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March 10, 2009

U.S. Army Engineer District, Nashville
ATTN: CELRN-EC-R (Ms. Kathy McClanahan)
110 Ninth Avenue South, Room 682
U.S. Court House Annex
Nashville, Tennessee 37203

Submittal of the Final Proposed Plan for TNT Area C
Former Plum Brook Ordnance Works, Sandusky, Ohio
Contract No. W912DR-05-D-0026: Shaw Project Number 119268

Dear Ms. McClanahan:

In accordance with the requirements of Delivery Order No. DX02 of Contract No. DACA62-00-D-0002, Shaw is pleased to submit this Final Proposed Plan for TNT Area C at the Former Plum Brook Ordnance Works located in Sandusky, Ohio.

Enclosed are four copies of this Proposed Plan for your records. Copies have also been sent to those on the distribution list as indicated. Additional copies have been made for distribution to the public at the March 12, 2009 Public Meeting. I will bring these additional copies to the meeting.

Should you have any questions or require additional information regarding this submittal, please do not hesitate to contact me at (865) 694-7496.

Sincerely,

for

Steven T. Downey, PE
Project Manager

Enclosures

Distribution List

Name	Copies
U.S. Army Engineer District, Nashville ATTN: CELRN-EC-R (Ms. Kathy McClanahan) 110 Ninth Avenue South, Room 682 Annex Nashville, TN 37203	4
U.S. Army Engineer District, Huntington ATTN: CELRH-PM-PP-P (Mr. Rick Meadows) 502 Eighth Street Huntington, West Virginia 25701-2070	13 (CD provided)
Mr. Paul Jayko Site Coordinator Division of Emergency and Remedial Response (DERR) Ohio Environmental Protection Agency 347 North Dunbridge Road Bowling Green, Ohio 43402-0466	2
Mr. Janusz Z. Byczkowski Division of Emergency and Remedial Response (DERR) Lazarus Government Center 1220 South Front Street Columbus, OH 43216-1049	1
Mr. Robert Lallier Environmental Coordinator NASA - Plum Brook Station 6100 Columbus Avenue Sandusky, Ohio 44870	1
Mr. Mark Bohne PBOW RAB Co-chairman 311 East Mason Road Milan, Ohio 44846	1
Ms. Julie Weatherington-Rice TAPP Contractor Bennett & Williams Environmental Consultants, Inc. 2700 East Dublin-Granville Road Suite 400 Columbus, OH 43231-4054	1
U.S. Army Corps of Engineers (**electronic only**) HTRW Center of Expertise ATTN: CEHNC-CX-EG (Vern StJohn) 1616 Capitol Avenue Omaha, Nebraska 68144-3869	(CD only)

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

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

March 2009

USACE ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the Preferred Alternative for the cleanup of contaminated soils and sediments associated with TNT Area C (TNTC) 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 and sediment 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 areas, in which soil and sediment 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 the 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 the PBOW associated with past U.S. Department of Defense (DoD) activities. The USACE Nashville District is acting as the contracting office for site investigations (SI) 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 over-sight.

The Proposed Plan is issued to accomplish the following:

DATES TO REMEMBER

Comment Period
March 12, 2009 through April 13, 2009

Public Meeting
7:00 p.m., March 12, 2009, at
Firelands Library - BGSU
Foundation Hall
One University Drive
Huron, Ohio

Comments can be directed to:

U.S. Army Corps of Engineers,
Huntington District
Attn: CELRH-PM-PP-P (Mr. Rick Meadows)
502 8th Street
Huntington, WV 25701
Phone: (304) 399-5388
(800) 822-8413
email:
Richard L. Meadows@usace.army.mil

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- Provide basic background information about the site
- Identify the Preferred Alternative for TNTC 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.

The USACE, after consulting with the OEPA, will select a remedy for TNTC 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 March 12, 2009 through April 13, 2009, and the public meeting will be held at 7:00 p.m. on March 12, 2008, at the Firelands Library, Firelands campus of Bowling Green State University (BGSU), Huron, Ohio. The remedy selected for TNTC will be documented in a Decision Document.

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 TNTC. Background documents for TNTC are listed on the next page 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 TNTC 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 9,009-acre PBOW facility was built in early 1941 as a manufacturing plant for 2,4,6-trinitrotoluene, 2,4-dinitro-toluene (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 TNT Area A (TNTA), TNT Area B (TNTB), and 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 TNTC manufacturing site consisted of widely scattered buildings of wood frame construction 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 TNTC manufacturing process lines were decontaminated by the Army in late 1945.

During decontamination, all structures, equipment, and debris associated with the manufacture of explosives were either removed and salvaged or

Primary Background Documents for TNTC

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, Incorporated, 1995a, ***Site Management Plan, Plum Brook Ordnance Works, Sandusky, Ohio,*** September.

International Consultants Incorporated, 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), 2009, ***Addendum, TNT Area C, Focused Feasibility Study for Soil and Sediment, Final, Former Plum Brook Ordnance Works, Sandusky, Ohio,*** January.

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.

U.S. Army Corps of Engineers (USACE), 2004, ***Final Action Memorandum for TNT Area C Interim Removal Action at the Plum Brook Ordnance Works, Sandusky, Ohio***, prepared for Huntington District, Huntington, West Virginia, May.

removed and burned. After it was certified as decontaminated, 3,230 acres of the property were initially transferred to the Ordnance Department, then to the War Assets Administration in 1946. This transfer did not include the Plum Brook Depot area, which consists of 2,800 acres. The Department of the Army reacquired the 3,230 acres in 1954 and performed cleanup efforts from the mid-1950s until 1963. In 1955, the Army specifically completed further decontamination of TNTC. This effort included removal of contaminated surface and subsurface soil around the buildings 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. On March 15, 1963, accountability and custody of the entire PBOW property (6,030 acres) were transferred to NASA. 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. The thoroughness of this decontamination effort at TNTC is not as well documented as that at TNTA (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 General Services Administration 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, Incorporated, 1995a).

TNTC occupies approximately 119 acres of land in the western portion of PBOW, as shown on Figure 2. Currently, the area is mostly overgrown with trees and brush. Several aboveground features that indicate former PBOW facilities were present are still evident at TNTC. These include roads, fire hydrants, water valves, a water valve control well, railroad beds, and former building pad foundations (Building 667, Maintenance Shop; Building 689, Acid & Fume Recovery; and Building 657, Wastewater Settling Basin). Several belowground features are also present: manholes, drains, and underground lines (indicated by aboveground water valves). There are no NASA buildings on the site, and NASA does not currently use the area. One building present on the site was constructed and used by the U.S. Environmental Protection Agency to perform noise abatement testing in the 1980s and is located near the former Wash House (Building 606) in Process Line 10. Former buildings and other site features are shown on Figure 3.

Currently, TNTC consists mostly of early and late old field combined with shrubby thicket vegetation, and TNTC is less than 10 percent wooded. Some wetland vegetation was found along TNTC drainage ditches and streams. During rain events, drainage from the ditches flows into either of three small streams that eventually flow to Pipe Creek, located northwest of TNTC. Areas east of TNTC are primarily old field and shrub, while to the south, southeast, northeast, north, and west it is primarily forested; to the southwest, it is old field and early shrub thicket.

Nitroaromatic compounds (i.e., explosives) are the major soil contaminants at TNTC. 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 and sediment that has resulted from past DoD activities at the site. Investigations of the surface water associated with TNTC indicate that the site contamination is not appreciably impacting surface water. The remediation of contaminated soil at TNTC will also preclude these areas from being potential sources of further groundwater contamination. Based on the analytical data presented in the TNTC focused feasibility study (FFS) (Shaw Environmental, Inc., 2003), 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 one of the excavations. This area, which is within the Building 682 Area, had concentrations of nitroaromatics (0.18 milligrams per kilogram [mg/kg] 2,4-DNT)

which were less than the remedial goal (RG) levels in soils at a depth of 4 to 6 feet; therefore, this area is interpreted as having very limited vertical extent of contamination, and excavation is not planned below a depth of 4 feet. A groundwater feasibility study (FS), which includes TNTC in addition to the other two TNT areas and two red water pond areas, is being prepared that will evaluate potential remedial approaches for individual areas of contaminated groundwater and source areas. A proposed plan for the groundwater associated with the TNT areas and red water pond areas will be issued that will acknowledge that the soil and sediment removal described in this Proposed Plan represents a source removal.

SITE CHARACTERISTICS

Field activities were conducted specifically to investigate environmental media at TNTC, 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 site investigation history. The groundwater analytical results and characteristics are not presented herein.

Remedial investigation (RI) activities were conducted separately for TNTC soils (415 samples), surface water (10 samples), and sediment (15 samples) in 2000 and for site groundwater in October 2001 through April 2002. Two overburden wells were sampled in 2000 and three were sampled in 2002. Two bedrock wells were sampled in both 2001 and 2002. As part of the RI, nine samples were collected from temporary piezometers in 2001, and samples were collected from two additional temporary piezometers in 2001 (though several others were dry). Prior to the groundwater RI activities, five overburden wells were sampled in 1997 and 1998. One of the bedrock wells (BED-MW13) was also sampled in 1994, 1996, 1997, and 1998.

As part of the 1993 investigation, one collocated surface water and sediment sample pair was collected just downstream of the confluence of Pipe Creek and a small tributary running east to west in the northern portion of TNTC. Two TNTC soil samples were collected during the 1993 investigation (Morrison-Knudsen Corporation, 1994) and 19 soil samples were collected during the 1994 SI (D&M, 1997).

Soil. During the RI, TNTC 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 29 building areas evaluated during the RI is presented in the paragraphs that follow. Samples stated as being collected from a given building (e.g., Building Area 692) may include not only the former building's footprint, but the general area surrounding the footprint as well. The 29 TNTC areas investigated during the RI include the following:

- *Wastewater settling tanks*
  - Building 657, wastewater
- *Process Line 8*
  - Building 681, mono house
  - Building 682, bi-tri house
  - Building 683, fortifier house
  - Building 686, wash house
  - Building 689, acid and fume recovery
- *Process Line 9*
  - Building 691, mono house
  - Building 692, bi-tri house
  - Building 693, fortifier house
  - Building 696, wash house
  - Building 698, nailing house
  - Building 699, acid and fume recovery
- *Process Line 10*
  - Building 601, mono house
  - Building 602, bi-tri house
  - Building 603, fortifier house
  - Building 606, wash house
  - Building 609, acid and fume recovery
- *Process Line 11*
  - Building 611, mono house
  - Building 612, bi-tri house
  - Building 613, fortifier house
  - Building 616, wash house
  - Building 618, nailing house
  - Building 619, acid and fume recovery.

- *Process Line 12*
  - Building 621, mono house
  - Building 622, bi-tri house
  - Building 623, fortifier house
  - Building 626, wash house
  - Building 628, nailing house
  - Building 629, acid and fume recovery.

Soil samples were also collected from 4 of these 29 areas during the 1994 SI (Building Areas 612, 613, 626, and 657).

Concentrations of nitroaromatics exceeding RG levels, which serve as cleanup criteria, were exceeded by one or more RI soil samples from the 13 areas listed below. The maximum detected concentration (MDC) of a nitroaromatic compound and the maximum depth interval of any nitroaromatic RG exceedance for each area are also shown below. Specific contaminated areas with soil concentrations that exceed at least one of the RG levels are identified on Figure 4 as "areas to be remediated."

- Building Area 602 (MDC: 10.2 mg/kg 4-amino-2,6-dinitrotoluene [4-ADNT]; maximum depth interval: 5-7 feet below ground surface [bgs])
- Building Area 603 (MDC: 56.1 mg/kg 2,4-DNT; maximum depth interval: 8-10 feet bgs)
- Building Area 606 (MDC: 6.9 mg/kg 2-amino-4,6-dinitrotoluene [2-ADNT]; maximum depth interval: 1-2 feet bgs)
- Building Area 616 (MDC: 2,226 mg/kg TNT; maximum depth interval: 8-10 feet bgs)
- Building Area 626 (MDC: 2.67 mg/kg 2-ADNT; maximum depth interval: 2.5-3.5 feet bgs)
- Building Area 629 (MDC: 456 mg/kg 2,4-DNT; maximum depth interval: 8-10 feet bgs)
- Building Area 682 (MDC: 41,261 mg/kg TNT; maximum depth interval: 1.5-2.5 feet bgs)
- Building Area 683 (MDC: 448 mg/kg TNT; maximum depth interval: 8-10 feet bgs)
- Building Area 686 (MDC: 5,067 mg/kg TNT; maximum depth interval: 2.5-3.0 feet bgs)
- Building Area 689 (MDC: 14.3 mg/kg 2,4-DNT; maximum depth interval: 4-6 feet bgs)
- Building Area 692 (MDC: 1,319 mg/kg TNT; maximum depth interval: 4-6 feet bgs)
- Building Area 693 (MDC: 8.07 mg/kg TNT; maximum depth interval: 8-10 feet bgs)
- Building Area 696 (MDC: 878 mg/kg TNT; maximum depth interval: 1.5-2.5 foot bgs).

In addition to nitroaromatics, Aroclor 1254 and Aroclor 1260 [polychlorinated biphenyls (PCB)] were detected at concentrations exceeding RG levels (Building Areas 629, 686, and 689), as were lead (Building Areas 629, 682, 686, and 696) and five polycyclic aromatic hydrocarbons (PAH), including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene (Building Areas 616, 686, 696, and 657; at Building Area 657, the only RG exceeded was for PAHs).

PCBs are likely associated with leaking electric power transformers, and the lead is likely associated with building materials. 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 TNTC buildings during demolition, as well as during periodic controlled vegetation burns conducted by NASA in the TNTC area. Elevated concentrations of PAHs at TNTC were observed only at former wash house locations, with one exception, where the crystallization of the TNT and a final washing step had been performed. The elevated PAHs at these wash house locations co-occurred with elevated nitroaromatics. The only other TNTC location where elevated PAH concentrations were encountered is the former waste settling basin. These elevated levels of PAHs at the former waste settling basin occurred only at a depth of 3 to 5 feet bgs. The occurrence at this subsurface level indicates that the PAHs are not likely to be

associated with any NASA activities.

Surface Water. In the 2000 RI, nitroaromatics were detected in 3 of the 10 TNTC surface water samples. Concentrations in surface water were determined to be unlikely to result in adverse human health or substantial adverse environmental effects. No other chemicals interpreted as potentially site related were detected in any of the surface water samples associated with TNTC.

Sediment. In the 15 RI sediment samples, seven nitroaromatics were detected, and total nitroaromatics concentrations ranged from nondetect to over 1,500 mg/kg at location TNTC-SD009 (1,496 mg/kg TNT). It was determined that at these TNTC-SD009 sediment concentrations, a potential existed for adverse human health and possible ecological effects. Three chemicals of concern (COC) were identified for TNTC sediment: TNT, 2-ADNT, and 4-ADNT. RGs were derived for sediment and exceeded only at TNTC-SD009. Other potentially site-related chemicals (PAHs, Aroclor 1260) were detected in the sediment samples, but at concentrations that were determined to be unlikely to result in adverse effects to human health or the environment (less than 1 mg/kg in each case).

Groundwater. As mentioned above, groundwater at TNTC is being evaluated separately and will be addressed in a separate Proposed Plan. Remediation of contaminated soil at TNTC in any event will also remove potential sources of groundwater contamination.

SCOPE AND ROLE OF TNTC

One of 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 TNTC soils and sediment only.

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

TNT Area C – 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 TNTC.

TNT Area A – An FFS for soils and sediment was completed in 2003. Completion of a Proposed Plan, which is scheduled for 2009, 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 Proposed Plan and Decision Document are being prepared and are scheduled for completion in 2009.

West Area Red Water Ponds and Pentolite Road Red Water Pond –A soil FS for the red water ponds 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 soils was presented to the public, then finalized in June 2003. An interim removal action began in June 2002 and was completed in fall of 2004. However, additional excavation was necessary for clean closure of the DERP-FUDS project. 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 is scheduled for completion in March 2009. At the end of the Removal Action, this project will return to the normal CERCLA process (RI/FS phase), and a Decision Document is scheduled for completion in 2010.

Acid Areas 1, 2, and 3 – The SIs 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 concerns. If not, new projects will be created to address the joint responsibility and the remediation of these areas.

Wastewater Treatment Plant Nos. 1&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 Pits 1&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 was SI completed in July 2000. This project was closed out in September 2006 with no further action, with concurrence from the State.

Pentolite Area Waste Lagoon – A limited SI was completed. This project was closed out in September 2006 with no further action, with concurrence from the State.

Lower Toluene Tanks – A limited SI completed in July 2000. This project was closed out in September 2006 with no further action, with concurrence from the State.

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 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 the separate Decision Document for that DERP-FUDS project.

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 Baseline Human Health Risk Assessment (BHHRA) and an Ecological Risk Assessment were performed for TNTC 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). (Note: "total soil" refers to a combination of surface and subsurface soil.)
- 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 potentially impacted 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 TNTC 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} (1 in 1,000,000) and 1×10^{-4} (1 in 10,000). OEPA considers total ILCR values greater than 1×10^{-5} in an environmental medium to be unacceptable.

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 (5×10^{-4}) from all groundskeeper exposure pathways to surface soil exceeds the OEPA criterion, and the site-related total HI (95) exceeds the acceptable value of 1. The groundskeeper ILCR and HI are both associated primarily with TNT.
- The site-related total ILCR (2×10^{-4}) from oral exposure to surface soil and dust by the indoor worker exceeds the OEPA criterion, and the site-related total HI

(41) exceeds the acceptable value of 1. The indoor worker ILCR and HI are both associated primarily with TNT.

- The site-related total ILCR for the hunter (3×10^{-5}) exceeds the OEPA criterion of 1×10^{-5} but is within the NCP acceptable risk range. The site-related total HI (5) for the hunter exceeds the acceptable value of 1. The ILCR and HI values are associated primarily with exposure to TNT via direct contact with surface soil, with insubstantial contributions from venison ingestion.
- The site-related total ILCR for the venison-consuming child (2×10^{-7}) is less than the OPEA criterion of 1×10^{-5}. An HI for the venison-consuming child could not be calculated because uptake of noncancer chemicals from vegetation growth on impacted soil was expected to be miniscule.
- The site-related total ILCR (5×10^{-5}) from all construction worker exposure pathways to total soil exceeds OEPA acceptable criterion but is within the NCP acceptable risk range. The site-related total HI (360) exceeds the acceptable value of 1. The construction worker ILCR is associated primarily with TNT (4×10^{-5}). The HI is associated primarily with TNT (355) and 2-ADNT (3).
- The site-related total ILCR (3×10^{-3}) from all future resident exposure pathways to total soil exceeds the OEPA acceptable criterion. The site-related total HI (1,241) exceeds the acceptable value of 1. The resident ILCR is associated primarily with TNT (3×10^{-3}) and 2,4-DNT (4×10^{-4}). The HI is associated primarily with TNT (1,227), 2-ADNT (9), and 4-ADNT (3).
- The construction worker ILCR for exposure to sediment (1×10^{-6}) is less than the OEPA criterion. However, the HI value for the construction worker (14) exceeds the criterion value of 1. The HI value is attributed mostly to TNT (12), 2-ADNT (0.8), and 4-ADNT (0.9).
- The resident ILCR for exposure to sediment (1×10^{-5}) does not exceed the OEPA acceptable criterion. However, the HI value for the resident (6) exceeds the criterion value of 1. The HI value is attributed mostly to TNT (5).
- The surface water ILCR values for the construction worker (2×10^{-8}) and resident (3×10^{-7}) are less than the OEPA criterion. The respective surface water HI values for these receptors (0.2 and 0.08) are less than the acceptable criterion of 1.

In summary, predicted levels of exposure to site-related chemicals in surface soil would result in unacceptable levels of exposure to a groundskeeper, indoor worker, and hunter, based on both cancer and noncancer health effects. Exposure of a child who may consume game from the site would not exceed the respective criteria for cancer risk or noncancer health effects. Predicted levels of exposure to total soil would result in unacceptable levels of cancer and noncancer risk to a construction worker and on-site resident. Results of the BHHRA indicate that site sediment may pose an unacceptable noncancer hazard to both the construction worker and resident; cancer risks associated with sediment do not exceed the OEPA acceptable criterion. Surface water would not pose any unacceptable human health risks.

The BHHRA results were used to identify 13 COCs for soil. These are chemicals identified as contributing significantly to risk as defined in the BHHRA. The 13 soil COCs are as follows:

- 2-ADNT
- 4-ADNT
- 2,4-DNT
- 2,6-DNT
- TNT
- Aroclor 1254
- Aroclor 1260
- Lead
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-c,d)pyrene.

Based on the BHHRA, the following three COCs were identified for TNTC sediment:

- TNT
- 2-ADNT
- 4-ADNT.

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

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

TNTC is composed of upland early and late old field and shrub thicket with less than 10 percent wooded. Some wetland vegetation was found along drainage ditches and the three small streams on TNTC. No areas of vegetative stress were observed on TNTC. Mammalian, avian, and herptilian wildlife species have been identified at PBOW, some of which would be expected and/or have been observed at TNTC.

Areas east of TNTC are primarily old field and shrub; areas to the south, southeast, northeast, north, and west are primarily forested; and areas to the southwest are old field and early shrub thicket. Several drainage ditches are present on TNTC. During rain events, these flow into three small streams that eventually flow to Pipe Creek, located northwest of TNTC. Note that even these three streams were not flowing throughout their length during RI sample collection. 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. However, they do provide a source of drinking water for terrestrial animals.

One Ohio potentially threatened species (closed gentian) was confirmed present in several locations in the western portion of TNTC. No other rare, threatened, or endangered animals or plants were identified as present at TNTC

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 TNTC 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 TNTC 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 mathematical summaries of actual field or laboratory observations or measurements. The assessment endpoints for TNTC 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, (up to an EHI value of 36,408 for the rabbit). These estimated EHIs were especially associated with concentrations of TNT and Aroclor 1260 (Table 2).
- EHI values associated with total soil were elevated for terrestrial receptors, represented by the shrew (5,621). These estimated EHIs were especially associated with concentrations of TNT and Aroclor 1260 (Table 2).
- Several surface water COPECs (carbon disulfide, aluminum, barium, cadmium, calcium, copper, iron, and manganese) and sediment COPECs (cadmium, lead, 1,3,5-trinitrobenzene, TNT, Aroclor 1260, fluoranthene, and benzo[a]anthracene) were detected at concentrations greater than the screening criteria. Considerable uncertainties exist associated with toxicity and estimating concentrations in aquatic insects.
- Aquatic macroreceptors (raccoon [up to 1,130] and mallard duck [up to 2,350]) are predicted to have elevated EHIs primarily from exposure to TNT, selenium, aluminum, 2-ADNT, and 4-ADNT in sediment (Table 3).

With respect to the last two bulleted items above, it is noted that the tributaries evaluated at TNTC are intermittent and are very limited, reducing concern for potential impacts to aquatic biota and animals assumed to use these tributaries.

REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAO) identified in the TNTC FFS are:

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

The RGs presented in Table 4 are chemical-specific concentrations derived for the COCs from the TNTC human health risk assessment and are

specifically designed to meet the TNTC RAOs. The soil RGs and sediment 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, and the sediment RGs are based on exposure by a construction worker. Residential land-use assumptions result in the most health-protective RGs for soil, and the assumption of a construction scenario results in the most health-protective RGs for sediment.

The RGs were used as not-to-exceed criteria for the purpose of identifying areas at TNTC 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 or sediment because of considerable uncertainties associated with toxicity and the fact that no vegetative stress has been observed on site. Also, the major risk-driving chemicals for terrestrial ecological risks in soil and sediment are predominant with respect to human health risks; therefore, the attainment of human health-based RG concentrations in soil and sediment would substantially reduce the estimation of ecological hazard.

It was determined that ecological concerns are insufficient to warrant remediation of surface water at TNTC 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 14 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 areas are shown on Figure 4, which also identifies the potential areas for remediation. Only one area (near the vicinity of sample TNTC-SD009) within any of the streams or drainage ditches was identified as exceeding sediment RGs. The following five alternatives were evaluated to mitigate risks associated with TNTC soil and sediment 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 2 through 5 would require the excavation of an estimated 9,205 cubic yards of contaminated soil from the locations shown on Figure 4. Of this, an estimated 6,805 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 Ohio EPA as appropriate facilities to receive CERCLA waste (40 CFR 300.440). The remaining 2,310 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 2,103 cubic yards of this contaminated soil are expected to be hazardous prior to treatment based on elevated 2,4-DNT concentrations and 400 cubic yards are expected to be hazardous based on elevated soil lead concentrations. Thus, nearly half of the high-lead soil is also expected to contain concentrations of 2,4-DNT that are sufficiently high to require treatment.

The technologies associated with Alternatives 2 through 5 are not designed to treat PCBs. Generally, areas with elevated concentrations of PCBs in TNTC soil are collocated with elevated nitroaromatics concentrations. Where this is the case, the nitroaromatic-contaminated soil will be treated and disposed of off site at an approved RCRA hazardous waste treatment, storage and disposal facility (TSDF) under each of the treatment alternatives. If areas with elevated PCB soil concentrations at TNTC are encountered that do not have elevated nitroaromatics, then this soil will be excavated and disposed of at a nonhazardous waste landfill without treatment. Disposal at a Toxic Substances Control Act approved hazardous waste landfill is not expected to be required because none of the RI soil or sediment samples had PCB concentrations that approached the concentration of 50 mg/kg that would result in a hazardous classification as a PCB remediation waste.

For Alternatives 2 through 5, hazardous soil must be treated to remove the hazardous characteristic and reduce the concentrations of any underlying hazardous constituents (including PCBs) to levels below the alternative LDR treatment standards for contaminated soil prior to off-site disposal.

The extent of soil excavation needed to attain RAOs would 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 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 would be confirmed by analysis using TCLP prior to disposal.

As described in the Summary of Risks, a single Ohio potentially threatened plant species (closed gentian) was identified in several locations in the western portion of TNTC. Prior to the implementation of Alternatives 2 through 5, a vegetation survey will be conducted in this area of TNTC so that actions may be taken to minimize any impact from remedial activities on this species and its habitat.

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 or sediment at the site. This alternative fails to meet the RAOs for soil and sediment 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 RAOs: *(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 and sediment from the areas depicted on Figure 4, TCLP testing, segregation of the hazardous lead-contaminated soil, windrow composting of the soil and sediment that is hazardous due to elevated levels of 2,4-DNT, off-site disposal of the composted materials and untreated nonhazardous soil and sediment at a nonhazardous solid waste landfill, and off-site disposal of the hazardous lead-contaminated soil at a Resource Conservation and Recovery Act (RCRA) hazardous waste TSDF.

The excavated soil and sediment would be hauled to an outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test. Materials that passed the TCLP criteria would be hauled to the Erie County Landfill or other nonhazardous solid waste landfill without treatment.

Soil and sediment that failed the TCLP testing for 2,4-DNT would be composted at the outdoor composting area established for TNTC 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 and sediment 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 and sediment with the amendments and periodic turning of the compost.

Contaminated soils which failed the TCLP test for lead would be hauled off site to a RCRA hazardous waste landfill for treatment and disposal.

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

Capital Cost:	*$3.27M*
Annual Operation and Maintenance Costs:	*$0*
Present Worth Costs:	*$3.27M*
Time to Implement:	*16-22 Months*
Time to Achieve RAOs:	*16-22 Months*

Alternative 3 – Excavation and Off-Site Treatment/Disposal

This alternative includes excavation of the contaminated soil and sediment from the areas depicted on Figure 4, TCLP testing, segregation of soil and sediment hazardous due to elevated levels of 2,4-DNT and lead, off-site disposal of nonhazardous soil and sediment at a nonhazardous solid waste landfill, and off-site treatment/disposal of hazardous soil and sediment at a RCRA hazardous waste TSDF.

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

Capital Cost:	*$2.86M*
Annual Operation and Maintenance Costs:	*$0*
Present Worth Costs:	*$2.86M*
Time to Implement:	*10-16 Months*
Time to Achieve RAOs:	10-16 *Months*

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

This alternative includes excavation of the contaminated soil and sediment from the areas depicted on Figure 4, TCLP testing, segregation of the hazardous lead-contaminated soil, segregation and windrow composting of hazardous 2,4-DNT contaminated soil and sediment, chemical stabilization of the lead-contaminated soil, and off-site disposal of the treated and untreated nonhazardous soil and sediment at a nonhazardous solid waste landfill.

The excavated soil and sediment would be hauled to an outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test. Soil and sediment that passed the TCLP test would be hauled to the Erie County Landfill or other nonhazardous solid waste landfill that can accept the wastes.

Soil and sediment that fail 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 hazardous soil are met. Composting would be performed at an outdoor area within TNTC specifically designed for the treatment (both stabilization and composting) of contaminated soil and sediment. During composting, the contaminated soil and sediment 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 and sediment with the amendments and periodic turning of the compost.

After composting, soil that failed 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 and sediment would be disposed of at a nonhazardous solid waste landfill after LDRs are met.

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

Capital Cost: *$3.23M*
Annual Operation and Maintenance Costs: *$0*
Present Worth Costs: *$3.23M*
Time to Implement: *16-22 Months*
Time to Achieve RAOs: 16-22 *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 and sediment from the areas depicted on Figure 4, TCLP testing, segregation of the hazardous lead-contaminated soil, segregation of the hazardous 2,4-DNT contaminated soil and sediment, 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), and the off-site disposal of the nonhazardous untreated soil at a nonhazardous solid waste landfill 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 when generated) will be placed on site rather than disposed of at a landfill.

The excavated soil and sediment will be hauled to the outdoor staging area and characterized as hazardous or nonhazardous using the TCLP test. Materials that pass the TCLP test will be hauled to the Erie County Landfill or other nonhazardous solid waste landfill.

Soil and sediment that failed 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 TNTC, until TCLP criteria for 2,4-DNT are met. Chemicals would be mixed into the soil and sediment using an excavator or wheel loader. The nitroaromatics are chemically reacted to less toxic compounds. Alkaline hydrolysis is effective at treating TNT, but is 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 will be polished using windrow composting until TCLP criteria are met. Composting is also expected to be effective in meeting RGs for PAHs. If RGs are also met, the composted material will be placed on site; if RGs are not met, then the composted material will 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 and sediment 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 will not be required, and the costs associated with this alternative would be decreased.

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

Capital Cost: *$2.44M*
Annual Operation and Maintenance Costs: *$0*
Present Worth Costs: *$2.44M*
Time to Implement: *16-22 Months*
Time to Achieve RAOs: 16-22 *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/sediment 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 Applicable or Relevant and Appropriate Requirements (ARAR)

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. 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 TNTC and is not further discussed in this evaluation of alternatives.

Primary Balancing Criteria. Alternatives 2 through 5 would be equally effective in the long term because the contaminated soil and sediment 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 may be treated at the RCRA treatment, storage, and disposal facility prior to disposal.

Each of the four action-based alternatives could be performed in less than 24 months upon commencement of field remediation activities. Alternative 3 is estimated to take the shortest duration (10 to 16 months). Alternatives 2, 4, and 5 could all be performed within a similar time frame (16 to 22 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 would allow 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 as a polishing step under Alternative 5. Alternative 3 is implementable, because it is simply off-site disposal/treatment. The primary technology for Alternative 5, alkaline hydrolysis, is proven to work on even high concentrations of nitroaromatics, especially TNT.

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

- Alternative 5 – $2.44M
- Alternative 3 – $2.86M
- Alternative 4 – $3.23M
- Alternative 2 – $3.27M.

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

THE COMMUNITY'S ROLE IN THE SELECTION PROCESS

The USACE solicits input from the community on the preferred alternative for TNTC. The USACE has set a public comment period from March 12 to April 13, 2009, 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., March 12, 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

not be required for stabilization under Alternative 5 because the alkalizing agent should precipitate the lead out as lead hydroxide. This represents an additional potential cost savings under this alternative.

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 and public in the past. Neither the State nor the public has expressed concern over any of these technologies in the past. Both composting (used in Alternatives 2, 4, and 5) and alkaline hydrolysis (though with lime; Alternative 5 uses caustic soda) have been presented to the State and public and in the past. Both of these technologies have been employed at different PBOW sites.

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 TNTC.

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 ($2.44M) is also estimated to be less costly than Alternative 3 ($2.86M). 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 ($2.44M) is recommended over Alternatives 2 ($3.27M) and 4 ($3.23M) 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. 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 or the public. This change would be reflected in the TNTC Decision Document, and the comment 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, an RAB, composed of local citizens with varying backgrounds, along with members from USACE, NASA, and 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), 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 TNTC 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 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 TNTC 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.

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
bgs	below ground surface
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
HI	hazard index
ILCR	incremental lifetime cancer risk
IT	IT Corporation
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
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	2,4,6-trinitrotoluene
TNTA	TNT Area A
TNTB	TNT Area B
TNTC	TNT Area C
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 C
Plum Brook Ordnance Works, Sandusky, Ohio

	Groundskeeper		Indoor Worker		Adult Hunter		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	Total HI	Total ILCR
Surface Soil	95.4	5.43E-04	40.8	2.32E-04	4.88	3.39E-05	NA	NA	NA	NA
Total Soil[c]	NA[d]	NA	NA	NA	NA	NA	360	5.01E-05	1241	3.48E-03
Surface Water[e]	NA	NA	NA	NA	NA	NA	0.2	1.77E-08	0.08	3.38E-07
Sediment[e]	NA	NA	NA	NA	NA	NA	14	1.36E-06	6	1.22E-05
Total across all media	**95**	**5E-04**	**41**	**2E-04**	**5**	**3E-05**	**374**	**5E-05**	**1247**	**3E-03**

[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. Risks less than 1E-6 are regarded as very minimal, and risks greater than 1E-5 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) A child venison consumer was also evaluated for TNT Area C. Cancer risks (less than 1E-6) and potential noncancer hazards (less than 0.1) for this receptor were found to be very minimal.

Table 2

Terrestrial Receptors Ecological Hazard Index (EHI) Summary
TNT Area C[a]
Plum Brook Ordnance Works, Sandusky, Ohio

Media	Terrestrial Receptor						
	Deer Mouse	**Cottontail**	**Shrew**	**Marsh Wren**	**Raccoon**	**Deer**	**Hawk**
Soil [b] EHI[c]	6,190–31,557	7,274–36,408	977–5,620	1,150–25,075	5,110–26,138	612–3,080	4–73
Risk Drivers:	TNT (plant intake) Aroclor-1260 (invertebrate intake)	TNT (plant intake)	TNT (soil intake) Aroclor-1260 (invertebrate intake)	TNT (invertebrate intake) Aroclor-1260 (invertebrate intake)	TNT (plant intake) Aroclor-1260 (invertebrate intake)	TNT (plant intake)	TNT (soil intake) Aroclor-1260 (shrew intake) (bird intake)
Surface Water EHI	0.2–2.0	0.2–2.0	0.2–1.3	0.3–1.7	0.3–2.5	2–20	0.004–0.02
Risk Drivers:	Aluminum (water intake)	Aluminum (water intake)	Aluminum (water intake)	Iron (water intake)	Aluminum (water intake)	Aluminum (water intake)	Iron (water intake)
Total Receptor EHI	6,190–31,559	7,274–36,410	977–5,621	1,150–25,077	5,110–26,141	614–3,100	4–73

[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 range indicates the CT-based values, and higher end of range is the RME-based values.

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.

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

Table 3

Aquatic Ecological Hazard Index (EHI) Summary
TNT Area C [a]
Plum Brook Ordnance Works, Sandusky, Ohio

Media	Aquatic Receptor	
	Mallard Duck	**Raccoon**
Sediment EHI[b]	97–2,350	265–1,130
Risk Drivers:	TNT (invertebrate intake)	TNT (invertebrate intake)
	2-ADNT (invertebrate intake)	Selenium (invertebrate intake)
	4-ADNT (invertebrate intake)	Aluminum (sediment intake)
		Aroclor-1260 (invertebrate intake)
Surface Water EHI	0.01–0.07	0.06–0.5
Risk Drivers:	Iron (water intake)	Aluminum (water intake)
Total Receptor EHI	97–2,350	265–1,130

[a] Details presented in ecological risk assessment.
[b] Lower end of the range is the CT-based value; upper end of the range is the RME-based value.
(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 – Trinitrotoluene.
2-ADNT– 2-Amino-4,6-DNT.
4-ADNT– 4-Amino-2,6-DNT.

Table 4

Remedial Goals for Total Soil and Sediment
TNT Area C
Former Plum Brook Ordnance Works, Sandusky, Ohio

COC	RG (mg/kg)	Basis	HQ	ILCR
Soil				
2-Amino-4,6-Dinitrotoluene	1.7	RBRC	0.4	NA
4-Amino-2,6-Dinitrotoluene	1.3	RBRC	0.3	NA
2,4,6-Trinitrotoluene	8.0	RBRC	0.2	6E-7[a]
2,4-Dinitrotoluene	6.5	RBRC	0.04[b]	9E-6
2,6-Dinitrotoluene	1.0	RBRC	0.01[b]	1E-6
Aroclor 1260[c]	1.0	TBC[d]	NA	3E-6 (5E-7)[e]
Aroclor 1254[c]	1.0	TBC[d]	0.6 (0.1)[f]	3E-6 (6E-7)[g]
PAHs	1.0	TBC[h]	NA	NA[i]
Lead	400	TBC[j]	NA	NA
Total HI/ILCR			1.0[k]	1.0E-5 (1.3E-5)[l]
Sediment				
2-Amino-4,6-Dinitrotoluene	5.0	RBRC[m]	0.3	NA
4-Amino-2,6-Dinitrotoluene	5.0	RBRC[m]	0.3	NA
2,4,6-Trinitrotoluene	41	RBRC[m]	0.3	9E-7[n]
Total HI/ILCR			1.0	9E-7

[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] Toxic Substances Control Act value of 1.0 mg/kg is for combined Aroclor 1254 and 1260 concentrations.
[d] 40 CFR 761.61
[e] Value shown in parentheses is the ILCR for the highest detected concentration (0.15 mg/kg) among the areas not proposed for remediation based on the nitroaromatic RGs; this value is *de minimis* (i.e., <1E-6).
[f] HQ value shown in parentheses is for the highest detected concentration (0.176 mg/kg) among the areas not proposed for remediation based on the nitroaromatic RGs.
[g] ILCR value shown in parentheses is for the highest detected concentration (0.176 mg/kg) among the areas not proposed for remediation based on the nitroaromatic RGs; this value is *de minimis* (i.e., <1E-6).
[h] OEPA policy for combined carcinogenic PAHs.
[i] Although carcinogenic, the ILCR would be based on the specific combination of PAHs present in a given sample.
[j] EPA Soil screening value for average lead concentration.
[k] Total HI reflects the additive effects of the nitroaromatics. The effects of Aroclor 1254 are not regarded as additive with those of the nitroaromatics, so its HQ is not added into the HI for nitroaromatic effects.
[l] 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.
[m] Based on the construction worker scenario.
[n] RG derived on the basis of noncancer effects; cancer risk is de minimis (<1E-6).

COC - Chemical of concern.
HQ - Hazard quotient.
ILCR - Incremental lifetime cancer risk.
mg/kg - Milligrams per kilogram.
NA - Not applicable.
PAH - Polycyclic aromatic hydrocarbon.
RBRC - Risk-based remediation concentration.
RG - Remedial goal.
TBC - To be considered criterion.

FIGURES

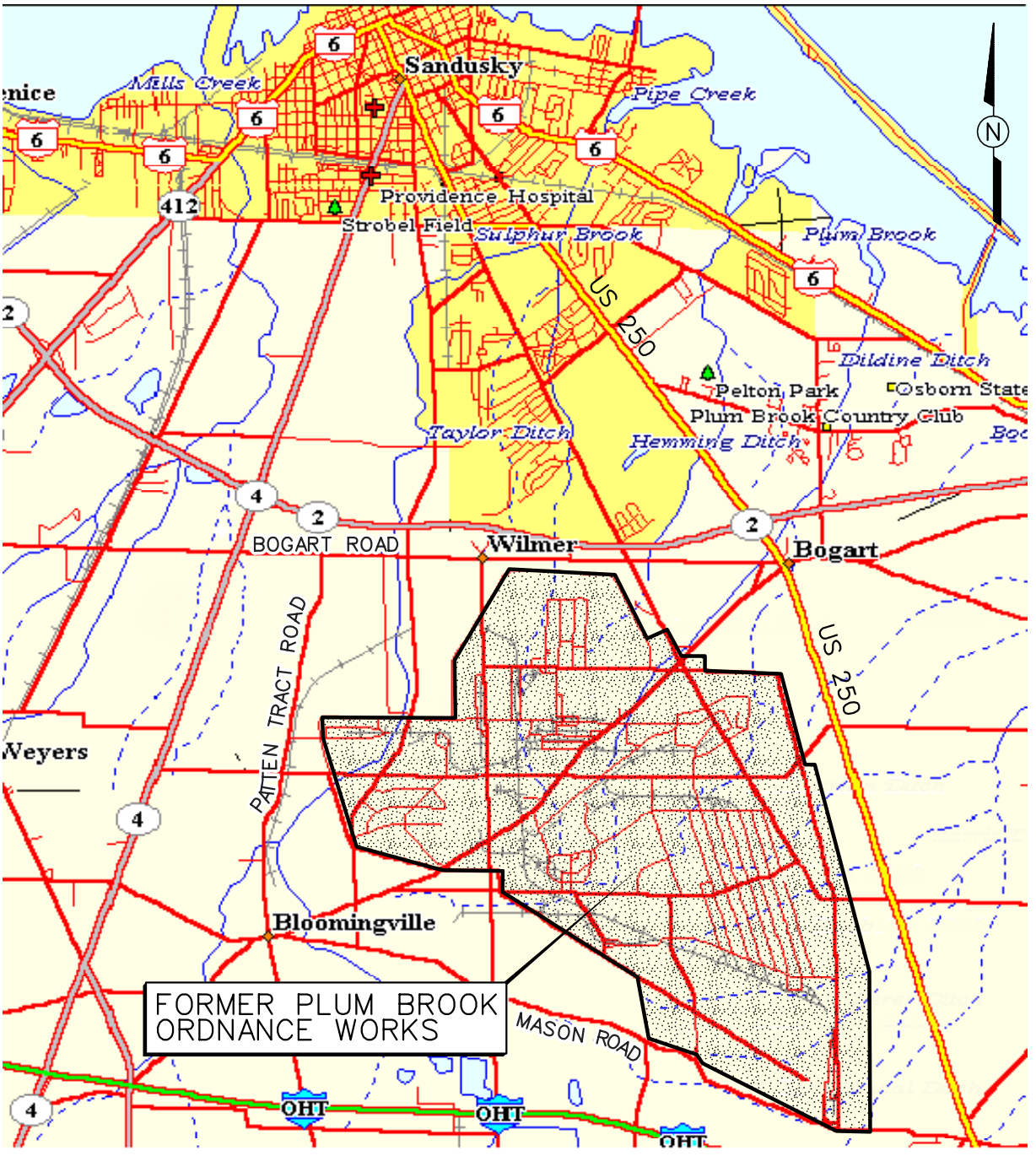

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FIGURE 1
VICINITY MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

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DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY	PROJ. NO.: 807112

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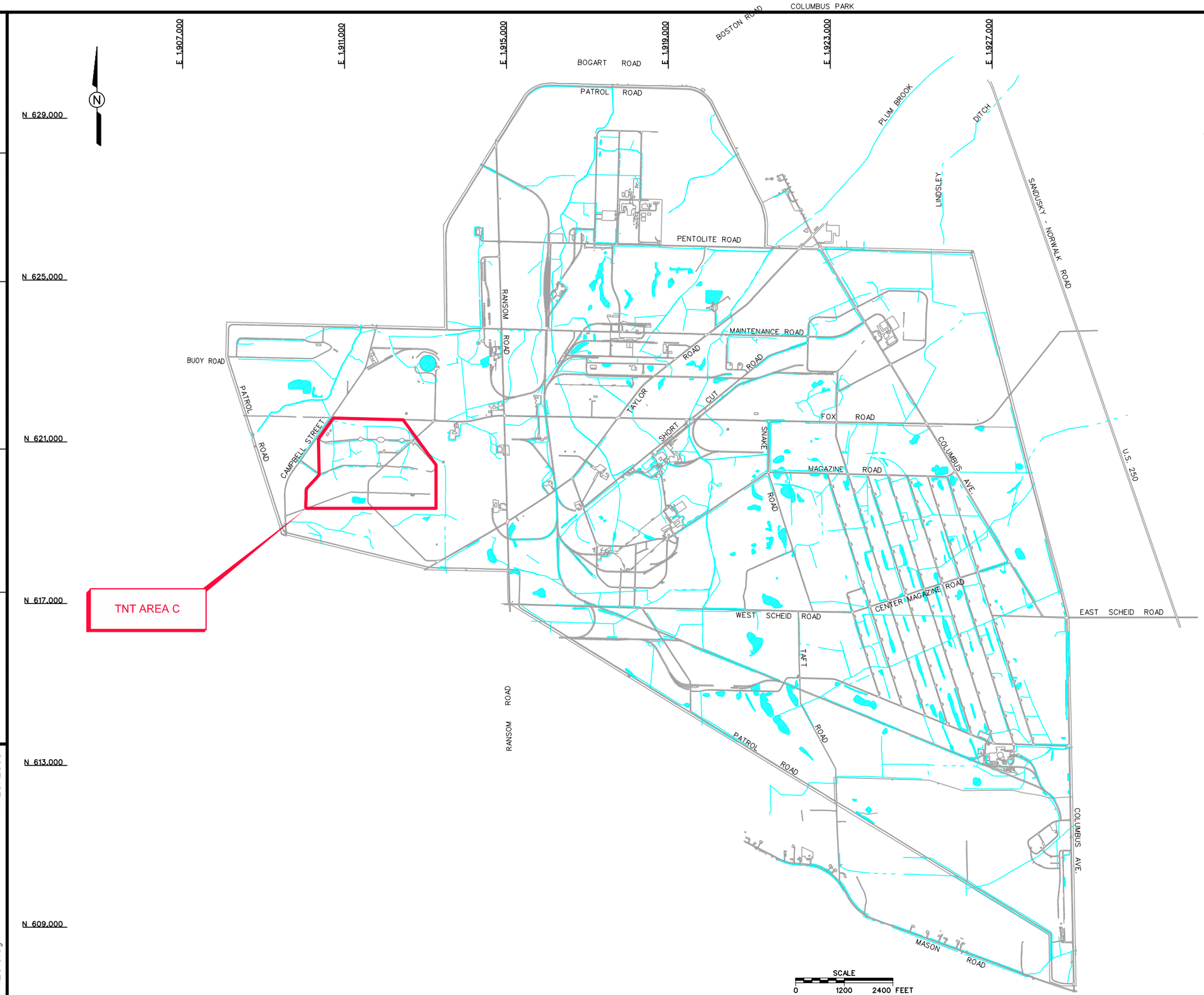

LEGEND

- AREA OF CONCERN
- BUILDINGS
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE (PBOW BOUNDARY)

FIGURE 2
TNT AREA C LOCATION MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

STARTING DATE: 06/22/05	DATE LAST REV.:	DRAFT. CHCK. BY:	INITIATOR: T. SIARD
DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY: T. SIARD	PROJ. MGR.: S. DOWNEY
			PROJ. NO.: 807111

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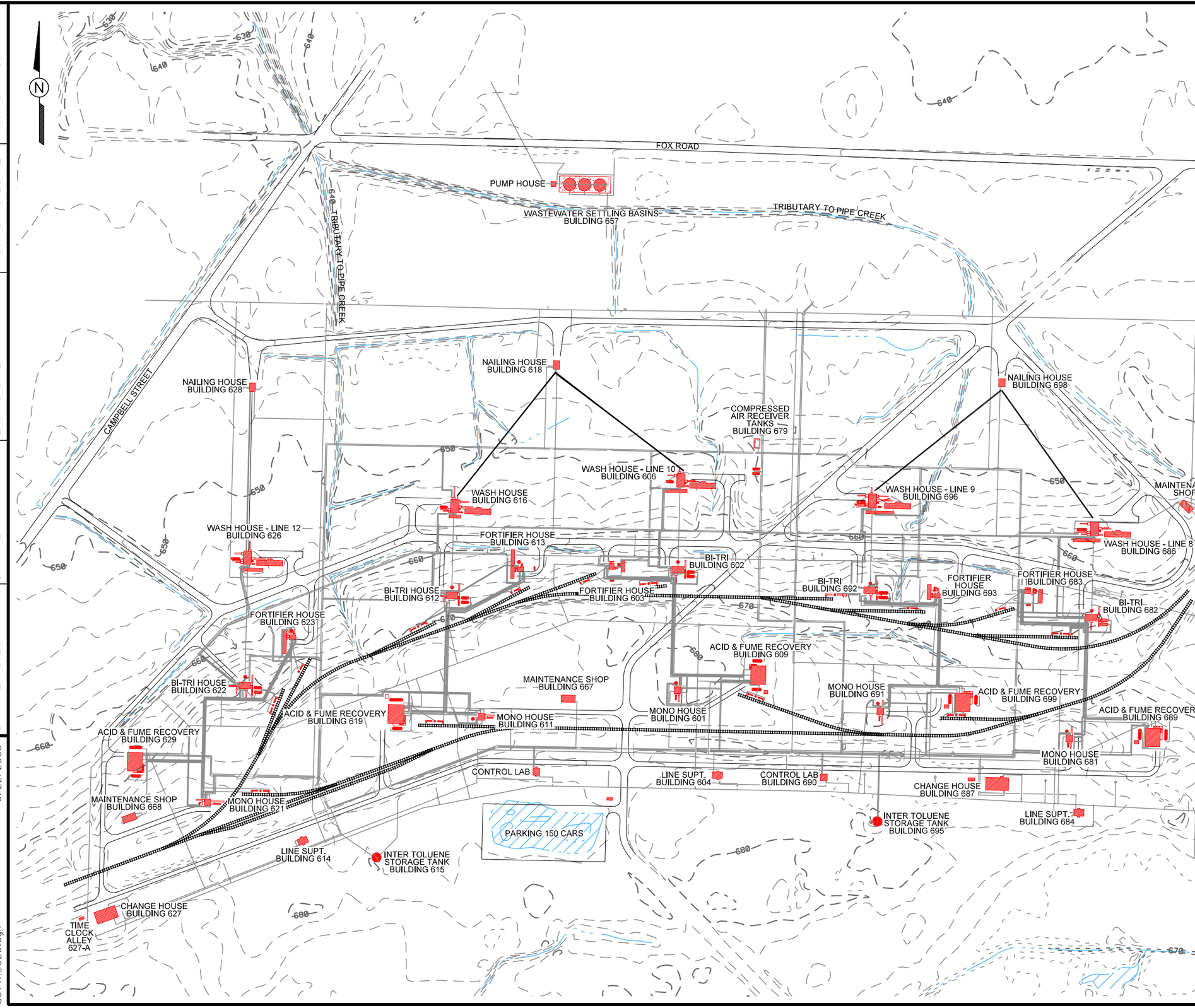

LEGEND

- DRAINAGE
- LOW, WET AREA
- STONE-LINED DRAINAGE DITCH
- ROAD
- HISTORICAL BUILDING OR STRUCTURE
- TANK
- HISTORICAL PROCESS LINE
- TOPOGRAPHIC CONTOUR LINE (FEET-MSL)
- RAILROAD

SCALE

0 300 600 FEET

FIGURE 3
TNT AREA C
GENERAL SITE FEATURES MAP

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

DWG. NO.: 807111_020.dgn	PROJ. NO.: 807111
INITIATOR: T. SIARD	PROJ. MGR.: S. DOWNEY
DRAFT. CHCK. BY:	ENGR. CHCK. BY:
DATE LAST REV.:	DRAWN BY:
STARTING DATE: 6/22/05	DRAWN BY: D. BOMAR

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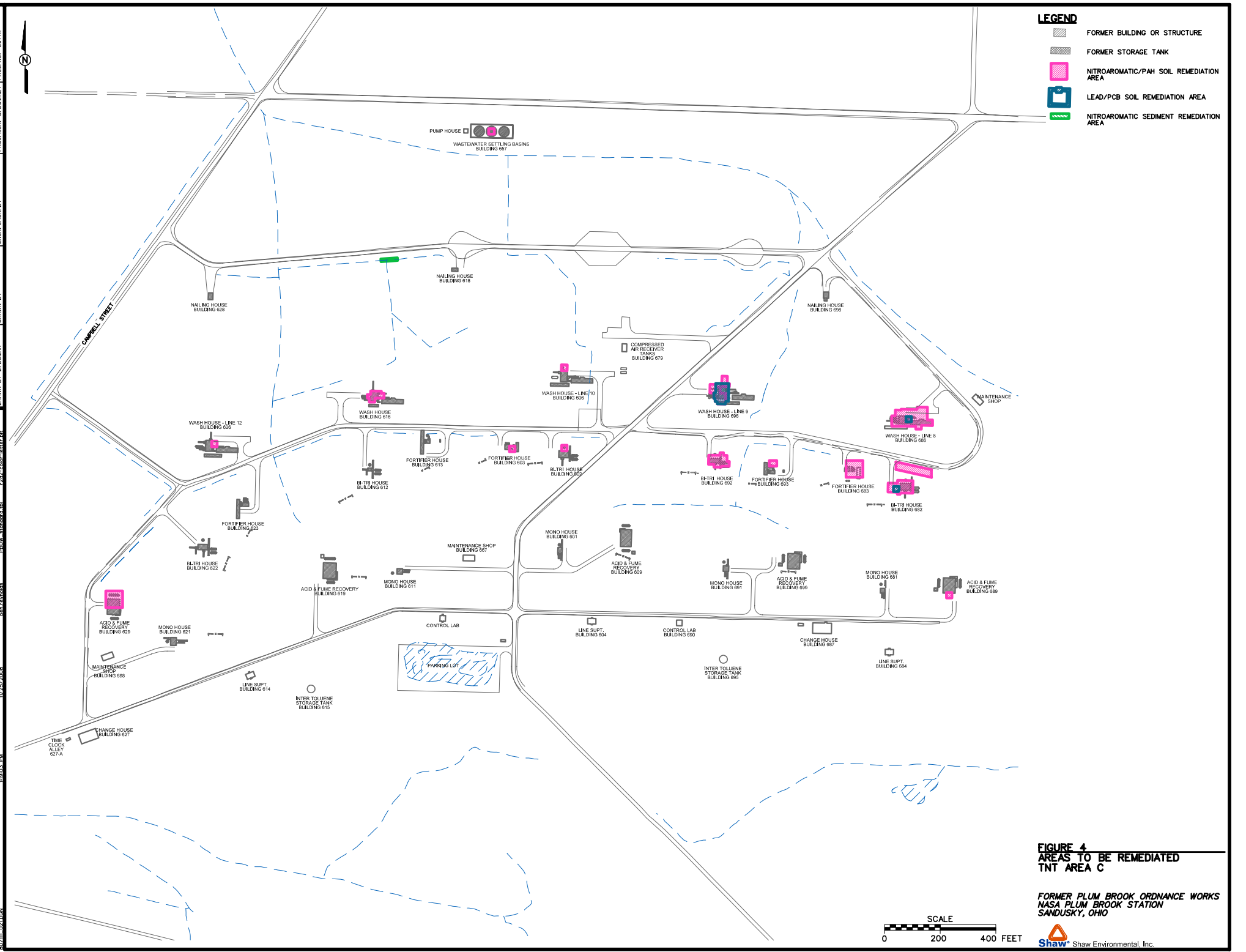

FIGURE 4
AREAS TO BE REMEDIATED
TNT AREA C

FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.

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DRAWN BY: D. BOMAR	DRAWN BY:	ENGR. CHCK. BY:	PROJ. MGR.: S. DOWNEY

DWG. NO.: 807111_021DGN
PROJ. NO.: 807111

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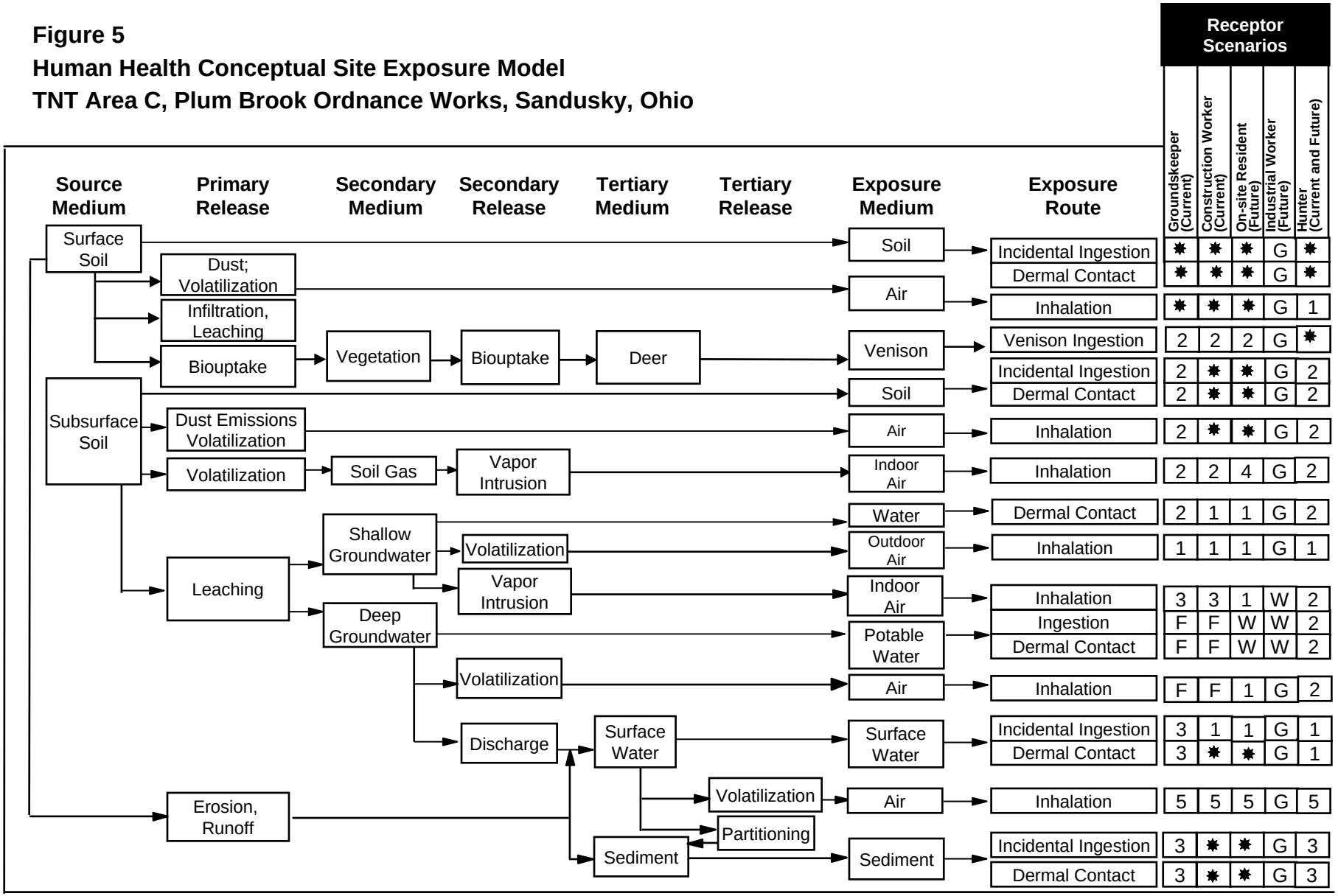
Figure 5
Human Health Conceptual Site Exposure Model
TNT Area C, Plum Brook Ordnance Works, Sandusky, Ohio



✸ = 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.

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Figure 6

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

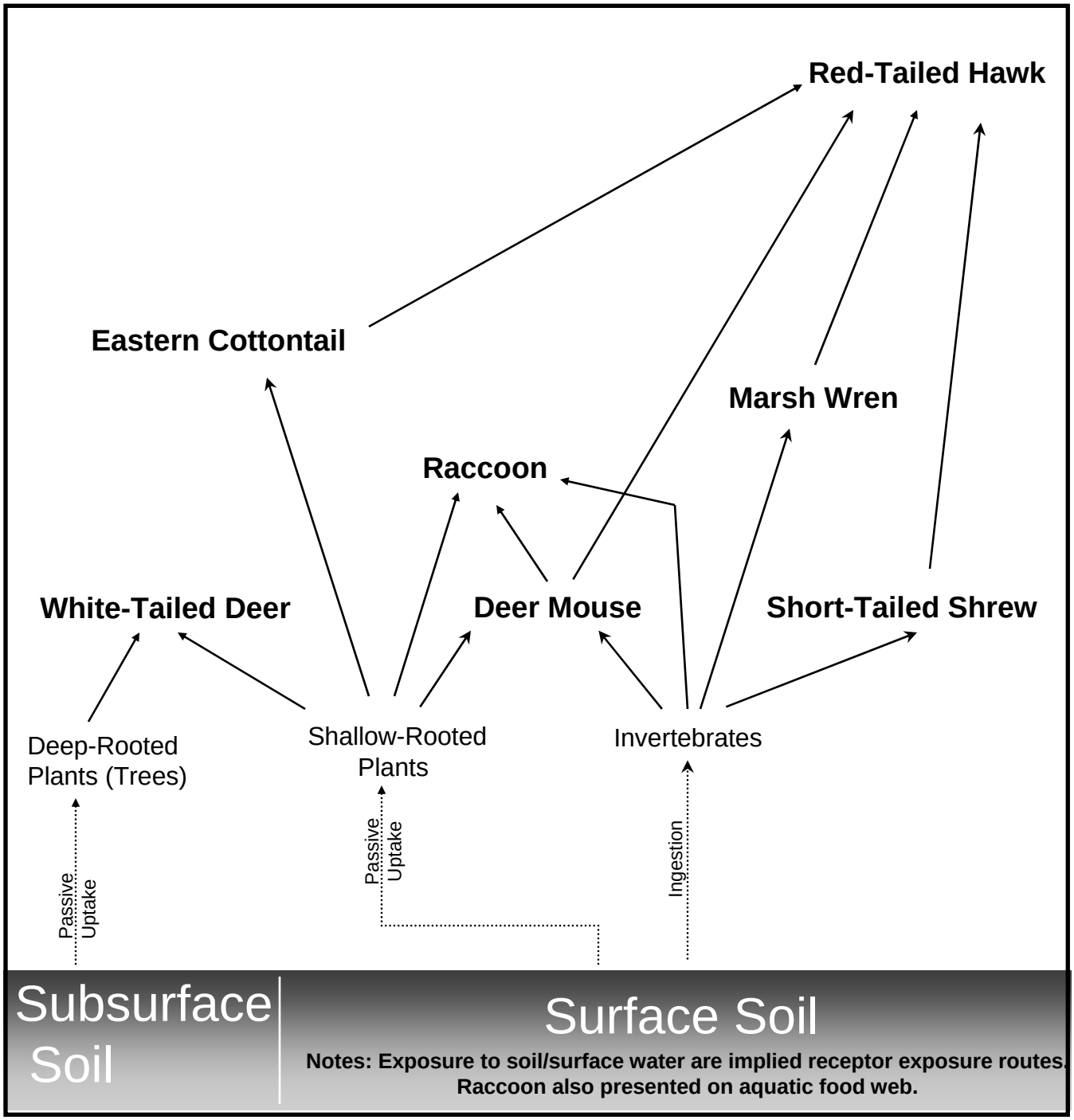
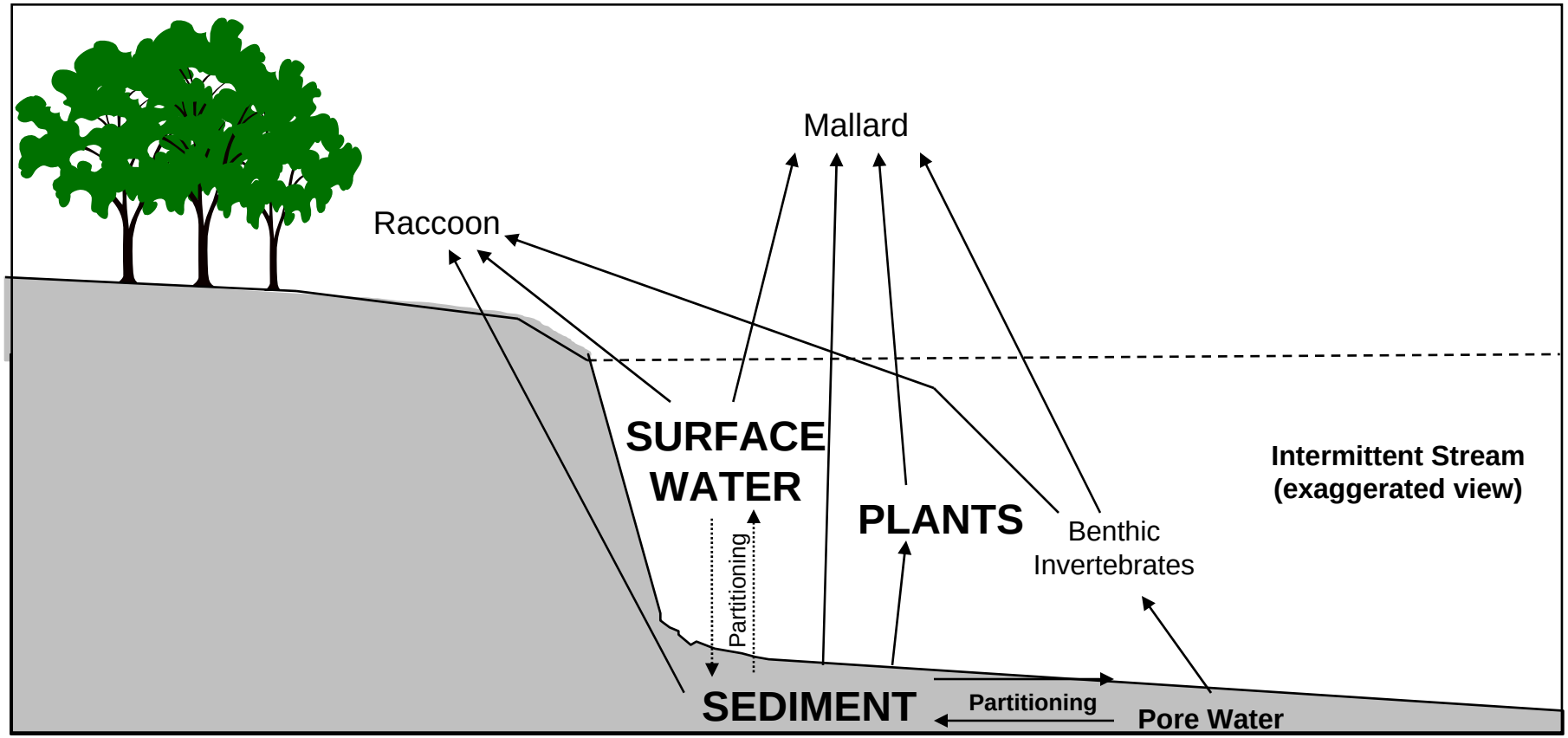


Figure 7

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



Note: Raccoon also presented on terrestrial food web.