FINAL
PROPOSED PLAN FOR SOILS
TNT AREA A
PLUM BROOK ORDNANCE WORKS, SANDUSKY, OHIO
DERP-FUDS PROJECT NUMBER G05OH001815

ISSUED BY: U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT

November 2009

U.S. ARMY CORPS OF ENGINEERS ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the Preferred Alternative for the cleanup of contaminated soils associated with TNT Area A (TNTA) of the former Plum Brook Ordnance Works (PBOW), Sandusky, Ohio (Figure 1) and presents the rationale for this preference. The Preferred Alternative, as well as the other alternatives described herein, addresses the human health and ecological risks associated with soil exposure pathways. Potential risks associated with exposure to groundwater will be addressed in a separate groundwater proposed plan for the TNT Areas and Red Water Pond (RWP) Areas, in which soil remediation described in the current Proposed Plan will be acknowledged as a source removal action. U.S. Army environmental investigations and remediation at PBOW are administered under the Defense Environmental Restoration Program - Formerly Used Defense Sites (DERP-FUDS), as required for such sites by the Superfund Amendments and Reauthorization Act of 1986 (SARA). The U.S. Secretary of Defense delegated authority to the U.S. Army Corps of Engineers (USACE) to administer the DERP-FUDS program.

The Proposed Plan is a document issued by the USACE Huntington District, the lead agency for environmental response actions at PBOW, to fulfill public participation requirements. It was prepared in partnership with the Ohio Environmental Protection Agency (OEPA). As the lead agency, the USACE is charged with planning and implementing environmental investigations and remedial actions at PBOW associated with past U.S. Department of Defense (DoD) activities. The USACE Nashville District is acting as the contracting office for environmental investigations and provides technical review. The USACE Huntington District is acting as the contracting and oversight office for remedial actions. The OEPA provides regulatory review, comment, and oversight.

The Proposed Plan is issued to accomplish the following:

- Provide basic background information about the site
- Identify the Preferred Alternative for TNTA and explain reasons for the preference
- Describe other remedial options considered
- Solicit public review and comment on all alternatives
- Provide information on how the public can be involved in the remedy selection process.

Comments can be directed to:

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Primary Background Documents for TNTA

Dames & Moore, Inc. (D&M), 1997, ***TNT Areas Site Investigation Final Report, Plum Brook Ordnance Works, Plum Brook Station/NASA, Sandusky, Ohio,*** prepared for U.S. Army Corps of Engineers, Nashville District/Huntington District, April.

International Consultants, Inc., 1995a, ***Site Management Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** September.

International Consultants Inc., 1995b, ***Community Relations Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** July.

IT Corporation (IT), 2001a, ***TNT Areas A and C Remedial Investigation, Volume 1 – Report of Findings***, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, November.

IT Corporation (IT), 2001b, ***TNT Areas A and C Remedial Investigation, Volume 2 – Human Health Risk Assessment***, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, November.

IT Corporation (IT), 2001c, ***TNT Areas A and C Remedial Investigation, Volume 3 – Ecological Risk Assessment***, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, November.

IT Corporation (IT), 1999, ***Summary Report, Site-Wide Groundwater Monitoring (1997-1998), Final, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** June.

IT Corporation (IT), 1997, ***Site-Wide Groundwater Investigation Report, Plum Brook Ordnance Works, Sandusky, Ohio,*** September.

Morrison-Knudsen Corporation, 1994, ***Site Inspection Report***, Plum Brook Station, Sandusky, Ohio, January.

Shaw Environmental, Inc. (Shaw), 2008, ***Addendum, TNT Area A, Focused Feasibility Study for Soil and Sediment, Revised Draft, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** December.

Shaw Environmental, Inc., (Shaw), 2006, ***Baseline Human Health Risk Assessment for Groundwater***, Former Plum Brook Ordnance Works, Sandusky, Ohio, September.

Shaw Environmental, Inc., (Shaw), 2005, ***2004 Groundwater Data Summary and Evaluation Report***, Former Plum Brook Ordnance Works, Sandusky, Ohio, April.

Shaw Environmental, Inc., (Shaw), 2003, ***TNT Areas A and C Remedial Investigation, Volume 4 – Focused Feasibility Study for Soil and Sediment***, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio, October.

The USACE, after consulting with the OEPA, will select a remedy for TNTA after the public has had an opportunity to comment on this Proposed Plan and all comments received have been reviewed and considered. The comment period for the Proposed Plan is from November 30, 2009 through January 13, 2010, and the public meeting will be held at 7:00 p.m. on November 30, 2009, at the Firelands Library, Firelands campus of Bowling Green State University (BGSU), Huron, Ohio. The remedy selected for TNTA will be documented in a Decision Document.

DATES TO REMEMBER

Comment Period
November 30, 2009 through January 13, 2010

Public Meeting
7:00 p.m., November 30, 2009, at Firelands Library - BGSU Foundation Hall
One University Drive

The USACE is issuing this Proposed Plan for public comment as part of its public participation responsibilities consistent with Sections 117(a), 113(k)(2)(B), and 121(f)(1)(G) of the Comprehensive Environmental Response Compensation, and Liability Act (CERCLA) of 1980, as amended by SARA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) under CERCLA Part 300.430(f)(2).

This document summarizes information presented in greater detail in documents contained in the Administrative Record (AR) for TNTA. Background documents for TNTA are listed above and can be found in the AR. The USACE and OEPA encourage

the public to review these documents and the entire AR to gain a more comprehensive understanding of TNTA and the associated site activities. The AR, which contains information upon which the selection of the response action will be based, is maintained at the Huntington District Office, 502 Eighth Street, Huntington, West Virginia, 25701. The AR can be viewed online at the USACE Huntington District website. http://www.lrh.usace.army.mil/projects/current/derp-fuds/pbow/documents. The local Public Repository of the AR is:

Firelands Library – BGSU
Foundation Hall
One University Drive
Huron, Ohio
Phone: 419-433-5560
Library hours vary throughout the year. Call for current hours. The AR is maintained on compact discs; ask librarian at front desk.

SITE BACKGROUND

PBOW is located approximately 4 miles south of Sandusky, Ohio, and 59 miles west of Cleveland (Figure 1). Although located primarily in Perkins and Oxford Townships, the eastern edge of the site extends into Huron and Milan Townships. PBOW is in general bounded on the north by Bogart Road, on the south by Mason Road, on the west by Patten Tract Road, and on the east by U.S. Highway 250. The area surrounding PBOW is mostly agricultural and residential (IT Corporation [IT], 2001a).

The PBOW facility was built on property totaling 9,009 acres in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene (TNT), 2,4-dinitrotoluene (DNT), and pentolite (International Consultants Inc., 1995a). Production of explosives at PBOW began in December 1941 and continued until 1945. It is estimated that more than 1 billion pounds of nitroaromatic explosives were manufactured during the 4-year operating period. The three explosive manufacturing areas were designated TNTA, TNT Area B (TNTB), and TNT Area C (TNTC). Twelve process lines were used in the manufacture of TNT: four lines at TNTA, three lines at TNTB, and five lines at TNTC.

The TNTA manufacturing site consisted of widely scattered wood-frame buildings with asbestos and sheet metal coverings. It also included a series of buried and/or overhead flumes and pipes used to transport various liquids associated with the manufacturing process.

After plant operations ceased, the TNTA manufacturing lines were decontaminated by the War Department in late 1945. During decontamination, all structures, equipment, and manufacturing debris were either removed and salvaged or removed and burned. After decontamination the property was initially transferred to the Ordnance Department, then to the War Assets Administration after it was certified by the U.S. Army to be decontaminated. In 1949, PBOW was transferred to the General Services Administration (GSA). In 1955, the GSA completed further decontamination of TNTA. This effort included removal of contaminated surface and subsurface soil around the building and wooden and ceramic waste disposal lines containing TNT. Thousands of pounds of TNT were discovered in catch basins; this TNT was removed and burned at the burning grounds.

Two property use agreements were entered into by the National Advisory Committee of Aeronautics, the predecessor of the National Aeronautics and Space Administration (NASA), and the Army in 1956 and 1958, respectively. Accountability and custody for the entire portion of the former PBOW property (6,030 acres) that had been under the accountability and custody of the Department of the Army were transferred to NASA on March 15, 1963. NASA performed further decontamination efforts in the TNT Areas during 1964. The NASA decontamination process included removing contaminated surface soil above the drain tiles, flumes, etc.; destruction of all buildings by fire; then removal of all soil, debris, sumps, and above-grade portions of concrete foundations. Portions of the concrete foundations located below grade were left

buried, and some that had been previously slightly above grade were likewise buried. All materials, including the soil in those areas, were flashed; the area was then rough-graded. The decontamination process was also to have included the burning of nitroaromatic-filled flumes that were excavated (Dames & Moore, Inc. [D&M], 1997).

NASA has operated and maintained PBOW since 1963, and the facility is currently the NASA Glenn Research Center, Plum Brook Station. NASA operates the former PBOW property as a space research facility in support of their John Glenn Research Center at Lewis Field, Cleveland, Ohio. Most of the aerospace testing facilities built in the 1960s at the site are presently on standby or inactive status. On April 18, 1978, NASA declared approximately 2,152 acres of PBOW as excess. The Perkins Township Board of Education acquired 46 acres of the excess acreage and uses this area as a bus transportation area. The GSA retains ownership of the remaining excess acreage and currently has a use agreement with the Ohio National Guard for 604 acres of this land. NASA presently controls approximately 6,400 acres. The details of land transactions are listed in the site management plan (International Consultants, Inc., 1995a).

TNTA currently consists of an area of approximately 114 acres in the northeastern part of PBOW, with Columbus Avenue bisecting the site (Figure 2). NASA constructed its administration building on the east side of Columbus Avenue in the central portion of TNTA. The NASA Administration Building and associated parking areas cover a small portion of the site and one of the former TNT process buildings (Building 121, Mono House). The rest of TNTA (less than 25 percent) is partially wooded and consists predominantly of large, open areas of grasslands. Controlled burning is used in the vicinity of TNTA. Much of the southeastern portion of TNTA around the Administration Building is mown lawn.

Several aboveground features are still evident at TNTA, indicating that former PBOW facilities were present. These include roads, fire hydrants, water valves, railroad beds, and sections of former building pad foundations (Building 111, Mono House, and Building 142, Bi-Tri House). Several belowground features are also present: manholes, drains, and underground lines (indicated by aboveground water valves).

TNTA is slightly hilly, generally increasing in elevation from southeast to northwest. Small ditches transect the site, eventually draining into a small east-west tributary to Lindsley Ditch, which is located just outside of TNTA to the north. The smaller ditches are dry during periods with little rainfall. Former and current site buildings, as well as other features, are shown on Figure 3.

Nitroaromatic compounds (i.e., explosives) are the major soil contaminants at TNTA. The presence of nitroaromatic soil contamination is likely due to spills on the surface and leaks from holding areas, flumes, and pipelines associated with former manufacturing operations.

It should be emphasized that this Proposed Plan addresses only contamination in soil that has resulted from past DoD activities at the site. Investigations of the surface water and sediment associated with TNTA indicate that the site contamination is not appreciably impacting these media. The remediation of contaminated soil at TNTA will also preclude these areas from being potential sources of further groundwater contamination. Based on the analytical data presented in the TNTA focused feasibility study (FFS), the soil excavation planned for each of the remediation areas, which is designed to mitigate direct exposure to contaminated soil, should result in removal of soil to either the water table or competent shale in all but 4 of the 18 areas proposed for excavation. These four are within Building Areas 139, 141, 146, and 148.

At the proposed remediation areas within Building Areas 139 and 141, concentrations of chemicals of concern (COC) exceeding the remedial goals (RG) were detected in these two areas to depths of 3 feet and 2 feet, respectively, but not at greater depths. Therefore, remediation in these two areas was assumed

in the FFS to extend to a depth of 8 feet, as the vertical extent of contamination is regarded as very limited.

For Building Area 146, the COCs were detected at concentrations exceeding the RGs even in the deepest samples, which were collected at 8 to 10 feet below surface. Therefore, remediation at this location was assumed in the FFS to extend to a depth of 15 feet. Excavation to a depth of 15 feet is protective of direct contact by construction workers and other future workers. Note that groundwater was not encountered in the overburden shale at this location and that the depth to limestone groundwater ranges from 45 to 65 feet below ground surface.

Nitroaromatic COCs were detected at concentrations exceeding RGs in the proposed remediation area at Building Area 148 to a depth of 1.7 feet. Soil samples were not collected below 1.7 feet at this location. Because concentrations of these COCs were not greatly elevated (i.e., less than 3 times the remedial goals), it was determined that the vertical extent of contamination is likely limited and it was assumed in the FFS that this area should be remediated to a depth of 7 feet, unless groundwater or bedrock is encountered first.

In summary, the remediation of contaminated soil at TNTA will also remove potential sources of groundwater contamination. Specifically, planned soil excavation in 14 of the 18 proposed remediation areas should result in removal of soil to either the water table or competent shale. In the other four areas, soil will be excavated until COC concentrations are nondetect or inconsequentially low, or soil will be excavated to a practicable maximum depth (i.e., Building Area 146). The TNT and RWP Areas groundwater feasibility study (FS) (Shaw Environmental, Inc. [Shaw], 2008) evaluated potential remedial approaches for individual areas of contaminated groundwater and source areas including TNTA. A TNT and RWP Areas groundwater proposed plan will be issued. The groundwater proposed plan will acknowledge that the preferred soil action described in this Proposed Plan represents a source removal.

SITE CHARACTERISTICS

Field activities were conducted specifically to investigate environmental media at TNTA, including soil, surface water, sediment, and groundwater. Even though this Proposed Plan does not directly address groundwater, the groundwater sampling efforts are mentioned to provide a context of the environmental investigation history. The groundwater analytical results and characteristics are not presented herein.

Remedial investigation (RI) activities were conducted separately for TNTA soils (479 samples), surface water (8 samples), and sediment (10 samples) in 2000 and for site groundwater in October 2001 through April 2002 (semiannual sampling from 2 overburden wells and 2 bedrock wells). One surface soil sample, 2 surface water samples, and 2 sediment samples were collected during an initial site inspection in 1993 (Morrison-Knudsen Corporation, 1994). Thirty-six soil samples were collected during the 1994 SI (D&M, 1997).

Prior to the groundwater RI, three overburden wells were sampled in 1993, and five were sampled in 1994, 1996, 1997, 1998, and 2002. As part of the RI, nine samples were collected from temporary piezometers in 2000. A total of 45 temporary piezometer groundwater samples had been planned in 2001 for TNTA, but samples could be collected from only two of these locations due to a lack of groundwater in the overburden. Two bedrock wells, one of which is located downgradient (BEDMW-17), were sampled in 1994, 1996, 1997, 1998, and 2002. An additional bedrock well was installed and sampled in 2001. This well (TNTA-BEDGW-001) was sampled again in 2002.

Soil. During the RI, TNTA soil was investigated by process line or process type, and the associated building areas are listed below. A summary of the analytical results for the 27 process areas and associated buildings evaluated during the RI is presented in the paragraphs that follow. Samples stated as being collected from a given building (e.g., Building 182) may include not only the former building's

footprint, but the general area surrounding the footprint as well. The 27 TNTA areas investigated during the RI include the following:

- DNT process buildings
  - Building 182, DNT sweating and graining building
  - Building 185, DNT nitrating building
  - Building 192, DNT sweating and graining building
  - Building 195, DNT nitrating building
- Wastewater settling tanks
  - Building 187, wastewater disposal settling tank
- Process Line 1
  - Building 111, mono house
  - Building 112, bi-tri house
  - Building 113, fortifier house
  - Building 116, wash house
  - Building 119, acid and fume recovery
- Process Line 2
  - Building 121, mono house
  - Building 122, bi-tri house
  - Building 123, fortifier house
  - Building 126, wash house
  - Building 128, nailing house
  - Building 129, acid and fume recovery
- Process Line 3
  - Building 131, mono house
  - Building 132, bi-tri house
  - Building 133, fortifier house
  - Building 136, wash house
  - Building 139, acid and fume recovery
- Process Line 4
  - Building 141, mono house
  - Building 142, bi-tri house
  - Building 143, fortifier house
  - Building 146, wash house
  - Building 148, nailing house
  - Building 149, acid and fume recovery.

Six of these 27 areas (Building Areas 136, 141, 142, 143, 187, and 192) were also investigated during the 1994 SI. Concentrations of nitroaromatics exceeding RGs, which serve as cleanup criteria, were exceeded by one or more samples from the 18 areas listed below. The maximum detected concentration (MDC) of a nitroaromatic compound and the maximum depth interval of RG exceedance for each area are also given below. Specific contaminated areas within TNTA that have soil concentrations that exceed at least one of the RG levels are identified on Figure 4 as “areas to be remediated.”

- Building Area 182 (MDC: 103 milligrams per kilogram (mg/kg) total DNT; maximum depth interval: 6-7 feet below ground surface [bgs])
- Building Area 192 (MDC: 3,201 mg/kg 2,6-DNT; maximum depth interval: 2-4 feet bgs)
- Building Area 195 (MDC: 10,274 mg/kg 2,6-DNT; maximum depth interval: 4-6 feet bgs)
- Building Area 187 (MDC: 580 mg/kg TNT; maximum depth interval 1.5-5 feet bgs)
- Building Area 111 (MDC: 12 mg/kg 2,4-DNT; maximum depth interval: 4-6 feet bgs)

- Building Area 112 (MDC: 1,298 mg/kg TNT; maximum depth interval: 8-10 foot bgs)
- Building Area 116 (MDC: 12.5 mg/kg 2-amino-4,6-dinitrotoluene [2-ADNT]; maximum depth interval: 8-10 feet bgs)
- Building Area 119 (MDC: 1,407 mg/kg 2-nitrotoluene; maximum depth interval: 8-9 feet bgs)
- Building Area 126 (MDC: 170 mg/kg TNT; maximum depth interval: 8-10 feet bgs)
- Building Area 129 (MDC: 27.7 mg/kg 2,4-DNT; maximum depth interval: 2-3 feet bgs)
- Building Area 131 (MDC: 278 mg/kg 2-nitrotoluene; maximum depth interval: 8-10 feet bgs)
- Building Area 133 (MDC: 18.8 mg/kg TNT; maximum depth interval: 3-3.5 feet bgs)
- Building Area 139 (MDC: 40.8 mg/kg total DNT; maximum depth interval: 2-3 feet bgs)
- Building Area 141 (MDC: 40.7 mg/kg TNT; maximum depth interval 1-2 feet bgs)
- Building Area 142 (MDC: 31.2 mg/kg TNT; maximum depth interval 2-3 feet bgs)
- Building Area 143 (MDC: 8.9 mg/kg TNT; 1.6-2.6 feet bgs)
- Building Area 146 (MDC: 2,385 mg/kg TNT; maximum depth interval 8-10 feet bgs)
- Building Area 148 (MDC: 13.2 mg/kg TNT; maximum depth interval 0.7-1.7 feet bgs)

In addition to nitroaromatics, Aroclor 1260 (a polychlorinated biphenyl [PCB]) and lead were detected at concentrations exceeding RGs. PCBs are usually associated with leaking electric power transformers; however, the widespread occurrence of PCBs across PBOW suggests some other source. The elevated lead concentrations are likely associated with building materials. The nitroaromatics, lead, and PCBs are the principal threat wastes.

Surface Water. According to the 2000 RI, the only nitroaromatics detected in TNTA surface water samples were detected at relatively low concentrations (< 5 micrograms/liter of total nitroaromatics) and in only two of the eight surface water samples. No other chemicals interpreted as potentially site related were detected in any of the surface water samples associated with TNTA. Low detections of nitroaromatics in the surface water samples indicate that the contaminants associated with TNTA are not appreciably impacting surface water. Therefore, remediation with respect to surface water is not required.

Sediment. In the 10 RI sediment samples, 6 nitroaromatics were detected, and total nitroaromatics concentrations ranged from nondetected to 9.3 mg/kg. Ten semivolatile organic compounds were detected, and 8 of these were polycyclic aromatic hydrocarbons (PAH). The others were 2,4-DNT (0.147 J mg/kg) and 2,6-DNT (0.0844 J mg/kg). (The J indicates that the concentration is an estimated value. The chemical was detected at a concentration below the lowest calibration standard.) One or more of the eight PAHs were detected in only three of the sediment samples.

PAHs are fairly ubiquitous in the environment and may result from incomplete combustion (either natural or associated with human activities including automobile exhaust), asphalt, and/or petroleum products. PAHs would also have been generated by burning the former TNTA buildings during demolition, as well as during periodic controlled vegetation burns conducted by NASA in the vicinity of TNTA. One or a combination of these sources may represent the major source(s) of PAHs in TNTA sediment.

No nitroaromatics were detected in the two 1993 sediment samples, which had low concentrations of three volatile organic compounds, three pesticides, and seven PAHs (total PAH concentration < 1 mg/kg).

In summary, low detections of nitroaromatics and other chemicals in the sediment samples indicate that the contaminants associated with TNTA are not appreciably impacting this medium. Therefore, remediation with respect to sediment is not required.

Groundwater. As mentioned above, groundwater at TNTA has been evaluated separately from other TNTA media and will be addressed, along with groundwater from the other two TNT Areas and the RWP Areas, in a separate groundwater proposed plan. Remediation of contaminated soil at TNTA in any event will also remove potential sources of groundwater contamination.

SCOPE AND ROLE OF TNTA

One of the DoD's specific goals from the Defense Planning Guidance for DERP-FUDS is to reduce risk to human health and the environment through implementation of effective, legally compliant, and cost-effective response actions. To that end, the environmental investigation of PBOW has been divided into 16 areas of concern, also referred to as DERP-FUDS projects, to address the potential concerns presented by each area associated with former DoD activities. A separate closeout document is required for each of the 16 DERP-FUDS projects. This current Proposed Plan specifically addresses contamination in TNTA soils only.

The 16 DERP-FUDS projects and their status are briefly identified below.

TNT Area A – An FFS for soils and sediment was completed in 2003. Completion of the Proposed Plan is the next step in the process, which is expected to lead to a remedy for TNTA.

TNT Area B – A soils FS has been completed. An Action Memorandum for a Non-Time Critical Interim Removal Action of soils was presented to the public on March 28, 2002 and the Public Comment period was from March 28 to 30 April, 2002. The Action Memorandum was finalized in June 2003 and the Removal Action completed in December 2006. The final report of the interim soil removal action was issued in 2007. A Decision Document was signed in September 2009.

TNT Area C – An FFS for soils and sediment was completed in 2003. A Decision Document, which is expected to lead to a remedy for TNTC, is pending approval.

West Area Red Water Ponds and Pentolite Road Red Water Pond –A soil FS for the RWP Areas was completed in December 2002. Investigations found no action necessary relative to soils at the West Area Red Water Ponds. For the Pentolite Road Red Water Pond (PRRWP), removal alternatives were evaluated and an Action Memorandum for a Non-Time-Critical Interim Removal Action of TNT in soils was presented to the public, and then finalized in June 2003. An interim removal action began in June 2002 and was completed in the fall of 2004. However, additional excavation was necessary for clean closure of the DERP-FUDS project. The USACE conducted field-scale and laboratory-scale treatability studies to determine the best approach to address the remaining contamination at the PRRWP site. A composting action was selected and began in 2007 and was completed in September 2008. The final report of the interim soil removal action was completed in March 2009, in that the RG for TNT in soil was met. A contract was awarded in April 2009 for additional delineation of nitroaromatics contamination in areas outside of the Non-Time-Critical Removal Action area. A Decision Document is anticipated in 2010.

Acid Areas 1, 2, and 3 – The site investigations (SI) of the three acid areas were completed in December 1998. The RI of Acid Areas 2 and 3 has begun with the Site Characterization Report being finalized in March 2007. The Acid Areas 2 and 3 risk assessments were completed in February 2008, and an FS with delineation sampling is scheduled for completion in 2009. Fieldwork for the Acid Area 1 RI was completed in 2008. The Site Characterization Report for Acid Area 1 is planned for 2009, and a risk assessment and FS will follow as necessary.

Reservoir No. 2 Burning Grounds – The RI began in 2004 and the Site Characterization Report was issued in January 2006. An interim action was proposed through the Engineering Evaluation and Cost Analysis process, but the decision was made to return to the normal CERCLA process (RI phase) due to lack of evidence to demonstrate an imminent threat to justify the removal action. A risk assessment was begun as part of the RI in 2008.

Additional Burning Grounds – A preliminary assessment (PA) was performed in 1991. This project is scheduled to be closed out in 2009 because the areas of concern to be addressed under this project have also been used by NASA. NASA may elect to take full responsibility for these areas of concern. If not, new projects will be created to address the joint responsibility and the remediation of these areas.

Wastewater Treatment Plant Nos. 1 and 3 – A limited SI was completed in July 2000. A contract for an RI was awarded in June 2008, and fieldwork began in December 2008.

Wastewater Treatment Plant No. 2 – A PA was performed in 1991. An RI is recommended but has not yet been funded.

Ash Pit 2 – A PA was performed in 1991. A contract for an RI was awarded in September 2008, and fieldwork began in January 2009.

Ash Pit Nos. 1 and 3 – A limited SI performed in July 2000 resulted in the recommendation that a full SI be performed. A contract for an RI was awarded in June 2008, and fieldwork began in December 2008.

TNT Loading Areas – A limited SI which recommended no further action was completed in July 2000. The State concurred with the SI recommendation, and the project was closed out in September 2006 with no further action.

Pentolite Area Waste Lagoon – A limited SI which recommended no further action was completed. The State concurred with the SI recommendation, and the project was closed out in September 2006 with no further action.

Lower Toluene Tanks – A limited SI which recommended no further action was completed in July 2000. The State concurred with the SI recommendation. and the project was closed out in September 2006 with no further action.

Garage Maintenance Area – A limited SI was completed for the Locomotive Building Area in July 2000 that resulted in the recommendations to proceed with further investigation. The Locomotive Building Area is in the eastern portion of the Garage Maintenance Area. A contract for an RI was awarded for the Locomotive Building Area in October 2008, and fieldwork began in December 2008.

TNT Area and Red Water Pond Area Groundwater – A baseline human health risk assessment (BHHRA) of groundwater associated with the three former TNT areas and two former red water ponds was finalized in September 2006, and an FS for groundwater associated with these areas was completed in December 2008. The groundwater associated with these five areas is expected to be addressed in a single Decision Document. Note that groundwater associated with each of the other seven active DERP-FUDS projects is expected to be addressed in each of the seven separate Decision Documents for those DERP-FUDS projects.

Soil Actions – The soil actions undertaken at the PRRWP Area and TNTB, as well as the proposed actions at Reservoir No. 2 Burning Grounds, TNTA, and TNTC, are actions being implemented by

USACE under DERP-FUDS. To date, no other removal or remedial actions have been recommended, in part because several of the other DERP-FUDS projects await funding for continuation of the CERCLA evaluation process. The DERP-FUDS mandate is to address only those areas associated with DoD-generated materials. NASA is investigating contamination at former PBOW property that is associated with impacts resulting from NASA activities.

SUMMARY OF POTENTIAL SITE RISKS

A BHHRA and an ecological risk assessment were performed for TNTA soil, surface water, and sediment (IT, 2001b,c). The results of these evaluations are summarized below.

Human Health Risks. The BHHRA evaluated potential risks under the following potential human receptor scenarios (exposure pathways evaluated in parentheses):

- Long-term indoor worker (ingestion of surface soil)
- Long-term groundskeeper (ingestion of surface soil; dermal exposure to surface soil; inhalation of particulates)
- Shorter-term construction worker (ingestion of total soil/sediment; dermal exposure to total soil/sediment; inhalation of particulates; dermal exposure to surface water)
- Hypothetical long-term future resident (ingestion of total soil/sediment; dermal exposure to total soil/sediment; inhalation of particulates; incidental dermal exposure to surface water)
- Hunter and child (consumers of contaminated venison; hunter ingestion of surface soil, dermal exposure to soil, and inhalation of particulates).

Figure 5 depicts the exposure pathways evaluated for each receptor in the BHHRA.

The incremental lifetime cancer risks (ILCR) that could result from a reasonable maximum exposure to potential carcinogenic (cancer-causing) chemicals detected at TNTA were determined under each human receptor scenario. The risks from each chemical and exposure pathway (e.g., ingestion of soil, dermal exposure to soil, inhalation of dust) were summed to calculate the combined risks to the individual receptor. The NCP states that acceptable exposure levels are generally concentrations that represent an excess upper bound lifetime cancer risk (or ILCR) to an individual between 1×10^{-6} (one in one million) and 1×10^{-4} (one in ten thousand). The OEPA has maintained a 1×10^{-5} ILCR as a target cancer risk for all PBOW sites.

Noncancer human health effects were characterized by estimating chemical-specific hazard quotients. The sum of the hazard quotients for all contaminants that affect the same system of the body (e.g., liver, central nervous system) across all pathways is the hazard index (HI) for a particular receptor. As stated in the NCP, acceptable exposure levels for systemic toxicants (i.e., noncancer effects) are represented by concentration levels to which a human population may be exposed without adverse effect during a lifetime or part of a lifetime, incorporating an adequate margin of safety. Consistent with U.S. Environmental Protection Agency risk assessment guidance, this is generally determined by a comparison of the calculated HI to a value of 1. An HI value greater than 1 indicates a possible concern for potential adverse health effects; HI values equal to or less than 1 indicate that adverse health effects are unlikely. The overall ILCR and HI values for each environmental medium and each receptor are summarized in Table 1. The following conclusions are drawn from the BHHRA results and uncertainty evaluations.

- The site-related total ILCR (6×10^{-6}) from all groundskeeper exposure pathways to surface soil is within the NCP acceptable range and meets the OEPA cancer risk criterion. The site-related total HI (0.6) is less than the acceptable value of 1. The groundskeeper ILCR is associated primarily with TNT, total DNT, and Aroclor 1260; the HI is associated primarily with TNT and 2-ADNT.

- The site-related total ILCR (3×10^{-6}) from oral exposure to surface soil and dust by the indoor worker is within the NCP acceptable range and meets the OEPA cancer risk criterion. The site-related total HI (0.3) is less than the acceptable value of 1. The indoor worker ILCR is associated primarily with TNT, total DNT, and Aroclor 1260; the HI is associated primarily with TNT and 2-ADNT.
- The site-related total ILCRs for the hunter (4×10^{-7}) and child (2×10^{-8}) venison consumers are less than the NCP acceptable range. The site-related total HI (0.03) for the hunter is less than the acceptable value of 1. An HI for the child could not be calculated because uptake of noncancer chemicals from vegetation growth on impacted soil was expected to be miniscule; therefore, it is highly unlikely that ingestion of game from TNTA site would represent a noncancer human health hazard.
- The site-related total ILCR (4×10^{-4}) from all construction worker exposure pathways to surface and subsurface soil exceeds the NCP acceptable range. The site-related total HI (60) exceeds the acceptable value of 1. The construction worker ILCR is associated primarily with 2,4-DNT (2×10^{-4}) and 2,6-DNT (2×10^{-4}). The HI is associated primarily with 2,4-DNT (17) and 2,6-DNT (38).
- The site-related total ILCR (3×10^{-2}) from all future resident exposure pathways to surface and subsurface soil exceeds the NCP acceptable range. The site-related total HI (219) exceeds the acceptable value of 1. The resident ILCR is associated primarily with 2,4-DNT (1×10^{-2}) , 2,6-DNT (1×10^{-2}), Aroclor 1260 (2×10^{-4}), and TNT (2×10^{-5}). The total HI is associated primarily with 2,4-DNT (60), 2,6-DNT (139), TNT (8), 2-ADNT (8), and 4-amino-2,6-dinitrotoluene (4-ADNT) (2).
- The surface water ILCR values for the construction worker (5×10^{-9}) and resident (1×10^{-7}) are less than the NCP acceptable range. The respective surface water HI values for these receptors (0.06 and 0.03) are less than the acceptable criterion of 1.
- The construction worker ILCR for exposure to sediment (6×10^{-8}) is less than the NCP acceptable range. No noncancer chemicals were identified for sediment.
- The resident ILCR for exposure to sediment (2×10^{-7}) is less than the NCP acceptable range. No noncancer chemicals were identified for sediment.

In summary, predicted levels of exposure to site-related chemicals in surface and subsurface soil would result in unacceptable levels of cancer and noncancer risk to a construction worker and on-site resident. Both cancer and noncancer risks to the groundskeeper, indoor worker, hunter, and child venison consumers would not exceed acceptable levels. Similarly, results of the BHHRA are interpreted as indicating that site surface water and sediment would not pose any unacceptable human health risks.

The BHHRA results were used to identify nine COCs for soil. These are chemicals identified as contributing significantly to risk as defined in the BHHRA. The nine soil COCs are as follows:

- 2-ADNT
- 4-ADNT
- 2,4-DNT
- 2,6-DNT
- TNT
- 2-nitrotoluene
- 4-nitrotoluene
- Aroclor 1260
- Lead.

Ecological Risks. An ecological risk assessment, composed of a screening-level ecological risk assessment (SLERA) and a predictive baseline ecological risk estimation (BERA), was performed as part

of the RI for TNTA (IT, 2001c). The SLERA is composed of two main parts: the ecological site description and the selection of chemicals of potential ecological concern (COPEC). Both of these are part of the problem formulation step of ecological risk assessment. A BERA was conducted for TNTA because the SLERA indicated that the potential for ecological risks could not be characterized as "minimal or nonexistent."

The BERA continues the problem formulation process that is begun in the SLERA. Additional problem formulation tasks performed under the BERA are selection of assessment receptors and ecological endpoint identification. Additional ecological risk assessment steps performed under the BERA are as follows:

- Exposure characterization
- Ecological effects characterization
- Risk characterization
- Conclusions and recommendations.

TNTA is composed of upland moderate and early old field, early shrub thicket, moderate forest, emergent wetland, and scrub/shrub wetland vegetative communities. Areas east of TNTA are primarily old field and shrub, areas to the south and west are primarily forested, and the north areas are early shrub thicket. Mammalian, avian, and herptilian wildlife species have been identified at PBOW, some of which would be expected and/or have been observed at TNTA. Surface water on the northern side of TNTA drains to an unnamed tributary to Lindsley Ditch. This tributary is parallel to and just outside of the northern boundary of TNTA (Figure 3). Surface water in the southwest part of TNTA flows south, turns east, and eventually drains into Lindsley Ditch. Given the nature of the surface waters at the site, they are not likely to support significant populations of forage fish due to their shallow depth and intermittent nature.

One Ohio endangered plant species (bayberry – *Myrica pensylvanica*) and one Ohio potentially threatened plant species (fringed gentian – *Gentianopsis crinita*) were found just south of the unnamed tributary to Lindsley Ditch. This location includes only the extreme northern perimeter of TNTA in the eastern portion of the site and the adjacent off-site area (Figure 3). No other rare, threatened, or endangered animals or plants have been observed at TNTA.

The BERA focuses on the potential exposure to species or ecological components that are the most likely to be affected, given the toxicological and mobility characteristics of the COPECs, and on those COPECs that would most likely produce the greatest effects in the on-site ecosystem.

Site biota are organized into major functional groups. The following seven receptor species were selected to evaluate the potential terrestrial effects for TNTA soil COPECs.

- Deer mouse (*Peromyscus maniculatus*) (small omnivorous mammal)
- Short-tailed shrew (*Blarina brevicauda*) (small insectivorous mammal)
- Eastern cottontail rabbit (*Sylvilagus floridanus*) (medium-sized herbivorous mammal)
- Marsh wren (*Cistothorus palustris*) (small insectivorous bird)
- White-tailed deer (*Odocoileus virginianus*) (large herbivorous mammal)
- Raccoon (*Procyon lotor*) (medium-sized omnivorous mammal)
- Red-tailed hawk (*Buteo jamaicensis*) (large carnivorous bird).

Potential impacts to terrestrial plants are considered qualitatively in the risk characterization. The following two receptor species were selected to evaluate the potential aquatic effects for TNTA surface water and sediment COPECs.

- Raccoon (*Procyon lotor*) (medium-sized omnivorous mammal)
- Mallard duck (*Anas platyrhynchos*) (medium-sized aquatic omnivorous bird).

Potential effects to macroinvertebrates and phytoplankton (algae) were assessed qualitatively in the risk characterization. Terrestrial and aquatic food web diagrams for the above receptors are provided as Figures 6 and 7, respectively.

Measurement endpoints for the BERA are based on toxicity values from the available literature and not on statistical or arithmetic summaries of actual field or laboratory observations or measurements. The assessment endpoints for TNTA are stated as "the protection of long-term survival and reproductive capabilities for terrestrial invertebrates, herbivorous mammals, omnivorous mammals, insectivorous mammals and birds, carnivorous birds, benthic invertebrates, omnivorous aquatic mammals, and omnivorous aquatic birds."

Ecological routes of exposure for biota may be direct (ingestion of soil or surface water; plants absorbing contaminants from soil) or indirect via the consumption of contaminated organisms. Media-to-tissue transfer factors and food-chain multiplier values were used to model indirect exposure via ingestion of contaminated biota.

The ecological effects characterization includes the selection of benchmark values and the development of reference toxicity values. These values focus on the growth, survival, and reproduction of species and/or populations and provide a reference point for the comparison of toxicological effects upon exposure to a contaminant.

The risk characterization integrates information on exposure, exposure-effects relationships, and defined or presumed target populations. The result is a determination of the likelihood, severity, and characteristics of adverse effects of COPECs present at a site, based on qualitative and quantitative approaches. The weight-of-evidence risk characterization results, in conjunction with the uncertainties described in the BERA, are summarized by the following statements.

- Impacts to terrestrial plants appear to be insubstantial.
- Ecological hazard index (EHI) values associated with surface soil were elevated for terrestrial receptors, especially mice (812) and wrens (1,420). These estimated EHIs were especially associated with concentrations of TNT, lead, and Aroclor (Table 2).
- EHI values associated with total soil were elevated for terrestrial receptors, represented by the shrew (848). These estimated EHIs were especially associated with concentrations of Aroclor 1260 and lead (Table 2).
- Several surface water COPECs (carbon disulfide, aluminum, barium, cadmium, calcium, cobalt, copper, iron, manganese, silver, and zinc) and sediment COPECs (Aroclor 1260, nickel, lead, mercury, fluoranthene, benzo[a]anthracene, benzo[a] pyrene, chrysene, phenanthrene, pyrene, and cadmium) were detected at concentrations greater than the screening criteria. However, the tributaries evaluated at TNTA are intermittent and are very limited, reducing concern for potential impacts to aquatic biota. Also, considerable uncertainties are associated with toxicity and estimating concentrations in aquatic insects.
- Aquatic macroreceptors (raccoon [86] and mallard duck [51]) are predicted to have elevated EHIs primarily from exposure to Aroclor 1260, TNT, and 2-ADNT in sediment (Table 3).

REMEDIAL ACTION OBJECTIVES

The remedial action objective (RAO) identified in the TNTA FFS is as follows:

- Prevent human exposure via any exposure route (ingestion, inhalation, or dermal contact) to soil containing any of the COCs at concentrations that exceed TNTA RG levels.

With the exception of the RG for PCBs (Aroclor 1260), the RGs presented in Table 4 are chemical-specific concentrations derived for the COCs from the TNTA human health risk assessment and are specifically designed to meet the TNTA RAO. The RG for PCBs (1 mg/kg) is based on an applicable or relevant and appropriate requirement (ARAR) for the cleanup level of PCBs in high occupancy areas (40 CFR 761.61(a)(4)(i)(A)). The soil RGs were derived assuming future unrestricted land use. This assumption is appropriate because the area surrounding the former PBOW facility is rural and residential. This is consistent with the remedial objectives of other PBOW sites that have been remediated by the USACE. Also, it is consistent with the cleanup goals used for PBOW sites remediated by NASA. The soil RGs are based on residential exposure. Residential land-use assumptions result in the most health-protective RGs for soil.

The RGs were used as not-to-exceed criteria for the purpose of identifying areas at TNTA requiring soil remediation. They will also be used statistically during excavation and confirmation sampling as part of a risk-based approach to aid in determining whether additional soil removal is required. This will involve the averaging of samples from each excavation and comparing the analytical results to the respective RGs. The exceedance of an individual RG will be acceptable for an area of an excavation as long as the overall OEPA risk goals are not exceeded for the area represented by those samples (ILCR$\leq$1E-5 and HI$\leq$1). Also, for Remedial Alternative 5 (described below), which is the only alternative that may include on-site placement of treated materials, the RGs would serve as cleanup criteria. If the treated material were to be placed on site, an exceedance of an individual RG would be acceptable for a given batch of treated soil as long as the overall OEPA risk goals were not exceeded for that batch (ILCR$\leq$1E-5 and HI$\leq$1).

RAOs based specifically on ecological risk were not recommended for soil because of considerable uncertainties associated with toxicity and no observation of vegetative stress at TNTA. Also, the major risk-driving chemicals for terrestrial ecological risks in soil are predominant with respect to human health risks; therefore, the attainment of human health-based RG concentrations in soil will substantially reduce the estimation of ecological hazard.

It was determined that ecological concerns are insufficient to warrant remediation of surface water or sediment at TNTA because of limited habitat quantity and quality as well as uncertainties associated with toxicity and estimating concentrations in aquatic insects.

SUMMARY OF THE REMEDIAL ALTERNATIVES

A total of 18 building areas were identified that require remediation, as they each had at least one COC present at a concentration that exceeds its RG level. These building areas and the associated estimated areas to be remediated are shown on Figure 4. The following five alternatives were evaluated to mitigate risks associated with TNTA soil in these areas:

- Alternative 1 – No Action
- Alternative 2 – Excavation, Windrow Composting, and Off-Site Disposal
- Alternative 3 – Excavation and Off-Site Treatment/Disposal
- Alternative 4 – Excavation, Windrow Composting, Chemical Stabilization, and Off-Site Disposal

- Alternative 5 – Excavation, Alkaline Hydrolysis, Windrow Composting, Chemical Stabilization, and Off-Site Disposal/On-Site Placement.

Each of the four action-based alternatives (Alternatives 2 through 5) would require the excavation of an estimated 17,157 cubic yards of contaminated soil from the locations shown on Figure 4. Of this, an estimated 12,380 cubic yards will be disposed of at an appropriate nonhazardous solid waste landfill without treatment. Landfills used for the disposal of nonhazardous soil in Alternatives 2 through 5 must be approved in advance by EPA as appropriate facilities to receive CERCLA waste (40 Code of Federal Regulations 300.440); OEPA will also be consulted. The remaining 4,777 cubic yards are anticipated to be a characteristic hazardous waste based on toxicity as determined by toxicity characteristic leaching procedure (TCLP) testing. This hazardous soil would require treatment prior to disposal at a nonhazardous waste landfill (Alternatives 2 through 5) or on-site placement (Alternative 5). Approximately 3,922 cubic yards of this contaminated soil are expected to be hazardous prior to treatment based on elevated 2,4-DNT concentrations and 1,399 cubic yards are expected to be hazardous based on lead concentrations. An estimated 544 cubic yards of the lead-contaminated soil is also hazardous based on 2,4-DNT. Approximately 119 cubic yards of soil of has an elevated level of PCBs (>50 mg/kg) which render this material a Toxic Substances Control Act (TSCA) remediation waste. This PCB-contaminated soil also contains hazardous levels of 2,4-DNT and a portion of it (approximately 60 cubic yards) contains hazardous levels of lead. The 119 cubic yards of PCB-contaminated soil will not be treated prior to off-site disposal.

The technologies associated with Alternatives 2 through 5 are not designed to treat PCBs. Generally, areas with elevated concentrations of PCBs (i.e., exceeding the RG of 1 mg/kg) in TNTA soil are collocated with elevated lead and/or nitroaromatics concentrations.

If the PCB concentration is 50 mg/kg or greater, then the soil is regulated under the TSCA as a PCB remediation waste and will be disposed of in a TSCA-permitted Resource Conservation and Recovery Act (RCRA) hazardous waste treatment, storage, and disposal facility (TSDF). In this case, treatment for lead and nitroaromatics will not be performed to meet alternative Land Disposal Restriction (LDR) treatment standards for contaminated soil. If the PCB concentration in soil exceeds the TNTA RG (1 mg/kg) but is less than the TSCA-regulated concentration (50 mg/kg), then the material would be treated under the treatment-based alternatives (i.e., Alternatives 2, 4, and 5) for lead and nitroaromatics to meet the alternative LDR standards for soil and the TCLP criteria. This soil would then be disposed of in an OEPA nonhazardous waste landfill.

The extent of soil excavation needed to attain the RAO will be confirmed in the field by sampling and analysis of the excavation sidewalls. Additional soil excavation may be required laterally if indicated by a comparison of the confirmation samples to the remedial goals and the OEPA's cancer risk goal ($\leq 1 \times 10^{-5}$) and noncancer HI goal (≤ 1); additional removal of soil to a greater depth is not anticipated because virtually all of the excavations are expected to extend to either bedrock or the water table, whichever is encountered first. Characterization of the excavated soil as hazardous or nonhazardous waste will be confirmed by analysis using TCLP prior to disposal.

As described in the Summary of Risks, two threatened/endangered plant species (fringed gentian and bayberry) were identified just south of a small unnamed tributary to Lindsley Ditch located along the extreme northern perimeter of the eastern portion of TNTA. These species were limited to a very narrow corridor and were not in close proximity to any areas that are expected to be remediated. Nonetheless, care will be taken during remedial activities not to disturb or adversely impact this area.

Alternative 1 – No Action

A no-action alternative is carried forward as a baseline for comparison. Under this alternative, no remedial action or monitoring would be conducted for contaminated soil at the site. This alternative fails to meet the RAO for soil at the site.

The following estimated costs and durations are associated with Alternative 1:

Capital Cost: $0 K
Annual Operation and Maintenance Costs: $0 K
Present Worth Cost: $0 K
Time to Implement: 0 Months
Time to Achieve RAO: (would not be met in the foreseeable future).

Alternative 2 – Excavation, Windrow Composting, and Off-Site Disposal

This alternative includes excavation of the contaminated soil from the areas depicted on Figure 4, TCLP testing, analysis for total PCBs in soil (for applicable areas), segregation of the hazardous lead-contaminated soil, segregation of the hazardous PCB-contaminated soil, windrow composting of the soil that is hazardous due to elevated levels of 2,4-DNT, off-site disposal of the composted materials and untreated nonhazardous soil at a nonhazardous solid waste landfill, and off-site disposal of the hazardous lead-contaminated and TSCA-regulated soil at a TSCA-permitted RCRA TSDF.

The excavated soil would be hauled to an outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test. TSCA-regulated material would be identified using the PCB analysis results. Contaminated soils which fail the TCLP test for lead and those with concentrations that exceed the TSCA PCB waste criterion (i.e., >50 mg/kg PCBs) would be hauled off site to a TSCA-permitted RCRA TSDF.

Materials that pass the TCLP criteria and are not TSCA regulated would be hauled to the Erie County Landfill or other nonhazardous solid waste landfill without treatment.

Soil that fails the TCLP testing for 2,4-DNT would be composted at the existing outdoor composting area until TCLP criteria for 2,4-DNT and the alternative LDR treatment standards for underlying hazardous constituents in hazardous soil are met. This contaminated soil would be blended with amendments, such as straw and manure, turned occasionally with a windrow compost turner, and kept moist. The nitroaromatic compounds are biodegraded and transformed into less toxic and less mobile compounds through a series of sequential aerobic and anaerobic treatments, which are facilitated by mixing the soil with the amendments and periodic turning of the compost.

The following estimated costs and durations are associated with Alternative 2:

Capital Cost: $5.2M
Annual Operation and Maintenance Costs: $0
Present Worth Costs: $5.2M
Time to Implement: 18-24 Months
Time to Achieve RAO: 18-24 Months.

Alternative 3 – Excavation and Off-Site Treatment/Disposal

This alternative includes excavation of the contaminated soil from the areas depicted on Figure 4, TCLP testing, analysis for total PCBs in soil (for applicable areas), segregation of soil that is hazardous or TSCA-regulated due to elevated levels of 2,4-DNT, lead, and/or PCBs, off-site disposal of nonhazardous soil at a nonhazardous solid waste landfill, and off-site treatment/disposal of hazardous soil at a TSCA-permitted RCRA TSDF.

The following estimated costs and durations are associated with Alternative 3:

Capital Cost: $4.7M
Annual Operation and Maintenance Costs: $0
Present Worth Costs: $4.7M
Time to Implement: 12-18 Months
Time to Achieve RAO: 12-18 *Months.*

Alternative 4 – Excavation, Windrow Composting, Chemical Stabilization, and Off-Site Disposal

This alternative includes excavation of the contaminated soil from the areas depicted on Figure 4, TCLP testing, analysis for total PCBs in soil (for applicable areas), segregation of the hazardous lead-contaminated soil, segregation of the TSCA-regulated PCB-contaminated soil (i.e., $\geq$50 mg/kg), segregation and windrow composting of hazardous 2,4-DNT contaminated soil, chemical stabilization of the lead-contaminated soil, off-site disposal of TSCA-regulated PCB-contaminated soil at a TSCA-permitted RCRA TSDF, and off-site disposal of the treated and untreated nonhazardous soil at a nonhazardous solid waste landfill.

The excavated soil would be hauled to an outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test and analysis for PCBs (where applicable). Soil that passes the TCLP test and the TSCA PCB criterion would be hauled to the Erie County Landfill or other nonhazardous solid waste landfill that is approved to accept the wastes.

Soil that fails the TCLP test for 2,4-DNT would be composted until TCLP criteria for 2,4-DNT and the alternative LDR treatment standards for underlying hazardous constituents in contaminated soil are met. Composting would be performed at the existing outdoor area specifically designed for the treatment (both stabilization and composting) of contaminated soil. During composting, the contaminated soil would be blended with amendments, such as straw and manure, turned occasionally with a windrow compost turner, and kept moist. The nitroaromatic compounds are biodegraded and transformed into less toxic and less mobile compounds through a series of sequential aerobic and anaerobic treatments, which are facilitated by mixing the soil with the amendments and periodic turning of the compost.

After composting, soil that fails the TCLP test for lead would be treated with a chemical (e.g., Maectite®) to immobilize the lead within the soil matrix. After treatment, TCLP testing would be used to confirm that the stabilized material is nonhazardous for lead.

All treated and nonhazardous untreated soil would be disposed of at a nonhazardous solid waste landfill after the alternative LDRs for contaminated soil are met.

The following estimated costs and durations are associated with Alternative 4:

Capital Cost: $5.1M
Annual Operation and Maintenance Costs: $0
Present Worth Costs: $5.1M
Time to Implement: 19-25 Months
Time to Achieve RAO: 19-25 *Months.*

Alternative 5 – Excavation, Alkaline Hydrolysis, Windrow Composting, Chemical Stabilization, and Off-Site Disposal/On-Site Placement

This alternative includes the excavation of the contaminated soil from the areas depicted on Figure 4, TCLP testing, analysis for total PCBs in soil (for applicable areas), segregation of the hazardous lead-

contaminated soil, segregation of the TSCA-regulated PCB-contaminated soil, segregation of the hazardous 2,4-DNT contaminated soil, alkaline hydrolysis or window composting or a combination of both (if necessary), neutralization of the treated soil (if necessary), chemical stabilization of the lead-contaminated soil (if necessary), off-site disposal of the nonhazardous untreated soil at a nonhazardous solid waste landfill, off-site disposal of TSCA-regulated, PCB-contaminated soil at a TSCA-permitted RCRA TSDF, and off-site disposal or on-site placement of the treated material. Treated soil that meets RGs, either without composting or after composting, and that complies with the alternative LDR treatment standards for underlying hazardous constituents in contaminated soil (provided the soil was hazardous due to lead or nitroaromatics when generated) will be placed on site rather than disposed of at a landfill.

The excavated soil will be hauled to the outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test; TSCA-regulated soil will be identified by a PCB concentration of 50 mg/kg or greater. Soils that are TSCA regulated must be segregated and hauled to a RCRA/TSCA TSDF.

Materials that pass the TCLP test as nonhazardous and have PCB concentrations less than 50 mg/kg will be hauled to the Erie County Landfill or other nonhazardous solid waste landfill that can accept the waste.

Soils that fail the TCLP testing for 2,4-DNT would be treated with an alkaline chemical mixture (e.g., caustic soda and ferric chloride) at a treatment area, which would be established for TNTA, until the TCLP criterion for 2,4-DNT is met. Chemicals would be mixed into the soil using an excavator or wheel loader. The nitroaromatics are chemically reacted to less toxic compounds. Alkaline hydrolysis is effective at treating TNT but less effective in the treatment of DNTs. Therefore, if necessary for on-site placement of alkaline-treated soil or to meet TCLP criteria, this treated soil would be polished using windrow composting until TCLP criteria are met. If RGs are also met, the composted material would be placed on site; if RGs are not met, then the composted material would be disposed of off site.

Soil that failed TCLP for lead would be treated with a reagent (e.g., Maectite) to immobilize the lead within the soil matrix. After treatment, TCLP testing would be used to confirm that the stabilized soil is nonhazardous for lead. Treated and nonhazardous untreated soil would be disposed of at a nonhazardous solid waste landfill unless RGs are met for on-site placement. It is possible that treatment with the alkaline agent (caustic soda) will irreversibly bind the lead to soil, even after neutralization. If this is the case, then treatment with Maectite would not be required, and the costs associated with this alternative would be decreased, accordingly.

The following estimated costs and durations are associated with Alternative 5:

Capital Cost: $4.0M
Annual Operation and Maintenance Costs: $0
Present Worth Costs: $4.0M
Time to Implement: 21-27 Months
Time to Achieve RAO: 21-27 *Months.*

Chemical addition to alkaline hydrolysis-treated soil may not be required to neutralize the soil pH for on-site placement because alkaline hydrolysis-treated soil at another site was not chemically neutralized, and the soil pH at this site dropped to near neutral over a period of 3 months while staged on site. If chemical addition is not required for pH neutralization, a further cost savings may be realized.

EVALUATION OF THE ALTERNATIVES

Each of the five soil alternatives was evaluated with respect to the following nine criteria, as required by the NCP at 40 Code of Federal Regulations 300.430 (e)(9)(iii). Criteria 1 and 2 are the threshold criteria, which *must* be met; Criteria 3 through 7 are the primary balancing criteria; and Criteria 8 and 9 are the modifying criteria.

Threshold Criteria
1. Overall Protectiveness of Human Health and the Environment
2. Compliance with ARARs

Primary Balancing Criteria
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment
5. Short-Term Effectiveness
6. Implementability
7. Cost

Modifying Criteria
8. State Support/Agency Acceptance
9. Community Acceptance.

Threshold Criteria. Each of the four action-based alternatives (i.e., Alternatives 2 through 5) meet the threshold criteria for protection of human health and the environment and compliance with ARARs. These ARARs include the Ohio hazardous waste management regulations, the Federal Substances Control Act regulations, and the Department of Transportation hazardous materials transportation regulations (Appendix A). Alternative 1, no action, does not meet the threshold criterion for protection of human health and the environment. Thus, Alternative 1 is not regarded as viable for TNTA and is not further discussed in this evaluation of alternatives.

Primary Balancing Criteria. Alternatives 2 through 5 are equally effective in the long term because the contaminated soil would be treated and/or taken off site. Alternatives 2, 4, and 5 would meet the preference for treatment technologies that result in a reduction in toxicity, mobility, or volume. Alternative 3 relies only on off-site disposal, although the materials that are the most highly contaminated would be treated at the RCRA/TSCA TSDF if needed to comply with the LDR requirements prior to disposal.

Each of the four action-based alternatives could be performed in less than 30 months upon commencement of field remediation activities. Alternative 3 is estimated to take the shortest duration (12 to 18 months). Alternatives 2, 4, and 5 could all be performed within a similar time frame (18 to 27 months). Alternatives 2 through 5 can all be carried out safely without appreciable risk to remediation workers, NASA employees, or nearby residents. However, it should be noted that Alternative 5 requires the handling of hazardous chemicals (e.g., caustic soda, ferric chloride). Although safety and health plans would be developed and followed for any of these remedial approaches, the chemicals that must be handled in Alternative 5 render it the inherently most hazardous of the alternatives to implement. Proper adherence to the safety and health plan allows for safe implementation of each alternative.

Each of the alternatives represents a proven technological approach and is regarded as implementable. Windrow composting, the primary technology of Alternatives 2 and 4, has been used successfully at PBOW sites TNTB and the PRRWP Area. Note that windrow composting may also be used either as a primary technology or as a polishing step under Alternative 5. Chemical stabilization of lead, included in Alternatives 2, 4, and 5, has also been used at various PBOW sites. Alternative 3 is implementable, because it is simply off-site disposal/treatment. The effectiveness of alkaline hydrolysis, which is potentially the primary technology for Alternative 5, has been demonstrated on even high concentrations of TNT (>99 percent destruction) and 2,4-DNT (~97 percent destruction), but is less effective for 2,6-DNT (~24 percent destruction).

Costs of the four action-based alternatives are as follows, from least to most expensive:

- Alternative 5 – $4.0M
- Alternative 3 – $4.7M
- Alternative 2 – $5.2M
- Alternative 4 – $5.1M.

In addition, it is possible that Alternative 5 will not require neutralization for on-site placement of the noncomposted soil which is planned to be placed below the surface. This would result in greater cost savings. Also, Maectite may not be required for stabilization under Alternative 5 because the alkalizing agent should precipitate the lead out as lead hydroxide. These possibilities represent additional potential cost savings under this alternative that are not reflected in the above estimate for Alternative 5.

Modifying Criteria. The two modifying criteria, state acceptance and public acceptance, are not fully evaluated until the Responsiveness Summary of the Decision Document is complete. The evaluation in the Responsiveness Summary is based on state comment on the Proposed Plan, State comment during the public meeting and comment period, and public comment during the public meeting and public comment period.

It is noted that each of the technologies represented by the four action-based alternatives have been presented to the State of Ohio and public in the past. Neither the State of Ohio nor the public has expressed concern over any of these technologies in the past. Both composting and alkaline hydrolysis have been presented to the State of Ohio and public and in the past. Both of these technologies have been employed at different PBOW sites. Also, the Preferred Alternative and the other alternatives considered in this Proposed Plan were presented during a March 12, 2009 public meeting for the TNTC Proposed Plan. No objections were expressed by the public or the State of Ohio to any of the technologies presented, either during the meeting or during the 30-day public comment period.

SUMMARY OF THE PREFERRED ALTERNATIVE

Alternative 5: Excavation, Alkaline Hydrolysis, Chemical Stabilization, Windrow Composting, and Off-Site Disposal/On-Site Placement, is selected as the preferred remedial alternative for TNTA.

Alternative 5 is recommended over Alternative 3 because it utilizes on-site treatment to satisfy the statutory preference for alternatives that reduce the toxicity, mobility, or volume of contamination through treatment. Alternative 3 does not utilize on-site treatment. Alternative 5 ($4.0M) is also estimated to be less costly than Alternative 3 ($4.7M). Both alternatives provide equal protection for human health and the environment.

Alternatives 2, 4, and 5 provide equal protection for human health and the environment. However, Alternative 5 ($4.0M) is recommended over Alternatives 2 ($5.2M) and 4 ($5.1M) because it would cost less to implement.

Alternative 5 is recommended over Alternative 1 because Alternative 1 does not meet the threshold criterion of protecting human health and the environment.

Alternative 5 is the most cost-effective alternative based on an evaluation of the five primary balancing criteria used in the FS process. The USACE expects Alternative 5 to satisfy the following statutory requirements of CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element, or explain why the preference for treatment will not be met. The Preferred Alternative is subject to change after the public comment period as the result of input

by the State of Ohio or the public. This change would be reflected in the TNTA Decision Document, and the comment(s) providing the basis for such change would be recorded in the Responsiveness Summary of the Decision Document.

COMMUNITY PARTICIPATION

A level of community relations activities is required for DERP-FUDS projects that is consistent with CERCLA, SARA, and the NCP. The objective of the community relations program at PBOW is to provide a mechanism for the communication and exchange of information among Army agencies, government agencies, and residents of local communities and those adjacent to Plum Brook downgradient from PBOW. In January 1997, a Restoration Advisory Board (RAB), composed of local citizens with varying backgrounds, along with members from the USACE, NASA, and the OEPA, was established to promote a two-way dialog to keep local citizens informed about site progress and to allow them the opportunity to provide input to DERP-FUDS project decisions. The USACE and RAB follow the community relations plan, which was developed in 1999 and is updated each year.

In compliance with CERCLA (Section 113), the USACE has developed the AR to provide documentation as to how and why decisions specific to the remediation of the site are made. To date, the investigations completed for TNTA are as follows: SI (D&M, 1997); RI Parts I, II, and III (IT, 2001a,b,c); and FFS (Shaw, 2003). The AR contains these final documents as well as all others for the PBOW site. Currently, the final RI/FFS and SI reports are located in the AR at the USACE Huntington District Office (Huntington, West Virginia), and at the Public Repository located at the BGSU Firelands Library (Huron, Ohio). All documents are available for public viewing.

Each of the technologies associated with the four additional remedial alternatives, including windrow composting, off-site disposal, on-site placement, chemical stabilization, and alkaline hydrolysis have been presented at previous public meetings. The public provided no substantive comments on these technologies during the public meetings or subsequent to these meetings.

The public will be informed through the RAB as to when funding for the TNTA remedial action becomes available and when remedial activities are to begin. During the course of the remedial action, the public will be updated at each RAB meeting on the progress of the project. At that time, any concerns relative to remedial activities as they might be impacting the community may be expressed.

THE COMMUNITY'S ROLE IN THE SELECTION PROCESS

The USACE solicits input from the community on the preferred alternative for TNTA. The USACE has set a public comment period from November 30, 2009 to January 13, 2010, to encourage public participation in the selection process. The comment period includes one public meeting, at which time the USACE will present the Proposed Plan, answer questions, and accept both oral and written comments. During the public comment period, a copy of the Proposed Plan is available at the Firelands Library, BGSU, Huron, Ohio. The Proposed Plan is also available at the Restoration Advisory Board website: http://www.lrh.usace.army.mil/projects/current/derp-fuds/pbow/documents/.

A public meeting is scheduled for 7:00 p.m., November 30, 2009, at the Firelands Library. Comments from the public will be summarized and responses will be provided in the Responsiveness Summary section of the Record of Decision. To send written comments or obtain further information, contact:

U.S. Army Engineers District – Huntington
Attn: CELRH-PM-PP-P (Mr. Rick Meadows)
502 8th Street, Huntington, WV 25701

Phone: (304) 529-5388; (800) 822-8413
between 8:00 a.m. and 4:30 p.m. Monday–Friday
email: Richard L.Meadows@usace.army.mil

ACRONYMS

Common acronyms and abbreviations used elsewhere in this Proposed Plan are defined below:

2-ADNT	2-amino-4,6-dinitrotoluene
4-ADNT	4-amino-2,6-dinitrotoluene
AR	Administrative Record
ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
BGSU	Bowling Green State University
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act (also referred to as "Superfund")
COC	chemical of concern
COPEC	chemical of potential ecological concern
D&M	Dames & Moore, Inc.
DERP-FUDS	Defense Environmental Restoration Program-Formerly Used Defense Sites
DNT	dinitrotoluene
DoD	U.S. Department of Defense
EHI	ecological hazard index
FFS	focused feasibility study
FS	feasibility study
GSA	General Services Administration
HI	hazard index
ILCR	incremental lifetime cancer risk
IT	IT Corporation
LDR	Land Disposal Restrictions
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OEPA	Ohio Environmental Protection Agency
PA	preliminary assessment
PAH	polycyclic aromatic hydrocarbon
PBOW	Plum Brook Ordnance Works
PCB	polychlorinated biphenyl
PRRWP	Pentolite Road Red Water Pond
RAB	Restoration Advisory Board
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RG	remedial goal
RI	remedial investigation
RWP	Red Water Pond
SARA	Superfund Amendments and Reauthorization Act of 1986
Shaw	Shaw Environmental, Inc.
SI	Site investigation
SLERA	screening level ecological risk assessment
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C
TSCA	Toxic Substances Control Act
TSDF	treatment, storage, and disposal facility
USACE	U.S. Army Corps of Engineers

TABLES

Table 1

Summary of Total Hazard Index and Total Cancer Risk from Site-Related Chemicals of Potential Concern
TNT Area A
Plum Brook Ordnance Works, Sandusky, Ohio

	Groundskeeper		Indoor Worker		Construction Worker		On-Site Resident	
Contaminant Source	Total HI[a]	Total ILCR[b]	Total HI	Total ILCR	Total HI	Total ILCR	Total HI	Total ILCR
Surface Soil	0.65	6.08E-06	0.028	2.71E-06	NA	NA	NA	NA
Total Soil[c]	NA[d]	NA	NA	NA	60	3.51E-04	219	2.59E-02
Surface Water[e]	NA	NA	NA	NA	0.06	5.13E-09	0.03	9.79E-08
Sediment[e]	NA	NA	NA	NA	NA	6.46E-08	NA	2.38E-07
Total across all media	**0.06**	**6E-06**	**0.3**	**3E-06**	**60**	**4E-04**	**219**	**3E-02**

[a]The hazard index (HI) is a measure of noncancer hazard for an exposed individual.
[b]The incremental lifetime cancer risk (ILCR) is the estimated extra cancer risk which an individual encounters based on exposure to a site.
[c]Total soil is combined surface and subsurface soil.
[d]NA = Not applicable.
[e]The surface water and sediment were screened out, indicating minimal risk.

Notes:

1) HI values equal to or less than 1 are unlikely to result in adverse noncancer human health effects for any member of the exposed population and are regarded as acceptable.
2) ILCR values equal to or less than 1E-5 (1 in 100,000) are generally regarded by the Ohio Environmental Protection Agency as acceptable. The U.S. Environmental Protection Agency (1990) National Oil and Hazardous Substances Pollution Contingency Plan under CERCLA (NCP) (40 CFR 300.430) states that cancer risks between 1E-6 and 1E-4 are generally regarded as acceptable. Risks less than 1E-6 are regarded as very minimal, and risks greater than 1E-4 indicate a need for cleanup (or further study if appropriate). It is noted that the average lifetime cancer risk of the general American population is estimated as about 300,000 in 1,000,000.
3) Shading indicates an unacceptable HI or ILCR value.
4) An on-site hunter and child venison consumer were also evaluated for TNT Area A. Cancer risks (less than 1E-6) and potential noncancer hazards less than 0.1) for these receptors were found to be very minimal.

Table 2

Terrestrial Receptors Ecological Hazard Index Summary
TNT Area A[a]
Plum Brook Ordnance Works, Sandusky, Ohio

Media	Terrestrial Receptor						
	Deer Mouse	Cottontail	Shrew	Marsh Wren	Raccoon	Deer	Hawk
Soil [b] EHI[c]	101-812	38-189	92-848	148-1,420	92-751	8.3-42	0.6-6
Risk Drivers:	Aroclor-1260 (invert. intake) TNT (plant intake)	TNT (plant intake)	Aroclor-1260 (invert. intake) Lead (invert. intake)	Aroclor-1260 (invert. intake) Lead (invert. intake)	Aroclor-1260 (invert. intake) TNT (plant intake)	TNT (plant intake)	Aroclor-1260 (shrew intake) (bird intake)
Surface Water EHI[c]	0.2-1.7	0.2-1.8	0.1-1.1	0.2-1.2	0.2-2.1	2.0-17	0.003-0.01
Risk Drivers:	Aluminum (water intake)	Aluminum (water intake)	Aluminum (water intake)	Magnesium (water intake)	Aluminum (water intake)	Aluminum (water intake)	Magnesium (water intake)
Total Receptor EHI[c]	101-814	38-191	92-849	148-1,421	92-753	10-59	0.6-6

[a] Details presented in the ecological risk assessment.
[b] All receptors exposed to surface soil, except burrowing shrew exposed to surface and subsurface soil via ingestion of soil and ingestion of terrestrial invertebrates, and deer exposed to surface and subsurface soil via ingestion of plants (e.g., tree leaves) that have translocated COPEC(s) via deep feeder roots.
[c] Lower end of the range is the CT EHI; upper end represents the RME EHI.

Notes :

(1) EHI values are generally interpreted as follows:
- <1 – No probable adverse ecological effects
- 1 to 10 – Low potential for adverse ecological effects
- 10 to 100 – Substantial potential for adverse ecological effects
- >100 – Highest potential for adverse ecological effects.

(2) Central tendency (CT) and reasonable maximum exposure (RME) approach assumptions include differences in exposure point concentrations; toxicity values; interclass toxicity uncertainty factor; and method of calculation of site-specific soil- to-invertebrate biological accumulation factors.

(3) Risk driver percentage based on intake pathway indicated.

COPEC - Constituent of potential ecological concern.
EHI - Ecological hazard index.
TNT - 2,4,6-Trinitrotoluene.

Table 3

Aquatic Ecological Hazard Index Summary
TNT Area A [a]
Plum Brook Ordnance Works, Sandusky, Ohio

Media	Aquatic Receptor	
	Mallard Duck	Raccoon
Sediment EHI[b]	6-51	10-86
Risk Drivers:	30% TNT (invertebrate intake)	75% Aroclor-1260 (invertebrate intake)
	21% Aroclor-1260 (invertebrate intake)	7% TNT (invertebrate intake)
	19% 2-ADNT (invertebrate intake)	
Surface Water EHI	0.01 - 0.05	0.05-0.4
Risk Drivers:	41% Magnesium (water intake)	85% Aluminum (water intake)
Total Receptor EHI	6-51	10-86

[a] Details presented in the ecological risk assessment.
[b] Lower end of the range is the CT EHI; upper end represents the RME EHI.

(1) EHI values are generally interpreted as follows:
<1 – No probable adverse ecological effects
1 to 10 – Low potential for adverse ecological effects
10 to 100 – Substantial potential for adverse ecological effects
>100 – Highest potential for adverse ecological effects.
(2) Central tendency (CT) and reasonable maximum exposure (RME) approach assumptions include differences in exposure point concentrations; toxicity values; interclass toxicity uncertainty factors; and method of calculation of site-specific surface water-to-fish and sediment-to-invertebrate biological accumulation factors.
(3) Risk driver percentage is based on intake pathway indicated.
EHI – Ecological hazard index.
TNT – 2,4,6-Trinitrotoluene.
2-ADNT – 2-Amino-4,6-dinitrotoluene.

Table 4

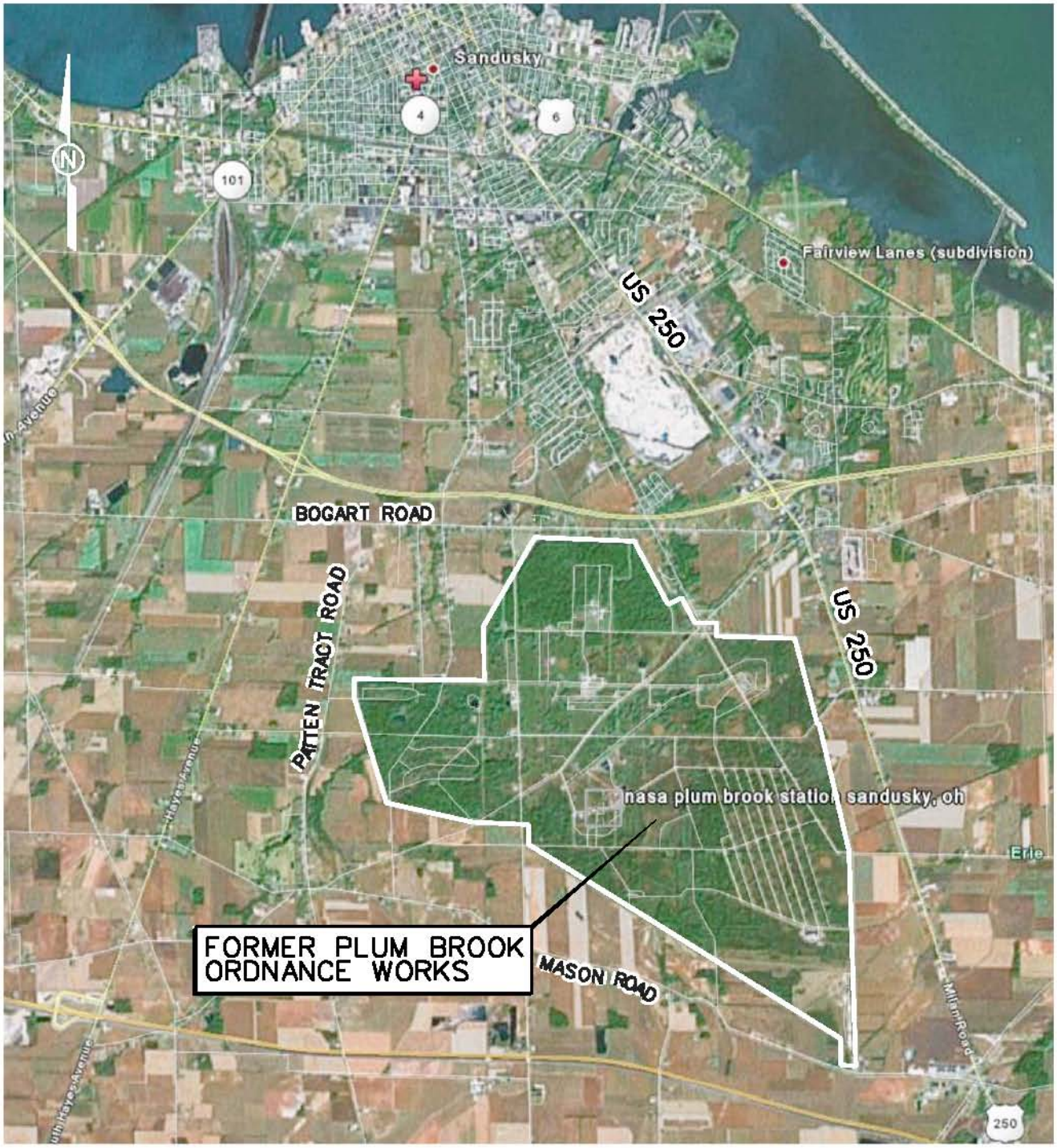
Remedial Goals for Total Soil
TNT Area A
Former Plum Brook Ordnance Works, Sandusky, Ohio

COC	Proposed RG (mg/kg)	Basis	HQ	ILCR
2-Amino-4,6-Dinitrotoluene	1.3	RBRC	0.3	NA
4-Amino-2,6-Dinitrotoluene	1.7	RBRC	0.4	NA
2,4,6-Trinitrotoluene	8.0	RBRC	0.2	6E-7[a]
2-Nitrotoluene	31	RBRC	0.04	NA
4-Nitrotoluene	9	RBRC	0.01	NA
2,4-Dinitrotoluene	6.0	RBRC	0.04[b]	8E-6
2,6-Dinitrotoluene	1.5	RBRC	0.02[b]	2E-6
Aroclor 1260	1.0	ARAR[c]	NA	3E-6 (5E-8)[d]
Lead	400	TBC[e]	NA	NA
Total HI/ILCR			1.0	1.0E-5 (1.3E-5)[f]

[a] RG derived on the basis of noncancer effects; cancer risk is *de minimis* (<1E-6).
[b] RG derived on the basis of carcinogenicity; noncancer effects are *de minimis* (HQ<0.1).
[c] 40 CFR 761.61(a)(4)(i)(A).
[d] Value shown in parentheses is the ILCR for the highest detected concentration among the areas not proposed for remediation based on the nitroaromatic RGs; this value is *de minimis* (i.e., <1E-6).
[e] EPA Soil screening value for average lead concentration.
[f] Value outside of parentheses is for nitroaromatics and the maximum detected concentration among the remaining samples for residual PCBs; value shown in parentheses is the total ILCR assuming the combined Aroclor 1254 and 1260 concentration is equal to the RG.

ARAR - Applicable or reasonable and appropriate requirement.
COC - Chemical of concern.
HQ - Hazard quotient.
ILCR - Incremental lifetime cancer risk.
mg/kg - Milligrams per kilogram.
NA - Not applicable.
RBRC - Risk-based remediation concentration.
RG - Remedial goal.
TBC - To be considered criterion.

FIGURES



NOT TO SCALE

FIGURE 1
PBOW VICINITY MAP

TNT AREA A PROPOSED PLAN
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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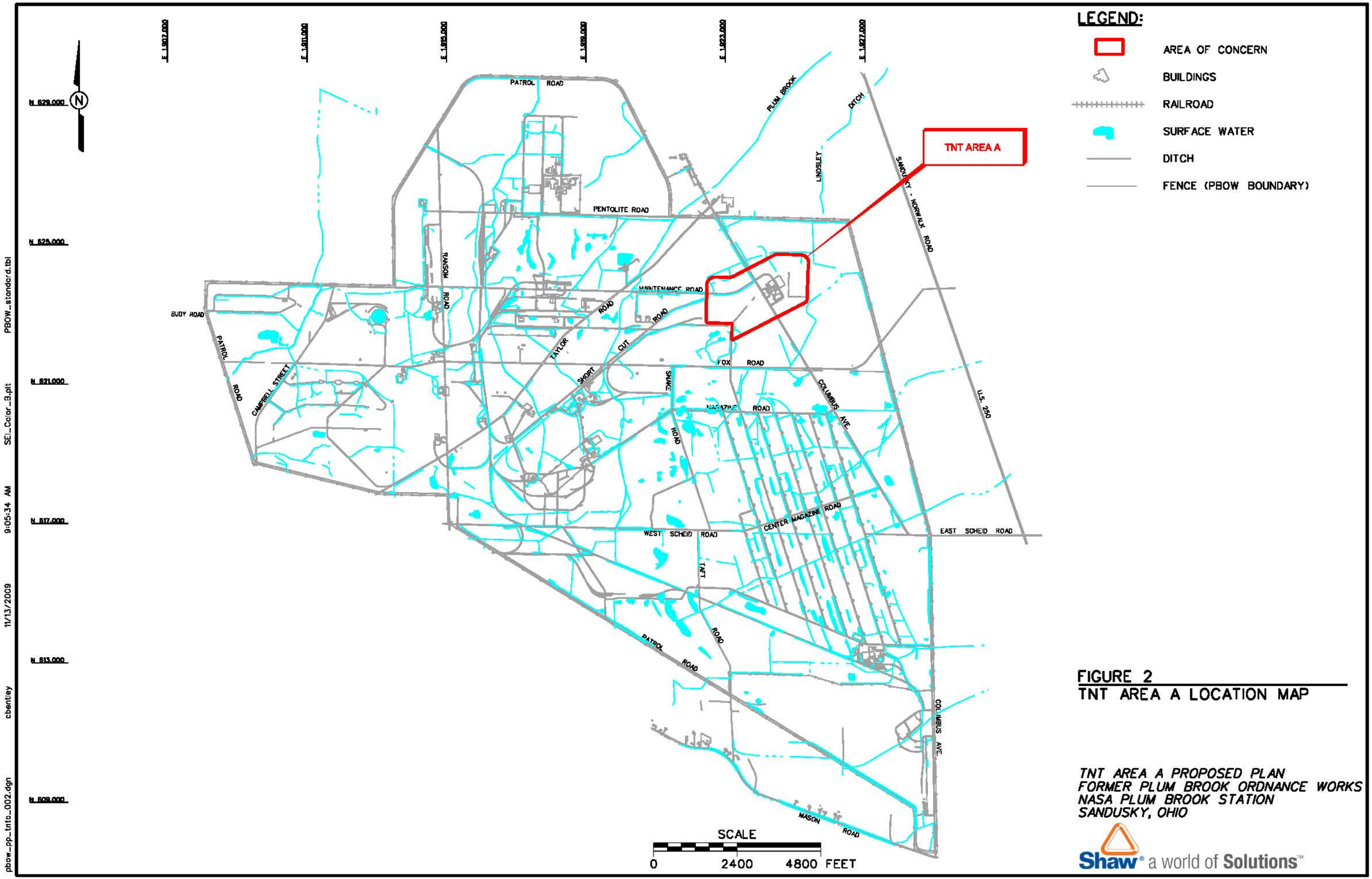

FIGURE 2
TNT AREA A LOCATION MAP

TNT AREA A PROPOSED PLAN
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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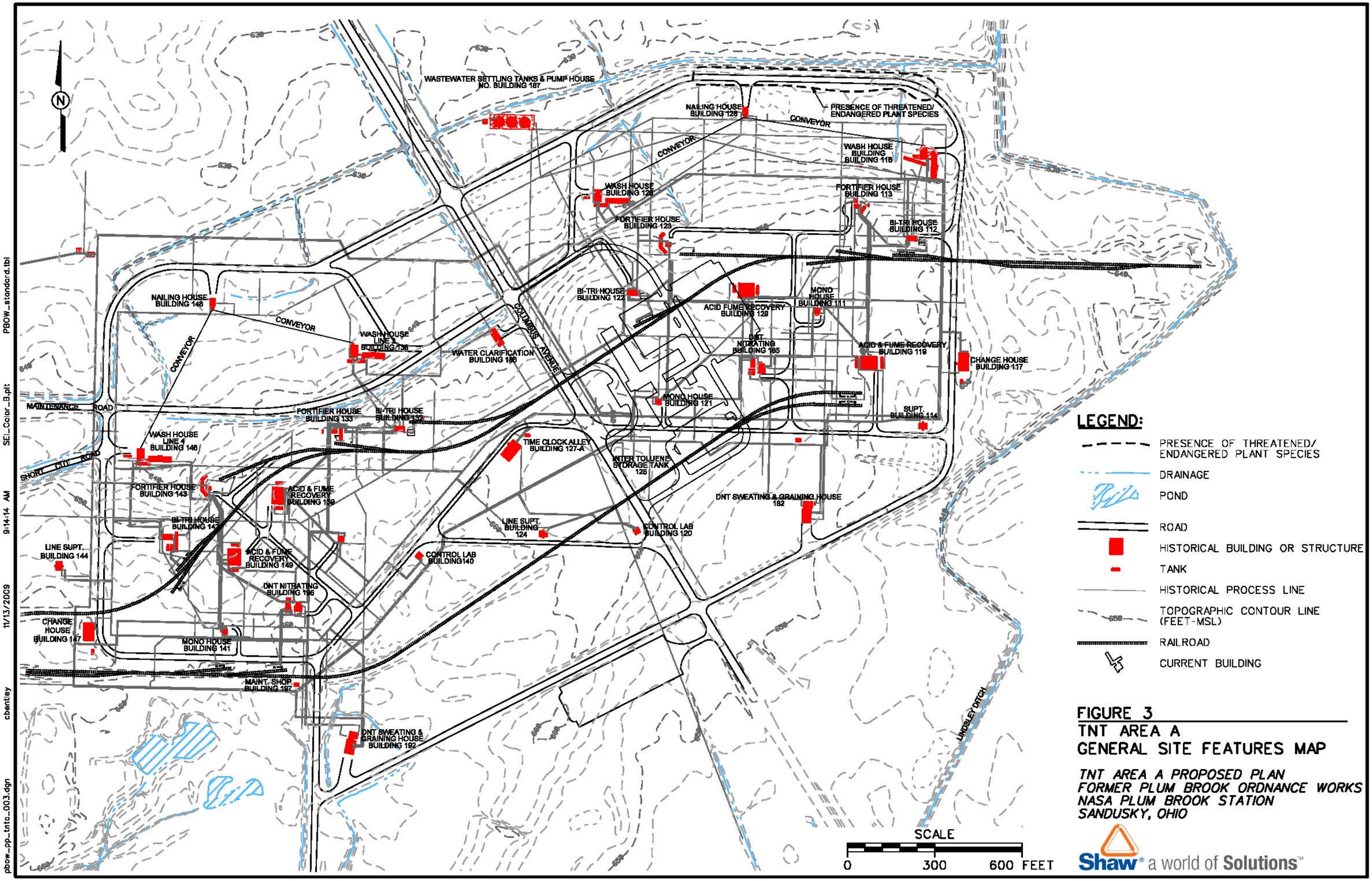

FIGURE 3
TNT AREA A
GENERAL SITE FEATURES MAP

TNT AREA A PROPOSED PLAN
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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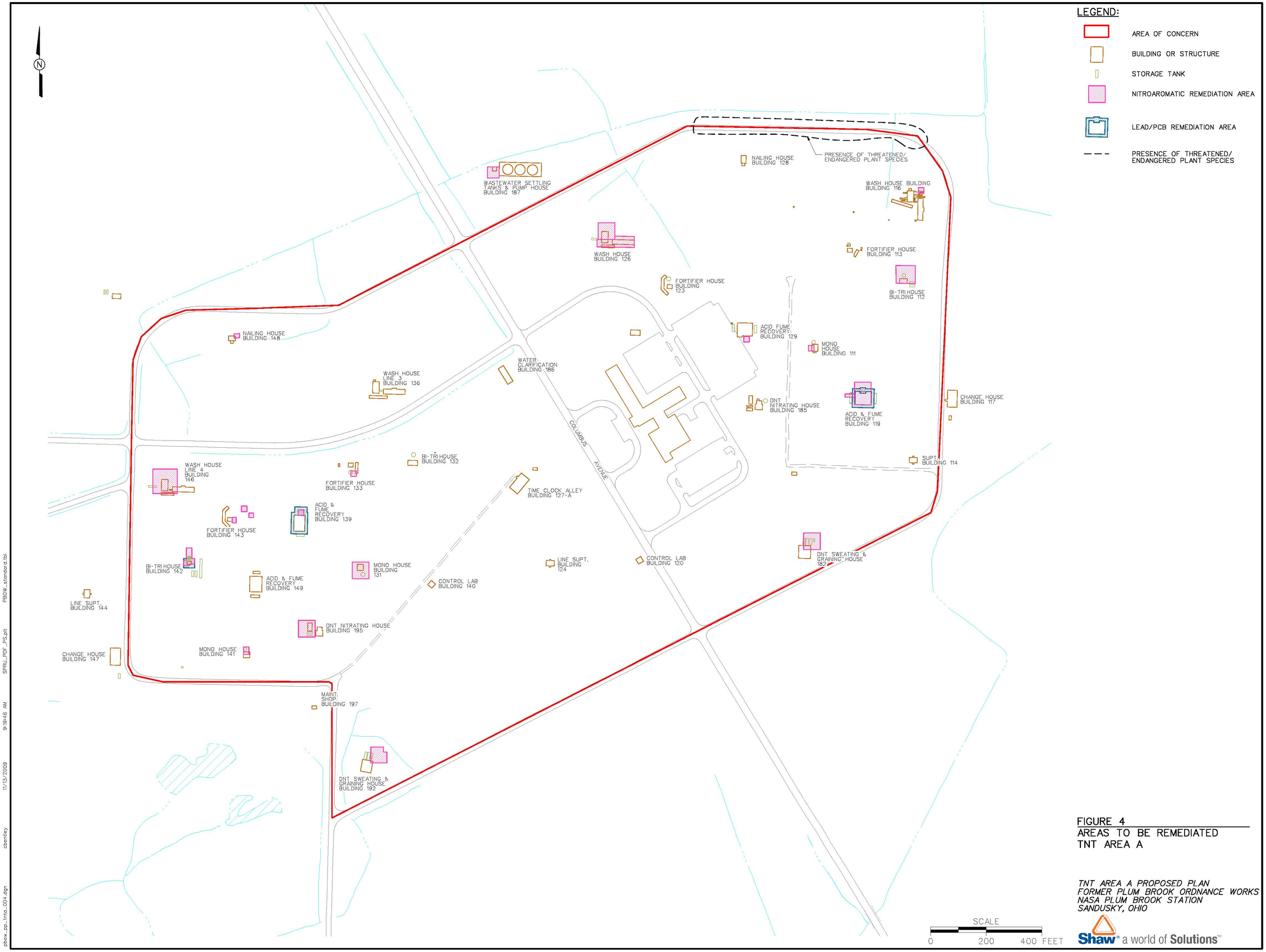

FIGURE 4
AREAS TO BE REMEDIATED
TNT AREA A

TNT AREA A PROPOSED PLAN
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

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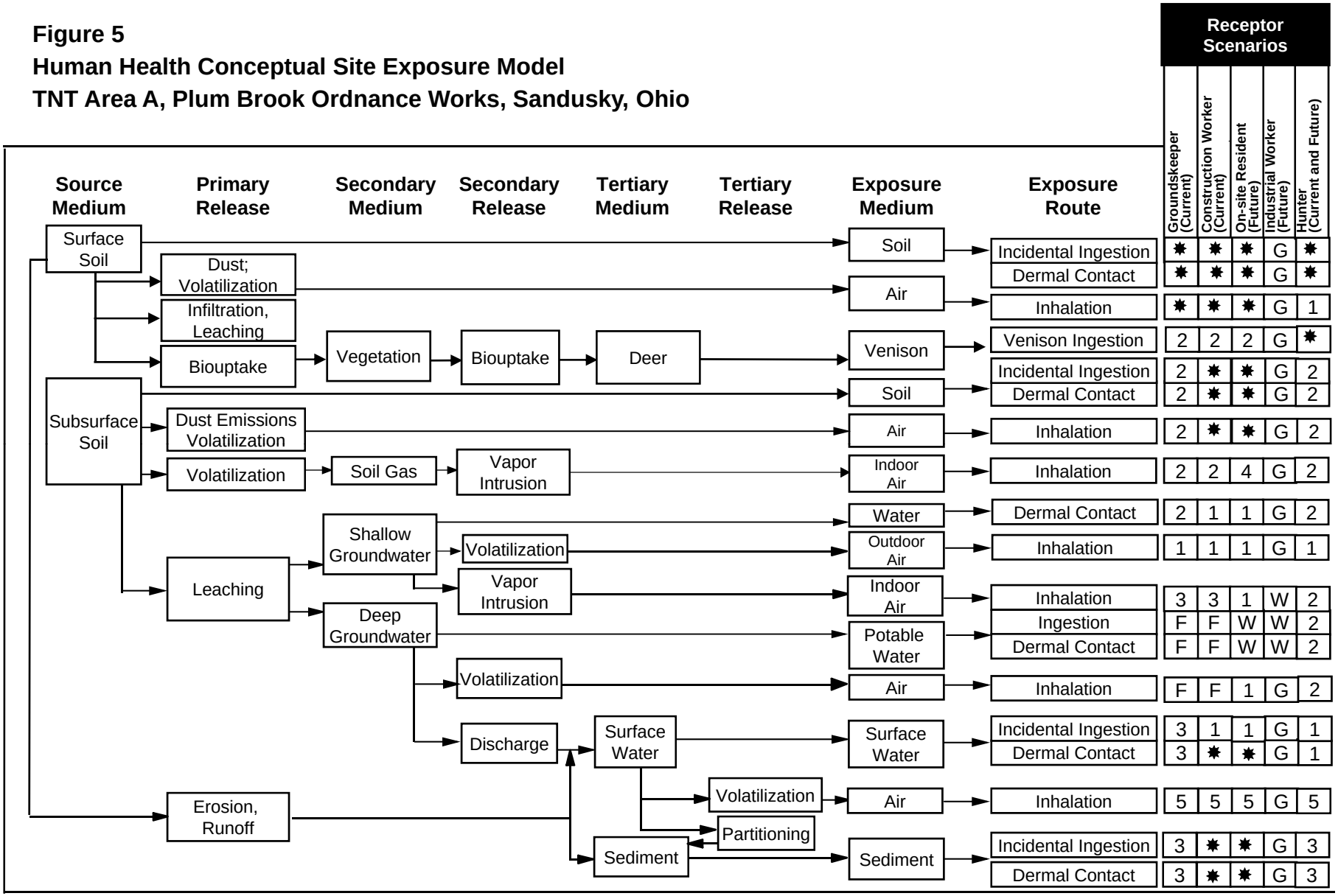
Figure 5
Human Health Conceptual Site Exposure Model
TNT Area A, Plum Brook Ordnance Works, Sandusky, Ohio



✸ = Complete exposure route quantified in the risk assessment
1 = Although theoretically complete, this pathway is not quantified as explained in risk assessment.
2 = There is no plausible pathway for exposure to this medium.
3 = Contact with this medium, although plausible, is not part of this receptor's normal or expected activities; therefore contact would be sporadic and is not quantified.
4 = Pathway not quantified because no volatile compounds were identified as chemicals of potential concern (COPC).
5 = Pathway not quantified because no volatile compounds were identified as COPC, and for reasons explained in the risk assessment.
G = Receptor evaluated for exposure to deep groundwater only; groundwater is not directly addressed in this Proposed Plan.
F = No current exposure. Exposure of future industrial worker to groundwater would be representative of future groundwater exposure for this receptor.
W = Complete pathway evaluated in the groundwater risk assessment; groundwater is not directly addressed in this Proposed Plan.

Figure 6

Simplified Terrestrial Food Web Site Model
TNT Area A
Plum Brook Ordnance Works, Sandusky, Ohio

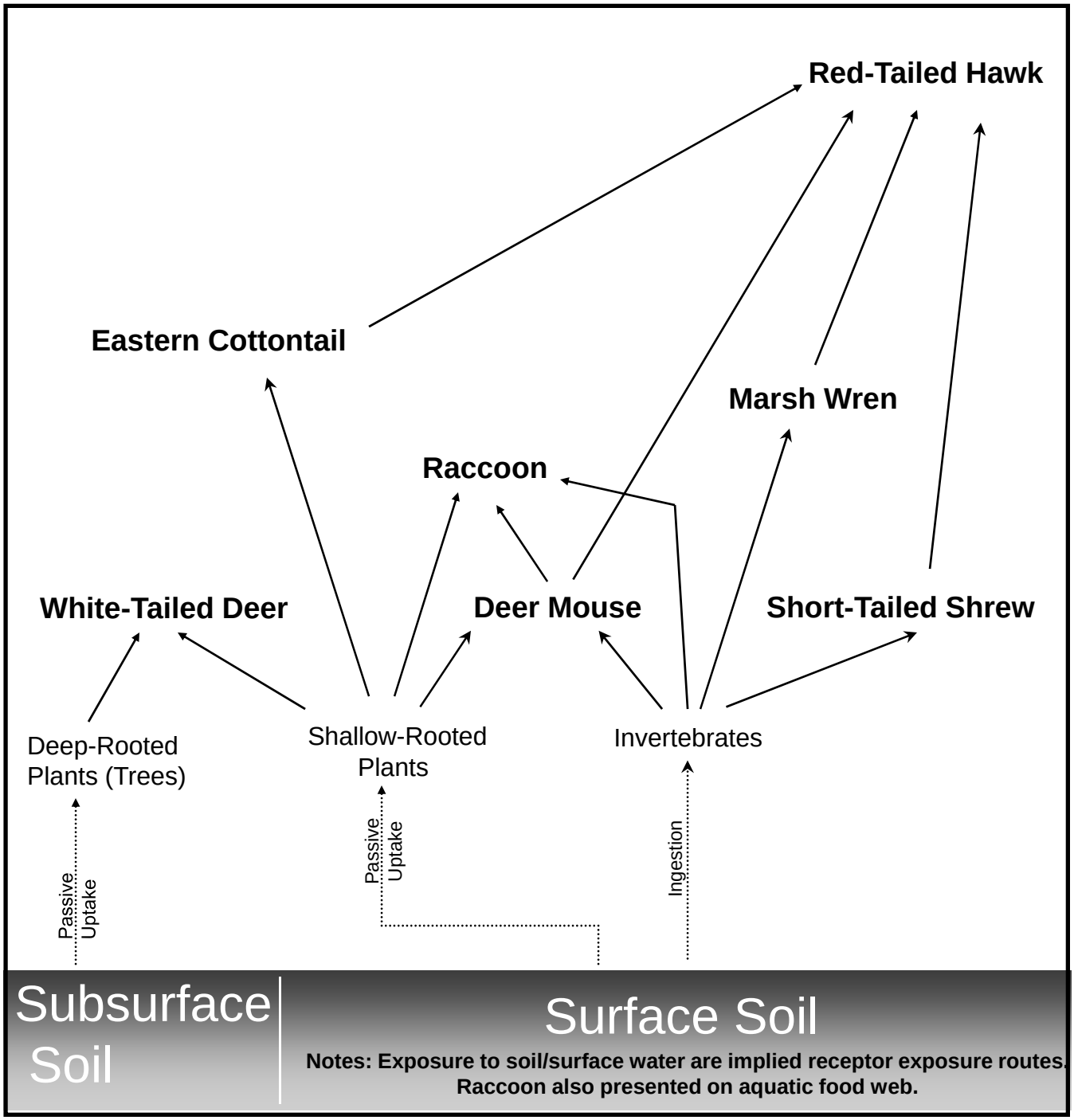
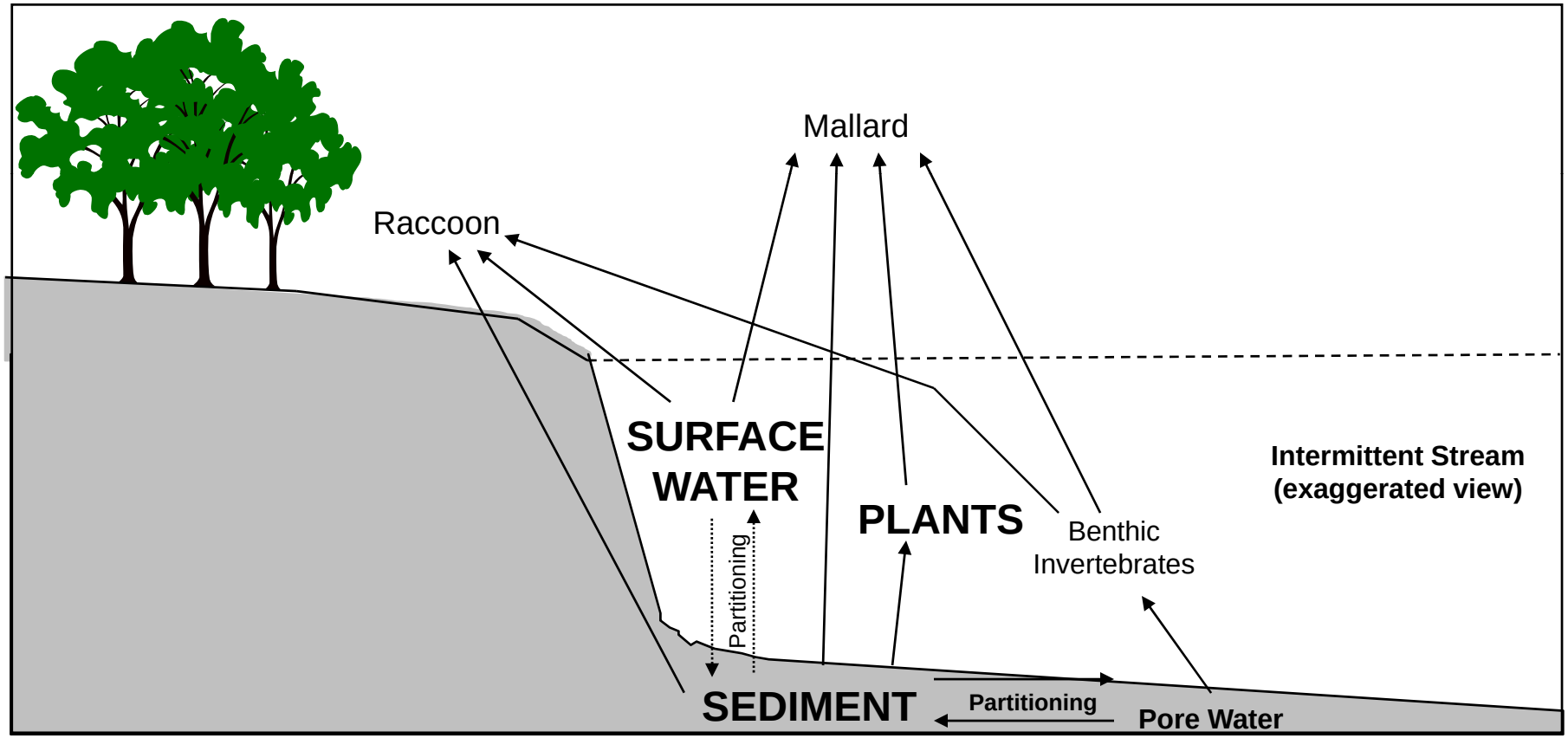


Figure 7

Simplified Aquatic Food Web Site Model
TNT Area A
Plum Brook Ordnance Works, Sandusky, Ohio



Note: Raccoon also presented on terrestrial food web.

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APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Table A-1

Applicable and Relevant or Appropriate Requirements for the Preferred Alternative
Alternative 5: Excavation, Alkaline Hydrolysis, Chemical Stabilization, Windrow Composting and Off-Site Disposal/On-Site Placement
TNT Area A, Former Plum Brook Ordnance Works, Sandusky, Ohio

Authority	Medium	Requirement	Status	Synopsis of Requirement	Action to be Taken to Attain Requirement
Ohio Environmental Protection Agency (OEPA)	Soil	Ohio Hazardous Waste Management Rules (3745-52 through 3745-59)	Applicable	Rules define what a hazardous waste is, how hazardous wastes must be managed and the restrictions on their land disposal.	The proposed remedy will comply with these requirements by identifying and properly disposing of hazardous wastes that are generated during remedial activities. Hazardous waste that exceeds requirements for land disposal will be treated to meet the criteria prior to disposal.
US Environmental Protection Agency (EPA)	Soil	Federal Toxic Substances Control Act (TSCA) Regulations (40 CFR 761)	Applicable	Rules define what a PCB remediation waste is and how PCB wastes must be managed.	The proposed remedy will comply with these requirements by identifying and properly disposing of PCB remediation wastes.
US Department of Transportation (DOT)	Soil	DOT Regulations (49 CFR 171-180)	Applicable	Rules define requirements for transportation of hazardous materials.	The proposed remedy will comply with these requirements by properly labeling, packaging and conveying hazardous materials. Personnel responsible for preparing hazardous materials for transport will be properly trained.