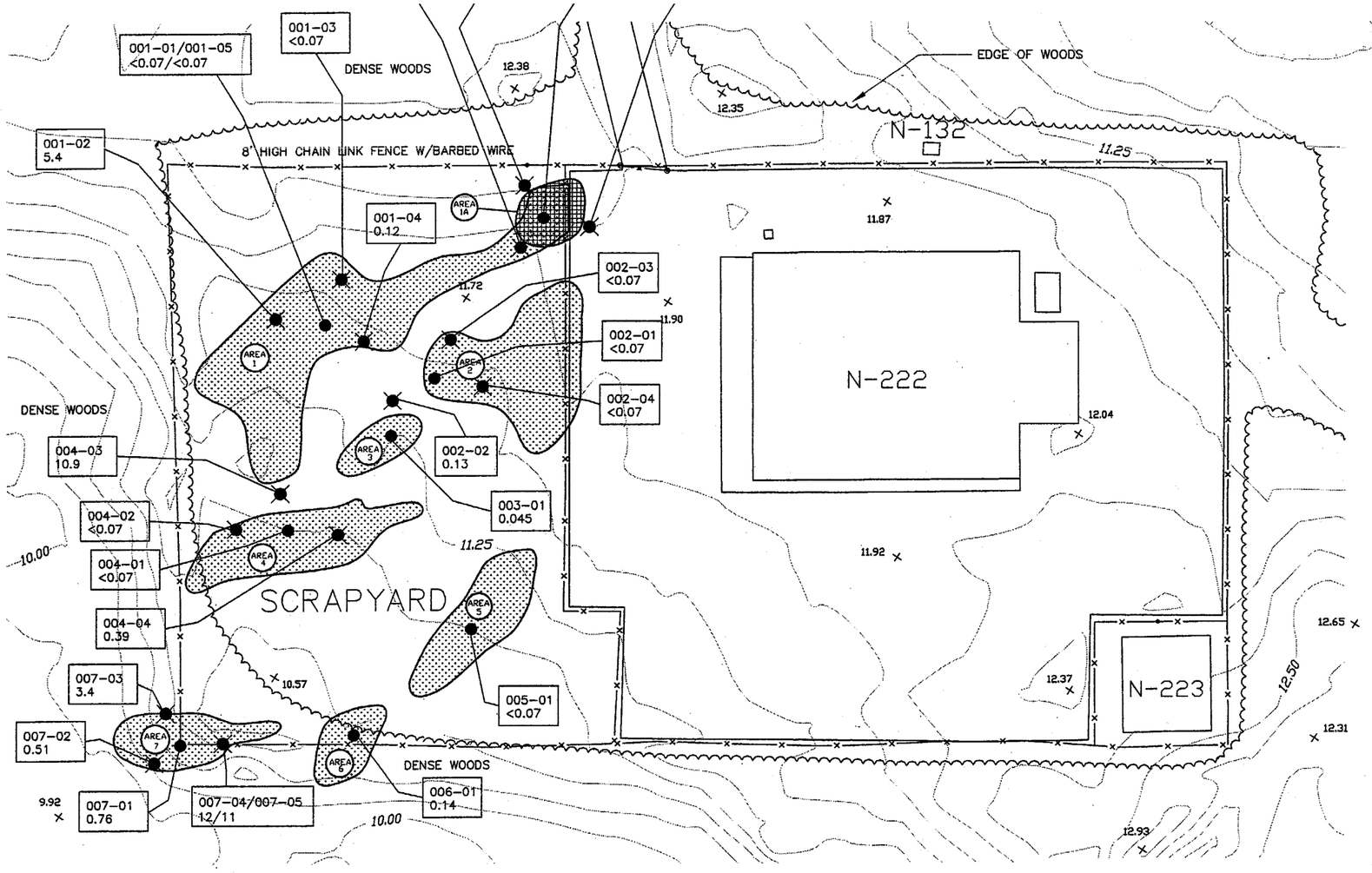
THE PCB REMOVAL ACTION EXCAVATION BOUNDARY WAS SURVEYED BY BALDWIN & GREGG ASSOCIATES. REFER TO APPENDIX D FOR THE ASSOCIATED COORDINATES AND ELEVATIONS.

SOURCE:
FIGURE 2-2 RADIOLOGICAL EXCAVATION BOUNDARIES AND CONFIRMATION SAMPLE LOCATIONS, REMOVAL ACTION COMPLETION REPORT, PREPARED BY TETRA TECH FWI, JUNE 2004

TETRA TECH NUS, INC.

2002 RADIOLOGICAL AREAS OF CONCERN AND 2004 RADIOLOGICAL EXCAVATION BOUNDARIES SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

SCALE	AS NOTED
FILE:	112G00198CM01-7
REV	0
DATE	05/08/07
FIGURE NUMBER	FIGURE 7



LEGEND

- ESTIMATED AREA OF PCB CONTAMINATION GREATER THAN 50 PPM BUT LESS THAN 500 PPM (M&E, 1995)
- ESTIMATED AREA OF PCB CONTAMINATION GREATER THAN 10 PPM BUT LESS THAN 50 PPM (M&E, 1995)
- 10.00 — GROUND SURFACE CONTOUR – METERS ABOVE MEAN SEA LEVEL
- 6" – 12" BELOW GROUND SURFACE SAMPLE
- 12" – 18" BELOW GROUND SURFACE SAMPLE
- 002-03 — SAMPLE INDENTIFICATION (WFF-SU-00x-0x)
- <0.07 — TOTAL PCB CONCENTRATION IN PARTS PER MILLION

NOTES:
SAMPLE LOCATIONS ARE APPROXIMATE.

ELEVATIONS SHOWN IN METERS

N

0' 25' 50' 100'

SCALE: 1" = 50'

NOTE: THIS DRAWING WAS COMPILED FROM WALLOPS FLIGHT FACILITY BASE CONFIGURATION DRAWINGS AND A SITE SURVEY PERFORMED BY GILMORE AND ASSOCIATES, INC. ON FEBRUARY 21, 1995, AS SHOWN ON "PROPOSED SURFACE CAP SITE PLAN" DATED 3/6/95

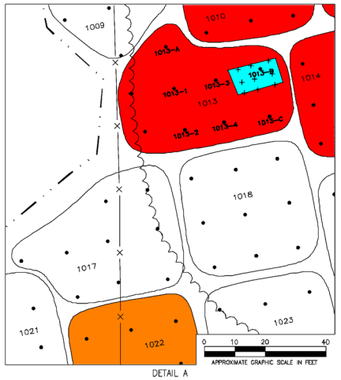
SOURCE:
FIGURE 3 PCB SAMPLE LOCATIONS, CONCENTRATIONS AND TOPOGRAPHIC SITE PLAN, REMOVAL ACTION WORK PLAN, PREPARED BY WEISS ASSOCIATES, MARCH 2003

TETRA TECH NUS, INC.

2003 REMOVAL ACTION WORK PLAN PCB SAMPLE LOCATIONS AND CONCENTRATIONS SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

FILE	SCALE
112G00198CM01-8	AS NOTED
FIGURE NUMBER	REV / DATE
FIGURE 8	0 / 05/08/07

112G00198/0213/112G00198CM01-6.DWG 05/08/07 MKB



DETAIL A

NOTES

THIS FIGURE WAS EXCERPTED FROM AN AUTOCAD FILE PROVIDED BY WEISS ASSOCIATES.

THE PCB REMOVAL ACTION EXCAVATION BOUNDARY AND CONFIRMATION SAMPLE POINTS WERE SURVEYED BY BALDWIN & GREGG ASSOCIATES. REFER TO APPENDIX D FOR THE ASSOCIATED COORDINATES AND ELEVATIONS.

SAMPLE ID# N222 WFF CF 1013-B WAS A COMPOSITE OF POINTS 1013-A, 1013-1, 1013-2, 1013-3, 1013-4, 1013-B, AND 1013-C.

SAMPLE ID# N222 WFF CF 1013-C(1) WAS A COMPOSITE OF POINTS 1013-A, 1013-1, 1013-2, 1013-3, 1013-4, AND 1013-C.

LEGEND

	PCB REMOVAL ACTION EXCAVATION BOUNDARY
•	COMPOSITE SAMPLE POINT
1001	COMPOSITE SAMPLE GROUP
	CHAIN LINK FENCE
1001	SAMPLE ID# N-222 WFF CF 1001
+	COMPOSITE SAMPLE POINT FOR SAMPLE ID# N-222 WFF CF 1013-C(2)
	EXCAVATED TO A DEPTH OF APPROX 12 INCHES BELOW GRADE
	EXCAVATED TO A DEPTH OF APPROX 18 INCHES BELOW GRADE
	EXCAVATED TO A DEPTH OF APPROX 24 INCHES BELOW GRADE
	EXCAVATED TO A DEPTH OF APPROX 48 INCHES BELOW GRADE

SOURCE:
FIGURE 2-5 PCB EXCAVATION BOUNDARIES AND CONFIRMATION SAMPLE LOCATIONS, REMOVAL ACTION COMPLETION REPORT, PREPARED BY TETRA TECH FWI, JUNE 2004

TETRA TECH NUS, INC.

2004 REMOVAL ACTION COMPLETION REPORT
PCB EXCAVATION BOUNDARIES AND CONFIRMATION SAMPLE LOCATIONS
SCRAPYARD SITE LOCATION
NASA WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

FILE	SCALE
112G00198CM01-6	AS NOTED
FIGURE NUMBER: FIGURE 9	REV: 0 — DATE: 05/08/07

112G00198/0213/112G00198CM02.DWG 05/08/07 MKB

N

SYMW-03

N222WFFCF1002

N222WFFCF1008-A

N222WFFCF1001

N222WFFCF1004-A

N222WFFCF1007

N222WFFCF1005

N222WFFCF1010-A

N222WFFCF1009

N222WFFCF1013-C(2)
(NOTE: COMPOSITE
FROM 9 SUB-POINTS)

N222WFFCF1006-A

N222WFFCF1003A

N222WFFCF1013-C(1)

WFFN222PIT1-B
WFFN222PIT2
WFFN222PIT3
WFFN222PIT4-A
WFFN222PIT5
WFFN222PIT6
WFFN222PIT7
WFFN222PIT8
WFFN222PIT9
(NOTE: VARYING FINAL DEPTHS
DURING STEP EXCAVATION)

N222WFFCF1012/1012D

N222WFFCF1011-A

N222WFFCF1015

SYMW-04

N222WFFCF1014-A/1014-AD

N222WFFCF1018

N222WFFCF1020-A

N222WFFCF1017

N222WFFCF1019/1019D

N222WFFCF1021

SYMW-02

N222WFFCF1022-A

N222GEOD18
N222GEOD26
N222TRENCH2
N222TRENCH4
N222TRENCH7
N222TRENCH8
N222TRENCH1-A
N222TRENCH3-A
N222TRENCH5-B
N222TRENCH6-A
(NOTE: VARYING FINAL DEPTHS
DURING STEP EXCAVATION)

SYMW-01

N222WFFCF1024

N222WFFCF1023

N222WFFCF1026

N222WFFCF1025

MW-07

N-223

N-222

11.25

10.00

12.50

LEGEND

- MONITORING WELL LOCATION
- COMPOSITE SAMPLE POINT
- PCB REMOVAL ACTION EXCAVATION BOUNDARY
- 1012 — COMPOSITE SAMPLE GROUP
- N222WFFCF1012 — CONFIRMATION SAMPLE NUMBER

0 50 100
SCALE IN FEET

TETRA TECH NUS, INC.

PCB EXCAVATION BOUNDARIES CONFIRMATION SAMPLE LOCATIONS AND MONITORING WELL LOCATIONS SCRAPYARD SITE LOCATION NASA WALLOPS FLIGHT FACILITY WALLOPS ISLAND, VIRGINIA

FILE	SCALE
112G00198CM02	AS NOTED
FIGURE NUMBER	REV / DATE
FIGURE 10	0 / 05/08/07

SOURCE:
SOILS INFORMATION EXTRACTED FROM, REMOVAL ACTION COMPLETION REPORT, PREPARED BY TETRA TECH FWI, JUNE 2004