Final Completion Report for the Sand Creek Culvert Replacement and Rocket Ridge Slope Stabilization at RVAAP-004-R-01 Open Demolition Area #2

Former Ravenna Army Ammunition Plant/Camp Ravenna Portage and Trumbull Counties, Ohio

> Contract No. W912QR-12-D-0004 Delivery Order No. 0003

> > **Prepared for:**



United States Army Corps of Engineers Louisville District 600 Dr. Martin Luther King, Jr. Place, Room 821 Louisville, Kentucky 40202-2267

Prepared by:



Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220

October 20, 2017

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188						
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John R. Kasich, Governor Mary Taylor, Lt. Governor Craig W. Butler, Director



September 26, 2017

Mr. Mark Leeper, P.G., MBA Team Lead Cleanup and Restoration Branch ARNG Directorate 111 George Mason St. Arlington, VA 22204

Re: US Army Ravenna Ammunition Plt RVAAP Remediation Response Project records Remedial Response Portage County 267000859089

Subject Receipt and Review of the "Draft Completion Report for the Sand Creek Culvert Replacement and Rocket Ridge Slope Stabilization at RVAAP-04-R-01 Open Demolition Area #2" at the Former Ravenna Army Ammunition Plant/ Camp Ravenna, Ravenna, Ohio; Dated August 29, 2017 (Work Activity No. 267000859089)

Dear Mr. Leeper:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the document entitled, "Draft Completion Report for the Sand Creek Culvert Replacement and Rocket Ridge Slope Stabilization at RVAAP-04-R-01 Open Demolition Area #2," dated August 29, 2017. This document, received by Ohio EPA's NEDO on August 30, 2017, was prepared for the U.S. Army Corps of Engineers (USACE) Louisville District, by Tetra Tech.

Ohio EPA has reviewed this documentation and has found no significant deficiencies. As a result, Ohio EPA is requesting that a final version of this document be submitted for approval. If you have any questions or concerns, please do not hesitate to contact me at (330) 963-1235.

Sincerely

Nicholas Roope Site Coordinator Division of Environmental Response and Revitalization

NCR/nvr

- cc: Craig Coombs, USACE, Louisville District Katie Tait/Kevin Sedlak, Camp Ravenna Environmental Office Shreffler/Harris, Vista Sciences
- ec: Bob Princic, Ohio EPA, NEDO, DERR Tom Schneider, Ohio EPA, SWDO, DERR

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Tetra Tech, Inc. has completed the preparation of this Completion Report for the Sand Creek Culvert Replacement and Rocket Ridge Slope Stabilization for RVAAP-04 Open Demolition Area 2 at the former Ravenna Army Ammunition Plant (RVAAP)/Camp Ravenna. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This independent technical review included review of methods, procedures, and materials used and disposed; conformity to Ohio Army National Guard specifications; and reasonableness of the results, including whether the product met the customer's needs consistent with law and existing USACE policy.

JN J

Scott Nesbit Project Manager

Robert Davis Independent Technical Review Team Leader

6/9/17 Date

10/9/17

Date

FINAL

COMPLETION REPORT FOR THE SAND CREEK CULVERT REPLACEMENT AND ROCKET RIDGE SLOPE STABILIZATION AT RVAAP-004-R-01 OPEN DEMOLITION AREA #2

Former Ravenna Army Ammunition Plant/Camp Ravenna Portage and Trumbull Counties, Ohio

> Prepared for: United States Army Corps of Engineers Louisville District

Prepared by: Tetra Tech 661 Andersen Drive Pittsburgh, Pennsylvania 15220

Multiple Award Remediation Contract Contract No. W912QR-12-D-0004 Delivery Order No. 0003

October 20, 2017

PREPARED UNDER THE SUPERVISION OF AND APPROVED FOR SUBMITTAL BY:

Sutt A-Nell

SCOTT NESBIT, PE PROJECT MANAGER TETRA TECH PITTSBURGH, PENNSYLVANIA

STEVEN H. RUFFING, PE PROGRAM MANAGER TETRA TECH PITTSBURGH, PENNSYLVANIA

	Name/Organization	Print	Electronic
Bob Princic, Ohio B	EPA	Transmittal	Letter
Tom Schneider, Oh	io EPA	Transmittal	Letter
Rodney Beals, Ohio	EPA DERR	Transmittal	Letter
Nick Roope, Ohio H	EPA DERR	1	3
Mark Leeper–ARN	G-ILE-CR	0	1
Kevin Sedlak, ARNG–Camp Ravenna Katie Tait, OHARNG–Camp Ravenna		Transmittal	Letter
Katie Tait, OHARN	IG–Camp Ravenna	Transmittal	Letter
Craig Coombs, USACE–Louisville		Transmittal	Letter
Nathaniel Peters II,	USACE–Louisville	1	1
Nathaniel Peters II, USACE–Louisville Gail Harris, AR Manager–Camp Ravenna		2	2
Pat Ryan, Leidos-R	EIMS	Transmittal	Letter
AR ARNG-ILE-CR ARNG CO DERR EPA OHARNG	Administrative Record Army National Guard–Installation Logistics Environmental- Camp Ravenna–Army National Guard–Camp Ravenna Joint Contacting Office Division of Environmental Response and Revitalization Environmental Protection Agency Ohio Army National Guard Camp Ravenna Joint Military Th	-Cleanup Restoration Military Training C	n Center
Mark Leeper–ARNG-ILE-CR Kevin Sedlak, ARNG–Camp Ravenna Katie Tait, OHARNG–Camp Ravenna Craig Coombs, USACE–Louisville Nathaniel Peters II, USACE–Louisville Gail Harris, AR Manager–Camp Ravenna Pat Ryan, Leidos–REIMS AR Administrative Record ARNG-ILE-CR Army National Guard–Installation Logistics Envir ARNG Camp Ravenna–Army National Guard–Camp Raven CO Contacting Office DERR Division of Environmental Response and Revitali EPA Environmental Protection Agency OHARNG Ohio Army National Guard Camp Ravenna Joint I			

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ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ARNG	Army National Guard
BEM	Buried Explosion Module
Camp Ravenna	Camp Ravenna Joint Military Training Center
DAR	daily activity reports
DOT	Department of Transportation
E&SC	erosion and sediment control
GOH	Glenn O. Hawbaker, Inc.
km	kilometer
MEC	munitions and explosives of concern
mm	millimeter
MDAS	material documented as safe
MPPEH	material potentially presenting an explosive hazard
NAB	North Atlantic Division, Baltimore District
NWP	Nationwide Permit
ODA2	Open Demolition Area #2
OHARNG	Ohio Army National Guard
PCN	Pre-Construction Notification
PE	Professional Engineer
PWS	Performance Work Statement
RVAAP	Ravenna Army Ammunition Plant
Tetra Tech, Inc.	Tetra Tech NUS, Inc.
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
UXO	unexploded ordnance
WBG	Winklepeck Burning Grounds

EXECUTIVE SUMMARY

Tetra Tech recently completed work at RVAAP-004-R-01 Open Demolition Area #2 (ODA2) at Camp Ravenna Joint Military Training Center (Camp Ravenna) under Contract No. W912QR-12 D-0004, Delivery Order No. 0003. The Performance Work Statement (PWS) for this Delivery Order included:

- Slope stabilization at Rocket Ridge;
- Removal and replacement of the culvert located where Sand Creek crosses the ODA2 access road; and
- Removal of munitions items from the culvert area.

This document will detail the processes by which each of these tasks were completed.

Rocket Ridge, located downstream of the Sand Creek culvert in the central portion of Camp Ravenna within ODA2, required stabilization along Sand Creek because creek flow was undercutting the toe of the hillside, and a storm event after a prior site restoration caused the slope to slump. The hillside was stabilized by planting native woody vegetation on the slope and placing Type A boulders in Sand Creek to promote flow along a previously diverted creek bed, which is now used as the main creek channel.

The ODA2 access road had previously been damaged from erosion of the northern banks of Sand Creek when storm water overtopped the roadway. It was also reported that existing backfill for the culvert was comingled with munitions items. As part of completion of the PWS, the concrete pipe culverts were removed, recycled, and replaced by an open-bottom concrete-arch culvert capable of passing the peak flow of the 100-year storm. A concrete pad was constructed on top of the culvert to facilitate travel across the culvert.

During construction of the new culvert, excavated munitions were characterized and removed from the culvert area.

1.0 PROJECT DESCRIPTION

This report describes the activities undertaken by Tetra Tech to complete the slope stabilization at Rocket Ridge, culvert replacement at the Sand Creek crossing, and munitions removal at the Former Ravenna Army Ammunition Plant (RVAAP)/Camp Ravenna Joint Military Training Center (Camp Ravenna) in Ravenna, Ohio. The work was performed in accordance with the design set forth in the Final Basis of Design and Work Plan (Tetra Tech, 2016).

This work was performed in accordance with United States Corps of Engineers (USACE), Louisville District Contract No. W912QR-12 D-0004, Delivery Order No. 0003. The performance objectives were specified in the Revised Performance Work Statement issued by the United States Army on June 26, 2015 (USACE, 2015).

1.1 BACKGROUND

Camp Ravenna is located in northeastern Ohio within Portage and Trumbull Counties, approximately 1.6 kilometers (km) (1 mile) northwest of the City of Newton Falls and 4.8 km (3 miles) east-northeast of the City of Ravenna (Figure 1-1). The facility is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; Norfolk Southern Railroad on the north; and State Route 534 on the east.

The installation was formerly known as the RVAAP and was used as a load, assemble, and pack facility for munitions. Administrative control of the facility (21,683 acres) has been transferred to the United States Property and Fiscal Officer for Ohio and was subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site. The RVAAP Installation Restoration Program, managed by the Army National Guard (ARNG) Directorate and OHARNG, encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP.

The Open Demolition Area #2 (ODA2) is an approximately 317.4-acre area located in the central portion of the facility within Portage County (Figure 1-2). ODA2 was previously used as an open burning and open detonation site. Rocket Ridge area is located adjacent to Sand Creek within ODA2. A site map showing the location of the Rocket Ridge and Sand Creek work areas within ODA2 is presented as Figure 1-2.

Munitions items had been observed within the backfill used for construction of a roadway located along Sand Creek South of RVAAP-05 Winklepeck Burning Grounds (WBG) and upstream of the Rocket Ridge area within ODA2. Anecdotal evidence suggests that material presenting a potential explosive hazard (MPPEH) may have been inadvertently incorporated into the backfill during repairs in this area following flood events. Prior actions at ODA2 involved removal of munitions items along Rocket Ridge adjacent to Sand Creek.

1.2 PROJECT OBJECTIVES

Three project objectives were established in the Performance Work Statement (PWS):

- Slope stabilization at Rocket Ridge;
- Removal and replacement of the culvert located where Sand Creek crosses the ODA2 access road; and
- Removal of munitions items from the culvert area.

The slope in the Rocket Ridge area was stabilized by planting native woody vegetation on the slope and by placing boulders at the location where Sand Creek diverges northwest of the slope. The native woody vegetation used for stabilization consisted primarily of native selected hardwoods consistent with those allowed by the Camp Ravenna Integrated Natural Resources Management Plan.

The existing Sand Creek culvert was removed at the ODA2 access road crossing in response to erosion of the roadway from overtopping during storm events. Coincident with the culvert installation, the PWS included the removal of munitions items present within the roadway backfill.

1.3 DOCUMENT ORGANIZATION

This document is organized as follows:

- Section 1.0, Project Description, provides an overview of site conditions and project objectives;
- Section 2.0, Open Demolition Area #2 Activities, provides descriptions of the activities required to stabilize the Rocket Ridge slope, replace the Sand Creek culvert, and remove munitions from excavated material at the Sand Creek culvert;
- Section 3.0, References, provides a list of documents referenced in this document.

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2.0 OPEN DEMOLITION AREA #2 ACTIVITIES

The activities discussed in this section were documented through daily activity reports (DARs) distributed to OHARNG, ARNG, and USACE. These DARs have been included in Appendix A along with photographs of the activities.

2.1 ROCKET RIDGE SLOPE STABILIZATION

2.1.1 Tree Planting

On May 16 and 17, 2016, Tetra Tech conducted tree-planting activities at Rocket Ridge in accordance with the approved plan (Figure 2-1). The tree planting effort was conducted to enhance slope stability at Rocket Ridge.

Two types of trees, *Quercus rubra* (Red Oak) and *Acer rubrum* (Red Maple), were purchased from a nursery within 200 miles of Camp Ravenna (Musser Forests, Inc., Indiana, PA) and planted at the site. A 40-foot by 60-foot grid was established for tree planting while maintaining an approximate 8-foot spacing between trees. Tree species were alternated between rows. After each tree was planted, a bamboo rod was placed in the ground adjacent to each tree to indicate the tree's location. Biodegradable flagging was attached to each bamboo rod to assist in locating the trees in the future. A total of 53 trees were planted at Rocket Ridge.

On June 6, 2016, Tetra Tech returned to ODA2 to water and evaluate the growth of the trees. Water from Sand Creek was used to water the trees. Tetra Tech also returned to water and inspect tree growth on June 22, 2016. During this inspection, the grassy, hillside vegetation was cleared next to each tree by hand to promote growth. On June 14, 2017, Tetra Tech evaluated tree growth at ODA2 and determined that approximately 80% of the original 53 trees were alive.

2.1.2 Boulder Placement

On February 8, 2017, boulder placement within Sand Creek was initiated. To facilitate placement, wooden beams were placed within the creek to allow a hydraulic excavator to place the boulders at the planned location without disrupting the creek flow.

Approximately 40 tons of Ohio Department of Transportation (DOT) Type A stone were transported to Rocket Ridge and placed along the southern edge of the creek channel to direct flow into the diverted creek channel. Due to the boulders obstruction of the southern, original channel, the diverted creek channel is now the stream's main channel. A diagram of boulder placement is included as Figure 2-2.

Following the completion of activities at Rocket Ridge the disturbed areas were regraded. Restoration activities are further discussed in Section 2.4.

2.2 SAND CREEK CULVERT REPLACEMENT

Prior to mobilization of heavy equipment for work at Rocket Ridge and the Sand Creek culvert, Tetra Tech developed a Basis of Design and Work Plan for the new culvert installation (Tetra Tech, 2016b). The plan was reviewed and approved by RVAAP restoration program stakeholders (i.e., USACE, ARNG, OHARNG, Ohio EPA). In addition, a Pre-Construction Notification (PCN) was prepared and submitted to USACE Pittsburgh (Appendix B). Approval of the PCN and coverage under Nationwide Permit (NWP) #14 was granted by USACE Pittsburgh in a letter dated August 12, 2016 (Appendix B). The work activities were conducted in compliance with the PCN and NWP #14

A kickoff meeting was held on February 6, 2017, at the OHARNG Environmental Office at Camp Ravenna. The meeting consisted of representatives from USACE, OHARNG, ARNG, Tetra Tech, and Tetra Tech's subcontractor Glenn O. Hawbaker, Inc. (GOH). The meeting agenda included topics such as safety, logistics, schedule, and coordination with onsite USACE North Atlantic, Baltimore (NAB) District personnel.

Equipment was mobilized to the site on February 6, 2017. The equipment mobilized to the staging area included two excavators, one mini-excavator, one bulldozer, and one equipment trailer.

Operations at the Sand Creek culvert began on February 7, 2017. The culvert work area is shown on Figure 2-3, and the Sand Creek culvert site layout is shown on Figure 2-4.

2.2.1 Tree Removal

The Northern Long-Eared Bat is a threatened species protected under the Endangered Species Act. As such the cutting of trees with a diameter of 3 inches or greater is prohibited during the roosting season, April 1 to September 30, according to the US Fish and Wildlife Service (USFWS). On March 29 and 30, 2016, Tetra Tech personnel mobilized to ODA2 at the Sand Creek culvert to remove trees within the project area with the potential to be habitat for the Northern Long-Eared Bat.

2.2.2 Surveying

Pre-construction and as-built surveys were conducted on February 8, and April 26, 2017, respectively, by Campbell & Associates of Akron, Ohio. Figures detailing pre- and post-construction conditions are provided in Appendix C.

2.2.3 Erosion and Sediment Controls

Erosion and sediment controls (E&SCs) were established according to the proposed site plan (Appendix C) where applicable to prevent runoff from entering nearby water bodies. Silt fence was installed along the northern and southern banks of Sand Creek downstream (east) of the culvert. Following completion of culvert installation and backfilling, additional silt fencing was established near the culvert wing walls and further east along the creek bank. These E&SCs were

inspected weekly beginning after demobilization and remained intact until the surrounding revegetation efforts reached 70-percent cover on May 18, 2017.

2.2.4 Creek Diversion

Removal of the existing concrete pipe culverts began on February 9, 2017. To facilitate removal, Sand Creek flow was diverted into parallel, 24-inch, corrugated, high-density polyethylene pipes placed beneath the roadway on the northern side of the work area. Concrete slabs from the existing culvert wing walls and riprap placed within Sand Creek were placed by excavator to divert the creek flow into the bypass pipes on February 13, 2017. In addition to the diversion, a 6-inch diesel pump, 2-inch diesel pump, and 2-inch submersible pump were used to dewater the work area during culvert removal and replacement activities by translocating the water downstream.

2.2.5 Excavation

At the initiation of culvert removal and replacement activities, a small dam within Sand Creek downstream of the original culvert was removed to allow unobstructed flow from the plunge pool adjacent to the work site. This lowered the creek water level and facilitated construction of the new culvert foundations without flooding. In addition to dam removal, a small wooden bridge was constructed across Sand Creek downstream of the work area. This allowed construction equipment to traverse between the northern and southern sides of the work site during culvert construction activities.

Excavation of the existing concrete pipe culverts began on February 13, 2017. Materials excavated along the northern side of the work area were stockpiled northeast of the culvert, and materials excavated from the southern side of the work area were stockpiled southeast of the culvert. The stockpiled materials were screened to identify and remove munitions items. Munitions items recovered from the excavated soil were transferred for later disposition to onsite representatives of the USACE NAB staff who were onsite completing a munitions removal action at ODA2. Munitions recovery is further discussed in Section 2.5.

Removal of the existing concrete pipe culvert segments was completed on February 14, 2017. The removed culvert segments were staged southeast of the construction site until disposition at project completion. Forty-five tons of concrete pipe were recycled at Earth 'n Wood Products, Inc., Canton, Ohio. Bill of lading and recycling documentation for the three truckloads of recycled culvert material is included in Appendix D.

2.2.6 Foundation and Culvert Installation

Prior to installation of the Sand Creek culvert foundations, a Tetra Tech Professional Engineer (PE) inspected the soil present at the base of each excavation to confirm conditions were suitable for supporting the foundations and culvert. Elevations were established throughout the construction with a rotary laser level starting with the base of each excavation. Approximately 4 inches of American Association of State Highway and Transportation Officials (AASHTO) No.

57 stone were then placed in the base of each excavation as a sub-foundation. The elevation was again established with a rotary laser prior to installing the foundations. Excavators began laying the culvert and wing wall foundations from west to east on the northern side and then the southern side of the culvert starting February 17, 2017. The final foundation was installed on February 23, 2017. After the each foundation was installed, top of foundation elevation measurements were taken, and the stone sub-foundation was reapportioned to achieve the design elevations.

Prior to installation of the arch culvert and wing walls, Ohio DOT Type D stone was placed on the creek bed.

On February 24, 2017, a 20-ton-capacity crane was delivered to the site to lay the wing walls, head walls, and culvert sections. The wing walls, head walls, and culvert sections were delivered on five flatbed trucks. The wing walls and head walls were placed along the access road approaching the culvert, and the three culvert segments were placed on the foundation with the crane. Subsequently, the crane placed the eight sections of head walls and wing walls. The installation of each section met the allowable tolerances indicated in the design. On March 2 and 3, 2017, concrete was poured into the culvert and wing wall foundations. Photographs of the activities are included with the DARs in Appendix A.

2.2.7 Backfilling and Concrete Pad

Excavated soil from culvert removal was used as backfill behind the wing walls. Prior to reuse, the soil was surveyed by unexploded ordnance (UXO) technicians. Detector-aided surveys were completed on 100 percent of the soil removed during culvert construction.

Due to the clayey nature of the soil, it was determined not to be suitable for use beneath the roadway. Therefore, Type 304 aggregate was used as backfill over the culvert and beneath the concrete pad.

Construction of the 6-inch-thick concrete pad on top of the culvert was completed on March 22, 2017. The concrete pad included a 14-foot-wide road surface with a 2-foot shoulder on each side and a 20-foot length perpendicular to Sand Creek. Photographs of the concrete pad are included in Appendix A.

2.3 SITE RESTORATION

2.3.1 Diversion Pipe Removal

At the conclusion of culvert installation activities, the corrugated creek diversion pipes were removed, and the diversion channels cut on the eastern and western sides of the road north of the culvert were backfilled with the screened soil from culvert construction.

2.3.2 Grading

Following installation of the concrete pad, debris from brush clearing was relocated to the southern staging area. During demobilization, the staging areas, embankments, and ODA2 access road were graded by an excavator.

2.3.3 Revegetation

On March 29, 2017, disturbed areas surrounding the culvert were hydroseeded in accordance with Camp Ravenna's revegetation guidance. Tetra Tech monitored the progress of the vegetation growth on a weekly basis and left E&SCs in place until vegetation reached approximately 70 percent cover on May 18, 2017.

2.4 MUNITION ITEMS SCREENING

On February 27, 2017, screening of stockpiled soil from culvert removal to remove munitions items was initiated. UXO technicians surveyed the soil with magnetometers and visually inspected the excavated soil, which was spread into to 2-foot lifts to facilitate screening. Surveying of excavated soil was completed on March 3, 2017.

Approximately 1,303 pounds of material documented as safe (MDAS) and 355 items classified as MPPEH were recovered during culvert excavation activities and subsequent UXO screening. The recovered items were relinquished to USACE NAB personnel for identification, management, and disposition. USACE NAB personnel transferred the items temporarily to a storage magazine at ODA2 where they were stored for future destruction at the Buried Explosion Module (BEM). Items recovered included 2.36-inch rocket motors, 155-millimeter (mm) projectiles and fragments, 90-mm projectiles, 75-mm armor-piercing projectiles, 75-mm high explosive projectiles, antipersonnel mines, smoke canisters, miscellaneous fuses, and other fragments.

No munitions and explosives of concern (MEC) items were recovered as part of these activities.

2.5 REPORTING

At the completion of the activities at the Sand Creek culvert, Tetra Tech submitted the Compliance Certification Form included in Appendix E to USACE Pittsburgh confirming that the activities permitted under NWP #14 had been completed.

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BARE ROOT TREES TO BE PLANTED

- 1. Mix of Northern Red Oak (Quercus rubra) and Red Maple (Acer rubrum).
- (Indiana, PA).

HANDLING TREES UPON ARRIVAL

- 1. Unpack trees as soon as they arrive.
- 2. Untie bundles and spread trees out.
- 3. Sprinkle tops and roots with water.
- drying.
- 5. Do not soak roots in water.
- 6. Keep roots moist and well covered until actual planting.
- 7. Plant within 2 days of arrival.

PLANTING BARE ROOT TREES

- moist burlap can also be used to keep roots covered while planting.
- 2. Plant in 40 foot by 60 foot area on an 8-foot by 8-foot spacing.



3. Dig hole large enough so roots can spread in a natural position without curling. Any excessively long roots should be trimmed back. A slow-release fertilizer tablet may be placed in bottom of hole and allow some soil to fall over it before inserting roots. Roots should not touch fertilizer tablet.

- 5. Do not incorporate or top dress with granular or liquid fertilizer when planting. However, slow release fertilizer tablets may be used at planting time provided there is an inch or so of soil between tablet and roots.
- 6. Correct depth: Soil line should be about one inch above top root. Roots are then spread out. Soil is tampered in a slight depression to catch rain water. Wrong depth (tree is planted too deep): Roots are twisted and curled.
- 7. Water each tree immediately after planting and weekly for one month.
- each stake.

2. Obtain trees from a nursery within 200 miles of Camp Ravenna. One possible source of trees is Musser Forests

4. Cover roots with damp packing material and cover packing material with straw, white plastic or burlap to prevent

1. Trees will be carried to planting site in a planting bag or white plastic bag to keep them cool and moist. A piece of



4. Pack soil firmly around roots and add water. Use heel to firmly pack soil. Make sure to leave no air pockets that would allow roots to dry out. Leave slight depression to collect water or rainfall.

Wrong depth (tree is planted too shallow): Roots are exposed to air, which may kill the tree.

8. Once planted, insert a bamboo stake into the ground next to each tree and attach a bright color biodegradable flag to







Aerial photograph obtained from © 2014 Google, Inc. Image used	Google Earth, a with permission.	CTO NUMBER		DATE		DATE	REV	4
		CONTRACT NUMBER		APPROVED BY		APPROVED BY	FIGURE NO.	7
				SAND CREEK CULVERT SITE LAYOUT	CAMP RAVENNA	PORTAGE AND TRUMBULL COUNTIES, OHIO		
Legend F	l Road REIMS Wetland - Palustrine Forest	DATE	4 04/27/17	Y DATE	05/22/17	DATE	SCALE	NOTED
Projectic SPCS O	n: NAD 1983 hio North (Feet).	DRAWN BY	J. ENGLISH	CHECKED B'	G. HEALY	REVISED BY	S	AS

3.0 REFERENCES

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