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NAS JACKSONVILLE
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PILOT STUDY WORK PLAN FOR OPERABLE UNIT (OU) 3 BUILDING 780 WITH TRANSMITTAL NAS JACKSONVILLE FL
8/15/2016
SOLUTIONS IES

Solutions-IES
Industrial & Environmental Services

1101 Nowell Road ■ Raleigh, NC 27607
(919) 873-1060 ■ Fax (919) 873-1074
www.solutions-ies.com

August 15, 2016

Tetra Tech, Inc.
ATTN: NIRIS RDM
661 Andersen Drive
Foster Plaza 7
Pittsburgh, PA 15220

Re: Final Pilot Study Work Plan
Bioremediation Pilot Study
Operable Unit 3 Building 780
Contract Number N69450-11-D-0100-0030
NAS Jacksonville
Solutions-IES Project No. 2014.0033.NAVY

Dear NIRIS RDM:

Please find enclosed for upload into NIRIS one hard copy and one CD of the Final Pilot Study Work Plan for the Bioremediation Pilot Study at OU-3 Building 780 at NAS Jacksonville in Jacksonville, Florida.

If you have any questions or need any additional information, please feel free to contact us at (919) 873-1060.

Yours truly,

Solutions-IES

Robert C. Borden, Ph.D., P.E.
Project Engineer

Bilgen Yuncu, Ph.D., P.E.
Project Manager

Electronic cc: Adrienne Wilson, NAVFAC SE RPM (adrienne.wilson@navy.mil)
(cover letter only)

Solutions-IES
Industrial & Environmental Services

1101 Nowell Road ■ Raleigh, NC 27607
(919) 873-1060 ■ Fax (919) 873-1074
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August 15, 2016 *Via E-mail: adrienne.wilson@navy.mil*

Ms. Adrienne Wilson, OPDE3
NAVFAC SE
NAS Jacksonville
PO Box 30, Bldg. 903
Jacksonville, FL 32212-0030

Re: Final Pilot Study Work Plan
Bioremediation Pilot Study
Operable Unit 3 Building 780
Contract Number N69450-11-D-0100-0030
NAS Jacksonville
Solutions-IES Project No. 2014.0033.NAVY

Dear Ms. Wilson:

Please find attached for your records a CD with the Final Pilot Study Work Plan for the Bioremediation Pilot Study at OU-3 Building 780 at NAS Jacksonville in Jacksonville, Florida. We have transmitted the report to FDEP and EPA for their records, as well as the Tetra Tech RDM per this cover letter.

If you have any questions or need any additional information, please feel free to contact us at (919) 873-1060.

Yours truly,

Solutions-IES

Robert C. Borden, Ph.D., P.E
Project Engineer

Bilgen Yuncu, Ph.D., P.E.
Project Manager

cc: Mr. Aaron Cohen, FDEP (1 HC + 1 CD)
Mr. Sam Hankinson, FDEP (1 HC + 1 CD)
Mr. Peter Dao, EPA (1HC + 1 CD)
Mr. Tim Curtin, NAS Jacksonville (1 HC + 1 CD)
Mr. Dave Ford, NAS Jacksonville (1 HC + 1 CD)
Mr. Mike Singletary, NAVFAC, SE (1 CD)
Tetra Tech RDM (1 HC + 1 CD)

FINAL
PILOT STUDY WORK PLAN

BIOREMEDIATION PILOT STUDY
OPERABLE UNIT 3 BUILDING 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Prepared for:
NAVFAC SE
Building 135, Code OPDE3
NAS Jacksonville
Jacksonville, FL 32212

Prepared by:
Solutions-IES, Inc.
1101 Nowell Road
Raleigh, NC 27607
919.873.1060

Prepared under:
Contract Number N69450-11-D-0100
Order Number 0030

August 15, 2016

Robert C. Borden, Ph.D., P.E.
Project Engineer

Bilgen Yuncu, Ph.D., P.E.
Project Manager

ROBERT C. BORDEN
LICENSE
No 80727
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

Solutions-IES
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Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Rick Scott
Governor

Carlos Lopez-Cantera
Lt. Governor

Jonathan P. Steverson
Secretary

June 23, 2016

Ms. Adrienne Wilson
Code OPDE3/AW
Department of the Navy
Naval Facilities Southeast
Attn: AJAX Street, Building 135N
P.O. Box 30A
Jacksonville, FL 32212-0030

Re: Draft Revision 2 Pilot Study Work Plan, Bioremediation Pilot Study, Operable Unit 3 Building 780, Naval Air Station Jacksonville, Jacksonville, Florida

Dear Ms. Wilson:

The Department has reviewed the Draft Revision 2 Pilot Study Work Plan, Bioremediation Pilot Study, Operable Unit 3 Building 780, dated May 13, 2016, (received May 18, 2016), prepared and submitted by Solutions- IES, Inc., under Contract Number N69450-11-D-0100-0030. The document is adequate for its intent and is approved.

Any questions regarding this letter should be directed to me at (850) 245-8935.

Sincerely,

Aaron B. Cohen
Remedial Project Manager
Department of Defense and Brownfields Partnerships
Bureau of Waste Cleanup

KAW

EC: Pete Dao, EPA Region IV, Atlanta
Tim Curtin, NAS Jacksonville
Mike Singletary, NAFACSE
Mark Peterson, TtNUS, Jacksonville
Amy Twitty, CH2M Hill
Todd Haverkost, Resolutions
Jessica Keener, Solutions-IES

DOD_7_3513

Debra Tabron

From: Wilson, Adrienne T CIV NAVFAC SE, JAXS <adrienne.wilson@navy.mil>
Sent: Thursday, August 11, 2016 4:14 PM
To: Sam McIntyre
Subject: FW: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

Sam,

Here is Pete's approval to proceed.

-----Original Message-----
From: Dao, Peter [mailto:Dao.Peter@epa.gov]
Sent: Wednesday, August 03, 2016 7:05 AM
To: Wilson, Adrienne T CIV NAVFAC SE, JAXS
Cc: Bilgen Yuncu
Subject: [Non-DoD Source] RE: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

I'm good with finalizing the document.

-----Original Message-----
From: Wilson, Adrienne T CIV NAVFAC SE, JAXS [mailto:adrienne.wilson@navy.mil]
Sent: Tuesday, August 02, 2016 4:44 PM
To: Dao, Peter <Dao.Peter@epa.gov>
Cc: Bilgen Yuncu <byuncu@solutions-ies.com>
Subject: FW: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

HI Pete,

I have asked Solutions to wait until I have an approval that you accept their response (below) before finalizing the document. Each of the pilot studies are being conducted so that the team can determine if the remedies work well enough that we may want to go forth with any of them as final remedies. Please let me know if they may proceed to consider the work plan final and they may get out in the field. Thanks.

R,

Adrienne
-----Original Message-----
From: Bilgen Yuncu [mailto:byuncu@solutions-ies.com]
Sent: Tuesday, August 02, 2016 4:22 PM
To: Wilson, Adrienne T CIV NAVFAC SE, JAXS
Cc: Sam McIntyre
Subject: [Non-DoD Source] RE: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

Hi Adrienne,

This task order was planned as a pilot study to test remedial design strategies and gather information for a full-scale remedial design. If the project works, we can extend the remediation to other areas in subject.

I recognize Pete's e-mail as EPA's approval for the workplan and move forward with the planning of injection. The final workplan will be distributed and transmitted for uploading to NIRIS.

Best Regards,

Bilgen

Bilgen Yuncu, PhD, PE, CAPM
Solutions-IES, Inc.
1101 Nowell Road
Raleigh, NC 27607
Phone: 919.873.1060 ext. 137
Web: www.solutions-ies.com

DID YOU KNOW.

Solutions-IES has consulted on environmental assessment and remediation projects in 19 countries throughout the world

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-----Original Message-----
From: Wilson, Adrienne T CIV NAVFAC SE, JAXS [mailto:adrienne.wilson@navy.mil]
Sent: Tuesday, August 02, 2016 3:40 PM
To: Bilgen Yuncu; Sam McIntyre
Subject: FW: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

Sam & Bilgen,

Please see Pete's comments below.

-----Original Message-----
From: Dao, Peter [mailto:Dao.Peter@epa.gov]
Sent: Tuesday, August 02, 2016 3:14 PM
To: Wilson, Adrienne T CIV NAVFAC SE, JAXS
Subject: [Non-DoD Source] RE: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

My one concern is that the injection wells are concentrated on the southern end of the building while the plume extend to MW9S and 10S. If the goal is just for a pilot study with potential further treatment then I'm good with what is planned. If it is meet our additional intended goal of treating all of the hot spot area and possibly getting the site to MNA then I don't think the proposed injection well network will do it.

-----Original Message-----
From: Wilson, Adrienne T CIV NAVFAC SE, JAXS [mailto:adrienne.wilson@navy.mil]
Sent: Tuesday, August 02, 2016 2:15 PM
To: Dao, Peter <Dao.Peter@epa.gov>

Subject: FW: OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

Hi Pete,

Did you have any comments on the Building 780 Pilot study work Plan? The contractor would like to get in the field soon

-----Original Message-----
From: Bilgen Yuncu [mailto:byuncu@solutions-ies.com]
Sent: Tuesday, August 02, 2016 2:04 PM
To: Wilson, Adrienne T CIV NAVFAC SE, JAXS
Subject: [Non-DoD Source] OU-3 Building 780 Pilot Study Work Plan Draft Rev 2

Good afternoon Adrienne,

We have submitted the Building 780 Pilot Study Work Plan Draft Rev 2 to Navy , FDEP and EPA on May 16, 2016. We have received FDEP approval on June 23, 2016 however, we haven't heard back from EPA yet. Do you mind if I contact EPA for the status? I would like to start injection as soon as possible so we can keep the project in schedule.

Best Regards,

Bilgen

Bilgen Yuncu, PhD, PE, CAPM

Solutions-IES, Inc.

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Raleigh, NC 27607

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_____

DID YOU KNOW.

Solutions-IES has consulted on environmental assessment and remediation projects in 19 countries throughout the world

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1.0 INTRODUCTION

This Pilot Study Work Plan (Work Plan) has been prepared to guide a bioremediation pilot study at Operable Unit 3 (OU-3) Building 780 at Naval Air Station (NAS) Jacksonville in Jacksonville, Florida (**Figure 1**). The Work Plan was prepared under Contract Number N69450-11-D-0100 Order Number 0030.

1.1 SITE LOCATION

NAS Jacksonville occupies approximately 3,900 acres on the western bank of the St. Johns River in southcentral Duval County, Florida. The station is approximately 13 miles south of downtown Jacksonville. NAS Jacksonville was commissioned in 1940 to provide facilities for pilot training and a Navy Aviation Trades School for ground crew members. Its physical size more than doubled in support of World War II military operations. Since 1951, the facility has served the dual purpose of training pilots and ground crew members and supporting operational carrier squadrons.

OU-3 is located south of the east-west runway on the eastern edge of the installation. Building 780 is located at the north end of OU-3 between Building 101S and 101N (**Figure 2**).

1.2 SITE AND REGULATORY HISTORY

Operational history of OU-3 consists mainly of the activities associated with the FRCSE, which has been the major industrial complex at the facility since its inception in 1940. Past and current land uses at OU-3 remain mostly unchanged since FRCSE became the primary tenant in the 1940s. FRCSE operations consist primarily of performing in-depth repair and modification of aircraft engines and aeronautical components. Building 780 was reportedly a paint stripping facility until 1992 when it was converted into a closed-loop solvent recycling facility.

In November 1989, NAS Jacksonville was added to the National Priorities List. Since the mid-1990s, several Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)-based investigations, interim actions, and selected remedies have been implemented at OU-3 under the direction of the NAS Jacksonville Installation Restoration (IR) Partnering Team (Partnering Team). The Partnering Team is comprised of representatives of NAS Jacksonville, Naval Facilities Engineering Command Southeast (NAVFAC SE), the United States Environmental Protection Agency (USEPA), the Florida Department of Environmental Protection (FDEP), and Navy contractors. These CERCLA-based actions have addressed Potential Sources of Contamination (PSCs) 11 through 16 and nine areas of groundwater contamination (Areas A through G, PSC 48 – Building 10, and Building 780).

OU-3 contains nine chlorinated solvent plumes, including one associated with Building 780. During development of the Remedial Investigation/Feasibility Study (RI/FS) (Harding Lawson Associates [HLA], 2000), it was determined that two of the groundwater areas were thought to present principle waste threats (PSC 48 – Building 106 and Building 780). As a result, an Interim Removal Action (IRA) was implemented at Building 780 beginning in 1998, which consisted of the installation of a soil vapor extraction (SVE) system to remove volatile organic compound (VOC) laden air from the subsurface and a groundwater pump and treat system (GWT) (ABB-ES, 1995). The IRA was designed to reduce contaminant concentrations in hot spots or source areas.

The GWT/SVE system was operated and maintained by CH2M HILL Constructors, Inc. (CCI) from April 2000 until it was shut down on January 28, 2005. NAVFAC SE (known then as NAVFAC EFD SOUTH) evaluated the GWT and SVE systems under their optimization program and the preliminary recommendations of the optimization review were to discontinue the system operations and reassess the site. The operational efficiency of the GWT system was 77.6 percent for the 7 years of system operation. Approximately 160 pounds of VOCs were removed during the operating life of the system. The operational efficiency of the SVE system is 69.7 percent for the 7 years of system operation. Approximately 4,455 pounds of VOCs were removed during the operating life of the SVE system (CCI, 2006). The system was dismantled and officially decommissioned by CCI in July 2008 (CCI, 2009).

A RI Addendum for OU-3 was completed in 2015 (Tetra Tech, 2015), which included an updated conceptual site model for the Building 780 source area (**Figure 3**). Based on the updated conceptual site model, the Building 780 area is covered with either pavement and/or building footprints. Beneath the pavement, the lithology near Building 780 consists of sand to approximately 8 feet (ft) below ground surface (bgs), sand with interbedded silts and clays from approximately 8 to 15 ft bgs, then confining clay beginning approximately 15 ft bgs.

Numerous VOCs (primarily chlorinated ethanes and to a lesser extent chlorinated ethenes, both parent and byproducts) were observed at the site. Molar mass concentrations were higher in the groundwater above the clay layer as compared to below the clay layer. The degradation product *cis*-1,2-dichloroethene (*c*DCE) was more prevalent in groundwater above the clay layer compared to below the clay layer, suggesting that degradation below the clay is less prevalent. In the Building 780 area, strong reducing conditions (likely sulfate reducing and potential methanogenesis) were found for the hot spot well with the highest 1,1,1-TCA concentrations (MW-780-MW4S, **Figure 2**). A strong reducing condition favors reductive dechlorination of 1,1,1-TCA to 1,1- DCA.

During the RI process, the Partnering Team agreed to initiate pilot studies in the three presumed groundwater source areas at OU-3. This bioremediation pilot study is focused on one of those areas in

and around Building 780. The purpose is to assess contaminant of concern (COC) concentrations, design and implement and emulsified vegetable oil (EVO) injection, and evaluate the effectiveness of enhanced reductive dechlorination. Field activities of the pilot study consist of four tasks:

1. Pre-injection assessment study using a combination of membrane interface probe (MIP)/ hydraulic profiling tool (HPT) and direct-push technology (DPT) to determine the placement of injection wells;
2. Baseline groundwater sampling event;
3. EVO and colloidal buffer injection; and
4. Four post-injection monitoring events.

This Pilot Study Work Plan describes the methods and procedures that will be used to perform the EVO and colloidal buffer injections, as well as baseline and post-injection monitoring events at Building 780.

2.0 PRE-INJECTION STUDY

2.1 EVENT #1 – OCTOBER 2015

During the first event of the pre-injection study conducted in October 2015, Zebra Technical Services (Zebra), Solutions-IES' (SIES) subcontractor, advanced eight combined MIP/HPT borings (780-MiHPT-1 through 780-MiHPT-8) and recorded VOC concentrations and estimated hydraulic conductivity from the ground surface to the top of the confining clay layer (approximately 20 ft bgs) (**Figure 4**). At each location, a dissipation test on the HPT was run at approximately 11 ft bgs. A second dissipation was run at approximately 16 ft bgs at MiHPT-3 through MiHPT-8.

The MIP measures the relative concentration of VOCs in the soil and aquifer adjacent to a sampling window in the probe body. The MIP is equipped with several detectors including electrical conductivity (EC), photoionization detector (PID), flame ionization detector (FID), and electron capture detector (ECD). ECD detects chlorinated VOCs (CVOCs), mainly tetrachloroethene (PCE) and TCE. The PID and FID are sensitive to CVOCs and aromatic hydrocarbons and provide additional confirmation of the ECD data. The MIP can detect the presence of gross VOCs, but does not produce concentration data or specific compound speciation. HPT measures pressure response of the soil to injection of water and translates the pressure and flow data profiles to relative hydraulic conductivity values.

SIES evaluated the results of the MiHPT during the field event, and subsequently collected confirmation groundwater samples. The vertical boundary for the groundwater investigation is defined by the water table and depth of the confining clay layer (approximately 20 ft bgs). Groundwater of interest includes groundwater within the shallow portions of the aquifer to the clay layer. Eight groundwater samples were collected at five of the MiHPT locations using DPT sampling equipment (DPT-1, DPT-3, DPT-4, DPT-5, and DPT-6) at two different depths (approximately from 8 ft to 10 ft bgs and 17 ft to 20 ft bgs) with the exceptions of DPT-3 and DPT 6 (only one groundwater sample collected at each of these locations

approximately from 17 ft to 20 ft bgs) (**Figure 4**). Also, one groundwater sample was collected from monitoring well OU3-780-MW4S. The samples were analyzed by Accutest Laboratories Southeast (Accutest), a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory located in Orlando, Florida for select VOCs by EPA Method 8260B including chloroethane, 1,1-Dichloroethane (1,1-DCA), 1,2-DCA, 1,1-Dichloroethene (1,1-DCE), total 1,2-Dichloroethene (1,2-DCE), *c*DCE, 1,1,1-TCA, TCE, tetrachloroethene (PCE), toluene and vinyl chloride (VC). The groundwater sampling methodologies, analytical methods and requirements for laboratory analysis, quality assurance and quality control procedures and investigation-derived waste (IDW) management are described in detail in the *Tier II Sampling and Analysis Plan* (SAP; SIES, 2015).

2.2 EVENT #2 – NOVEMBER 2015

Using the results from the Pre-Injection Study Event #1, SIES planned and conducted a second event which was conducted in November 2015. Six additional DPT points (DPT-3 [shallow sample], DPT-7, DPT-8, DPT-9, DPT-10 and DPT-11) were advanced and eleven additional groundwater samples were collected using DPT sampling equipment at two different depths (approximately from 8ft to 10ft bgs and 17 ft to 20 ft bgs) with the exception of DPT-3 (only one groundwater sample collected at this location from 8 ft to 10 ft bgs) (**Figure 4**). Groundwater samples were submitted to Accutest for select VOC analysis by EPA Method 8260B.

Direct-push borings were advanced using a Geoprobe® at 3 DPT locations to collect continuous soil cores (DPT-1-SO [SB-1], DPT-3-SO [SB-3], and DPT-4-SO [SB-4])) to describe the lithology (**Figure 4**). Also, five soil samples were collected from DPT-1-SO at depths of 5 ft to 12 ft, 12 ft to 13 ft, and 13 ft to 20 ft and from DPT-4-SO at depths of 12 ft to 15 ft and 17 ft to 20 ft. Samples were submitted to the North Carolina State University (NCSU) Environmental Engineering Laboratory for analysis of soil acidity to determine the buffering capacity of the aquifer material and the dosing requirement of colloidal buffer that would be required during injection in order to raise the aquifer pH to a more suitable range (6 to 8 Standard Units [SU]) for anaerobic bioremediation.

Additionally, four of the investigated DPT borings were converted to 1-inch pre-pack permanent monitoring wells; OU3-780-MW7S through OU3-780-MW10S (**Figure 4)**. OU3-780-MW-7S was screened from 5 ft to 10 ft bgs and OU3-780-MW8S, OU3-780-MW9S and OU3-780-MW10S were screened from 10 ft to 20 ft bgs. The monitoring wells were completed in accordance with 62-532 F.A.C., and were secured in bolt-down flush-mount manholes with locking well caps and labels. Well construction details are provided in **Appendix A**.

2.3 BASELINE SAMPLING

Following the pre-injection study, baseline groundwater sampling was conducted at eight monitoring wells on December 1 and December 2, 2015. Prior to collecting groundwater samples, groundwater levels were measured in twelve monitoring wells (**Table 1**) and field measurement parameters including dissolved oxygen (DO), temperature, oxidation-reduction potential (ORP), pH, specific conductance, and turbidity were collected during monitoring well purging. At the completion of purging, field NA parameters (ferrous iron, alkalinity, DO, and sulfide) were measured using CHEMetrics© field test kits. Groundwater samples at each site were collected into laboratory-supplied glassware and submitted to Accutest for select VOC analysis by EPA Method 8260B and NA parameters including chloride, methane, ethane, ethene (MEE), sulfate, and total organic carbon (TOC), and to Microbial Insights, Inc. (Microbial Insights) for molecular biological tools (MBTs). Specifically, MBTs will be used to determine the abundance of total bacteria (EBAC), dechlorinating bacteria and reductase genes (e.g., *Dehalococcoides spp.* [DHC], *Dehalobacter spp*. [DHBt], TCE reductase, BVC reductase, and VC reductase).

2.4 RESULTS

2.4.1 Geology/Hydrogeology

MiHPT profiles indicated the presence of a relatively high permeable zone from approximately 4 ft to 10 ft bgs (top 4 ft from the ground surface determined as backfill soil) and a moderate permeable zone from approximately 10 ft to 19 ft bgs (except MiHPT-7) across the study area. Hydraulic conductivity estimates ranged from 20 to 100 ft/day in the upper zone and ranged from 10 to 20 ft/day in the lower zone. MiHPT logs are presented in **Appendix B**.

The three soil borings advanced within the study area (SB-1, SB-3, and SB-4) support the general profile described above. Based on the soil borings, the subsurface consists of fine sand from about 1 ft to approximately 18 ft bgs with a clayey fine sand/fine sandy clay layer between 11.5 ft to 13.5 ft bgs, followed by clayey fine sand to a depth of 20 ft bgs. **Figure 5** represents a cross-section encompassing borings SB-1, SB-3, and SB-4. Soil boring logs are provided in **Appendix C.**

Depth to groundwater was measured at approximately 6 ft bgs during the baseline sampling (**Table 1**), which is consistent with the historical data collected from the monitoring wells MW-780-1 and MW-780-2 (data not shown). The localized direction of groundwater flow could not be determined and specific groundwater velocities near Building 780 could not been calculated since the top of casing elevations to convert the water levels to the groundwater elevations are not available for most of the monitoring wells. However, based on previous site information, groundwater generally flows to the east beneath the site towards the St. Johns River. Aquifer tests (pumping tests) conducted in the vicinity of Building 780 determined a groundwater migration velocity of approximately 2 ft/year above the clay layer as compared

to about 12 to 35 ft/year below the clay layer (Tetra Tech, 2013). Groundwater migration above the clay layer is also affected by leaky storm sewers with inlets located beneath the water table

2.4.2 Contaminant Profile

For the MiHPT boring located along the southwest corner of the Building 780 (MiHPT-1; **Figure 4**), the ECD profile identified a zone of relatively high CVOC contamination from approximately 6 to 20 ft bgs. The profiles for borings MiHPT-3 and MiHPT-4, located on the south of the building, identified moderate CVOC contamination increasing with depth; however, the detector response in this area was lower than MiHPT-1. Similarly, borings located on the east of the building (MiHPT-5, MiHPT-7 and MiHPT-8) indicated moderate CVOC contamination from approximately 10 to 20 ft bgs, increasing with depth with the exception of MiHPT-6 which did not identify any substantial CVOC contamination throughout the profile; only a small increase in probe response between 18 ft and 20 ft bgs. Lastly, MiHPT-2 located on the west of the building did not show any substantial CVOC contamination. MiHPT borings are provided in **Appendix B**.

Samples collected from DPT points confirmed the high concentrations of CVOCs in groundwater on the south of the Building 780 (DPT-1, DPT-3 and DPT-4) in both shallow (~ 7 ft to 10 ft bgs) and deep (~ 17 ft and 20 ft bgs) zones. **Table 2** summarizes the groundwater VOC analytical results. Concentrations of numerous chlorinated ethanes and chlorinated ethenes (both parent and byproducts) collected from DPT-1, DPT-3 and DPT-4 exceeded their respective FDEP Groundwater Cleanup Target Levels (GCTLs) at both zones. In general, high concentrations of chlorinated ethanes (chloroethane, 1,1-DCA, 1,1,1-TCA) were detected in the shallow zone whereas chlorinated ethenes and their degradation products (PCE, TCE, 1,1-DCE, *c*DCE, and VC) were more prevalent in the deeper zone especially at DPT-1. Additionally, toluene concentrations exceeded their FDEP GCTL at DPT-1, DPT-3 and DPT-4 in both zones. On the east side of the building, 1,1-DCE, 1,2-DCA, *c*DCE, total 1,2-DCE, TCE and VC were detected higher than their respective GCTLS in both zones and a high concentration of PCE (1,460 □g/L) was detected only in the deeper zone at DPT-5. Only a deep groundwater sample (19 ft – 20 ft bgs) was collected from DPT-6. 1,1-DCE, 1,2-DCA, *c*DCE, total 1,2-DCE, and PCE exceeded their respective GCTLs at this location. In general, concentrations detected on the east of the Building 780 were relatively lower than the concentrations detected on the south of the building. Samples collected from DPT-7 to DPT-11 showed that CVOC concentrations decrease moving from west (DPT-1) to east, but chlorinated ethenes (1,1-DCE, TCE and *c*DCE) still appear to be higher than their respective GCTLs in the deep zone. Especially, at DPT-8, TCE was detected at a concentration of 17.7 mg/L in the groundwater collected from the deep zone which is the highest TCE concentration reported across the site. These results suggest that TCE and degradation products are migrating from the impacted area near DPT-1 (MW-780-MW4S).

Similarly, high concentrations of chlorinated ethanes, chlorinated ethenes and toluene were reported during the baseline sampling in MW-780-MW4S screened from 10 ft to 20 ft bgs and MW-780-MW7S screened from 5 ft to 10 ft bgs. 1,1,1-TCA was detected only in these two wells amongst the eight wells sampled. High CVOC concentrations were also detected in MW-780-MW8S which is located on the southeast corner of the building. Several CVOCs were reported higher than their respective GCTLs in MW-780-1, MW-780-MW9S and MW-780-MW10S. However, concentrations were relatively low with the exceptions of TCE in MW-780-MW9S, and TCE and *c*DCE in MW-780-MW10S. CVOCs were not detected in MW-780-MW5S and MW-780-PZ-024 with the exceptions of *c*DCE concentration of 2.4 g/L, 1,2-DCE (total) concentration of 2.4 g/L and an estimated concentration of 0.41 g/L in MW-780-PZ-024 (**Table 2**).

Groundwater pH ranges from 4.20 (MW-780-MW4S) to 7.07 (MW-780-MW5S) within the monitoring wells at the site. DO and ORP range from 0.24 mg/L (MW-780-MW10S) mg/L to 0.45 mg/L (MW-780-MW5S) and 193.4 mV (MW-780-MW7S) to -53.6 mV (MW-780-MW8S), respectively (**Table 3**). DO and ORP results suggest that reducing conditions (likely sulfate reducing and potential methanogenesis) were established within the site especially for the hot spot wells with the highest CVOC concentrations (MW-780-MW4S and MW-780-MW7S). Groundwater samples were also analyzed for the natural attenuation parameters (TOC, alkalinity, dissolved iron [ferrous iron], chloride, MEE, sulfate and sulfide) to establish baseline conditions. High TOC concentrations (66 mg/L) were detected in MW-780-MW4S and MW-780-MW7S; most likely due the presence of toluene in these wells. MBT results confirmed the presence of dechlorinating bacteria (DHC and DHBt) and reductase genes within the site, especially in MW-780-MW4S (**Table 4**).

For select soil samples from SB-1 and SB-3, initial pH values were within the range of 4.5 to 5. Titration results indicated that approximately 15 meq of NaOH per kg of soil is required to achieve neutral pH (~7) within the fine sand. The clayey sand material required 27 meq of NaOH per kg to achieve neutral pH (**Appendix D**). The information obtained from the soil titration testing was used to estimate the alkaline buffer requirement for the pilot injection.

3.0 *IN SITU* REMEDIAL DESIGN

The pre-injection study data provide a basis to design a plan (the appropriate location and depth for the injection points) to inject the treatment area with electron donor organic substrate and increase the pH into a more favorable range for bioactivity. The remediation objectives and approach are discussed in the following sections.

3.1 REMEDIATION OBJECTIVES AND APPROACH

The remedial objective is to reduce subsurface CVOC contaminant concentrations in groundwater near Building 780 to below the FDEP GCTLs.

Results of the pre-injection study indicate that the use of an organic substrate to enhance the reductive dechlorination has the potential to achieve this objective. The addition of buffer is intended to further optimize the conditions and increase the potential for success. Thus, this Work Plan includes the injection of an EVO product (EOS Pro) to maintain anaerobic, electron donor rich, reducing conditions in the aquifer along with the injection of a buffer (CoBupH-Mg™) intended to raise the groundwater pH and optimize conditions for growth of indigenous DHC and DHB populations capable of degrading chlorinated solvents. Since the abundance of dechlorinating bacteria and reductase genes were observed within the site during the baseline sampling, bioaugmentation will not be conducted.

Post-injection groundwater monitoring will be conducted for a period of 12 months following injection to assess the performance of the treatment. Evidence for success will be reduction of COCs and both the formation and reduction of biodegradation daughter products/end products. It is not a goal of this project to reach FDEP GCTLs within this monitoring period. However, the design assumes injection of sufficient residual substrate and buffer throughout the treatment zone will continue supporting bioactivity beyond the contractual monitoring period.

3.1.1 Injection Design

EOS Pro and CoBupH-Mg™ will be purchased from EOS Remediation, LLC (Raleigh, NC) for the substrate and buffer injections. EOS Pro is a concentrated emulsion composed of emulsified vegetable oil, rapidly biodegradable soluble substrate, emulsifiers, micronutrients and preservatives. CoBupH-Mg™ is a premium colloidal suspension of alkaline solids providing long-term, slow release adjustment of pH.

First, 9 shallow and 16 deep permanent injection wells will be installed in two rows with injection points spaced approximately 15 ft on-center as shown in **Figure 6**. The shallow wells will be screened from 6 to 11 ft bgs and the deep wells will be screened from 11 to 21 ft bgs. The shallow injection wells are concentrated in the south-western portion of Building 780 where contaminants are present in the shallow zone. The deep injection wells extend along the southern side of Building 780 where contaminants are present in the deep zone. The injection wells will be installed by first coring through the concrete pavement, advancing with DPT to the target depth, installing a 1-inch diameter section of 0.010-slot PVC well screen and PVC casing, sand pack, 12-inch bentonite seal above the sandpack, and then backfilling with clean soil to the surface.

Injection into the shallow wells will involve the following per each well: a) inject one 5-gallon pail of CoBupH-Mg™ diluted with 4 pails of water; b) inject one drum of EOS Pro diluted with 4 drums of water; and c) inject 1050 gallons of chase water to uniformly distribute the CoBupH-Mg™ and EOS Pro throughout the target treatment zone. Injection into the deep wells will involve the following per each well: a) inject two 5-gallon pail of CoBupH-Mg™ diluted with 8 pails of water; b) inject two drums of EOS Pro diluted with 8 drums of water; and c) inject 2100 gallons of chase water to uniformly distribute the CoBupH-Mg™ and EOS Pro throughout the target treatment zone.

The wells will be injected in two phases. In Phase 1, 5 shallow and 8 deep wells will be injected. In Phase 2, 4 shallow and 8 deep wells will be injected. To the extent possible, every other well set will be injected in Phase 1 with the remaining wells injected in Phase 2. This approach is used to reduce the formation of stagnation zones between injection points and improve amendment distribution. Following injection of the Phase 1 wells, nearby monitor and injection wells will be sampled for pH and turbidity to determine if the CoBupH-Mg™ and/or EOS Pro have reached these locations. If there is extensive breakthrough of CoBupH-Mg™ or EOS Pro at Phase 2 injection points, Phase 2 injection volumes may be reduced proportionately. The total volumes of materials proposed to be injected in this project are shown in table below.

	Shallow	**Deep**
CoBupH-Mg™ Volume per well	5 gal	10 gal
EOS Pro Volume per well	53 gal	106 gal
Chase and dilution water volume per well	1,282 gal	2,564 gal
Total fluid volume per well	1,340 gal	2,680 gal
Number of wells	9	16
Total fluid volume in all wells	12,060 gal	42,880 gal

Injection pressures will be maintained below 5 pounds per square inch (psi) at the ground surface. Based on relatively high permeability of the subsurface formation, SIES anticipates injection rates of 1-2 gpm in the shallow zone and approximately 2-4 gpm in the deep zone. With these flowrates, each injection phase should require 4 to 6 days to complete. The proposed injection point locations, shown in **Figure 6**, may be adjusted in the field based on the location of site infrastructure and/or underground utilities.

3.2 POST-INJECTION MONITORING

Monitoring events will be conducted approximately 3 months, 6 months, 9 months, and 12 months post-injection. Eight monitoring wells will be sampled using low flow techniques and groundwater will be analyzed for:

- Select COCs that include the following VOCs: chloroethane, 1,1-DCA, 1,2-DCA, 1,1-DCE, 1,2-DCE (total), *c*DCE, 1,1,1-TCA, TCE, PCE, toluene, and VC;
- NA parameters including chloride, methane, ethane, ethene (MEE), sulfate, and TOC and MBTs. Specifically, MBTs will be used to determine the abundance of total bacteria, dechlorinating bacteria and reductase genes (e.g., *Dehalococcoides spp*., *Dehalobacter spp*., TCE-reductase, and VC-reductases);
- Ferrous iron, alkalinity, DO and sulfide using field test kits; and
- Groundwater field parameters including DO, temperature, ORP, pH, specific conductance, and turbidity to evaluate the aquifer and to determine when groundwater is representative of site conditions.
- Synoptic groundwater level measurements will be completed during each round of sampling at twelve monitoring wells.
- During each sampling event, one duplicate, one matrix spike (MS), one matrix spike duplicate (MSD), one equipment rinsate blank, and one trip blank (volatile COCs, only) will also be submitted per event.

The groundwater sampling methodologies, analytical methods and requirements for laboratory analysis, quality assurance and quality control procedures and IDW management are described in detail in the *Tier II Sampling and Analysis Plan* (SAP; SIES, 2015).

4.0 REFERENCES

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SIES, 2015. *Tier II Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan*. Bioremediation Pilot Study, Operable Unit 3 Building 780, Naval Air Station Jacksonville, Jacksonville, Florida. Final. July

Tetra Tech, 2015. *Remedial Investigation Addendum for Operable Unit 3, Naval Air Station Jacksonville, Jacksonville, Florida*. November.

FIGURES

PROJECT NUMBER 2014.0033.NAVY

DRAFTER KTS

CHECKED BY NS

PROJECT MANAGER NS

DATE 7/2/2014

FILE Building 780.dwg

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SITE LOCATION MAP
BUILDING 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

FIGURE: 1

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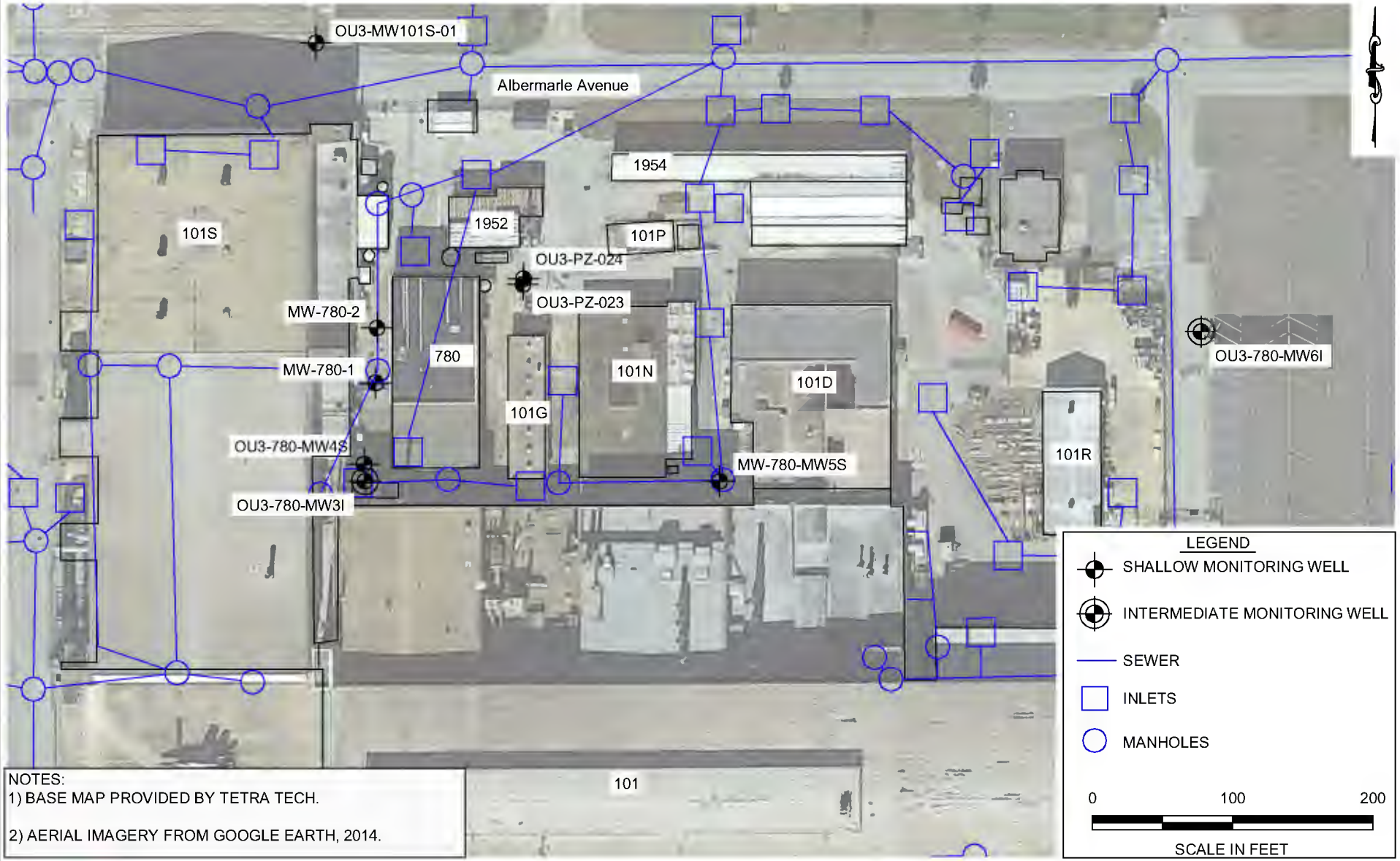

NOTES:
1) BASE MAP PROVIDED BY TETRA TECH.

2) AERIAL IMAGERY FROM GOOGLE EARTH, 2014.

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SITE MAP
BUILDNG 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

FIGURE:
2

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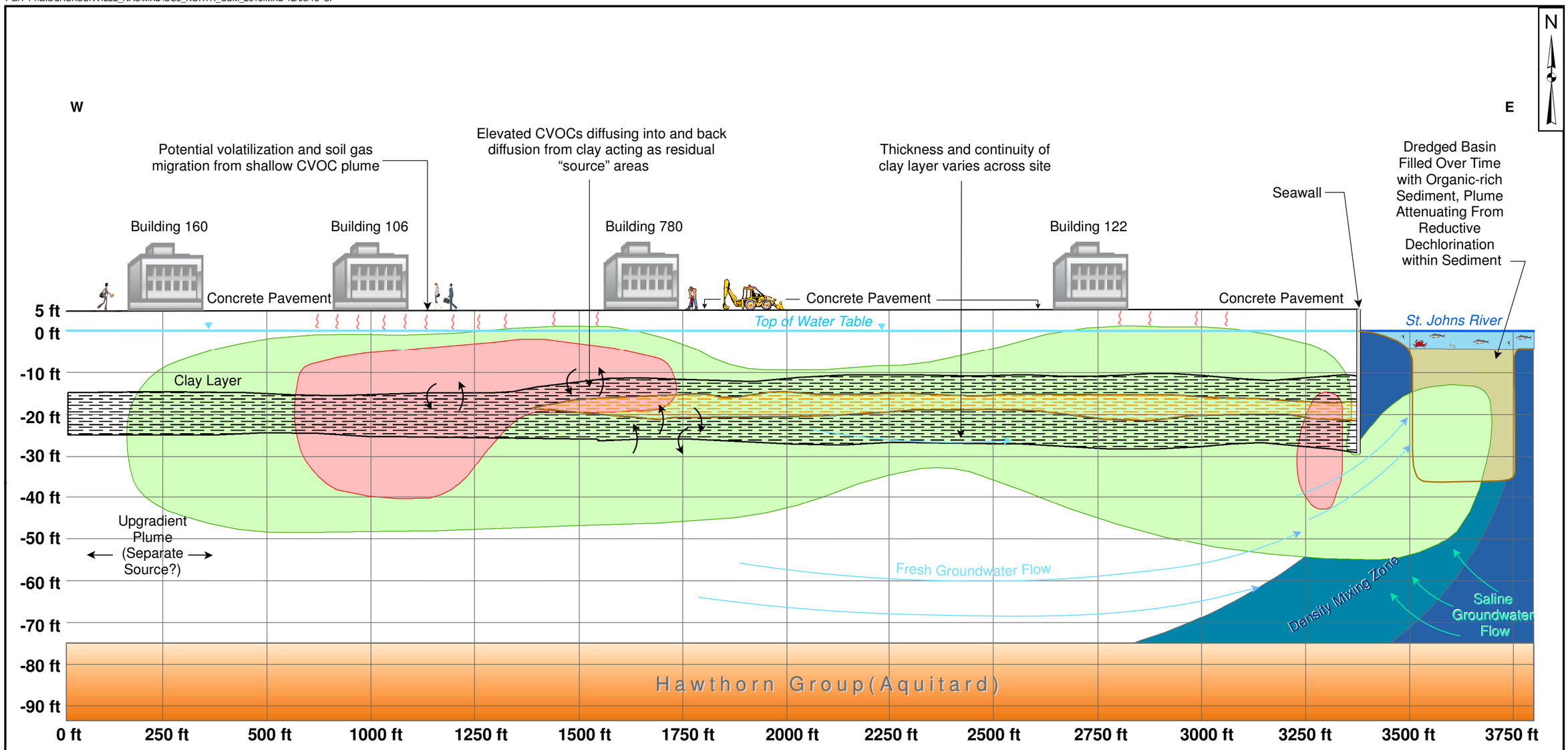
PGH P:\GIS\JACKSONVILLE_NAS\MXD\OU3_NORTH_CSM_2013.MXD 12/06/13 SP



Legend

- Clay
- Sandy Clay/Clayey Sand
- Elevated CVOC Plume
- Overall CVOC Plume Extent

Note: This Conceptual Site Model is based on Total VOC data.

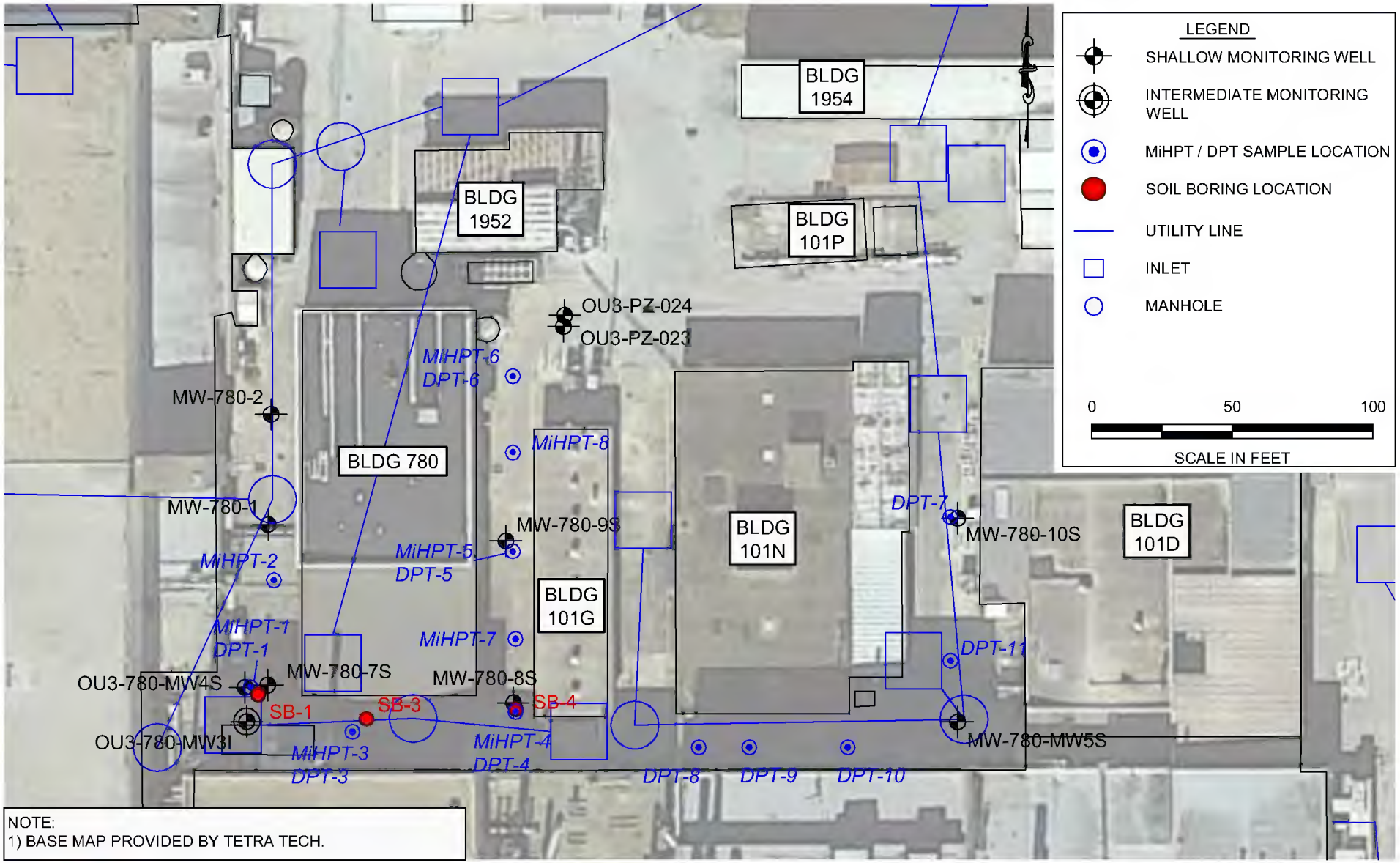
DRAWN BY	DATE
S. PAXTON	10/22/13
CHECKED BY	DATE
S. ANDERSON	12/06/13
REVISED BY	DATE
S. PAXTON	12/06/13
SCALE	
AS NOTED	

NAVFAC

CONCEPTUAL SITE MODEL
OU3 BUILDINGS 106 AND 780 PLUME
NAS JACKSONVILLE
JACKSONVILLE, FLORIDA

CONTRACT NUMBER	CTO NUMBER
2106	0154
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 3	REV 0

FILE	DATE	PROJECT MANAGER	CHECKED BY	DRAFTER	PROJECT NUMBER
Building 780 Workplan.dwg	2/8/2016	BY	BY	KTS	2014.0033.NAVY



NOTE:
1) BASE MAP PROVIDED BY TETRA TECH.

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PRE-INJECTION STUDY
BUILDNG 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

FIGURE:
4

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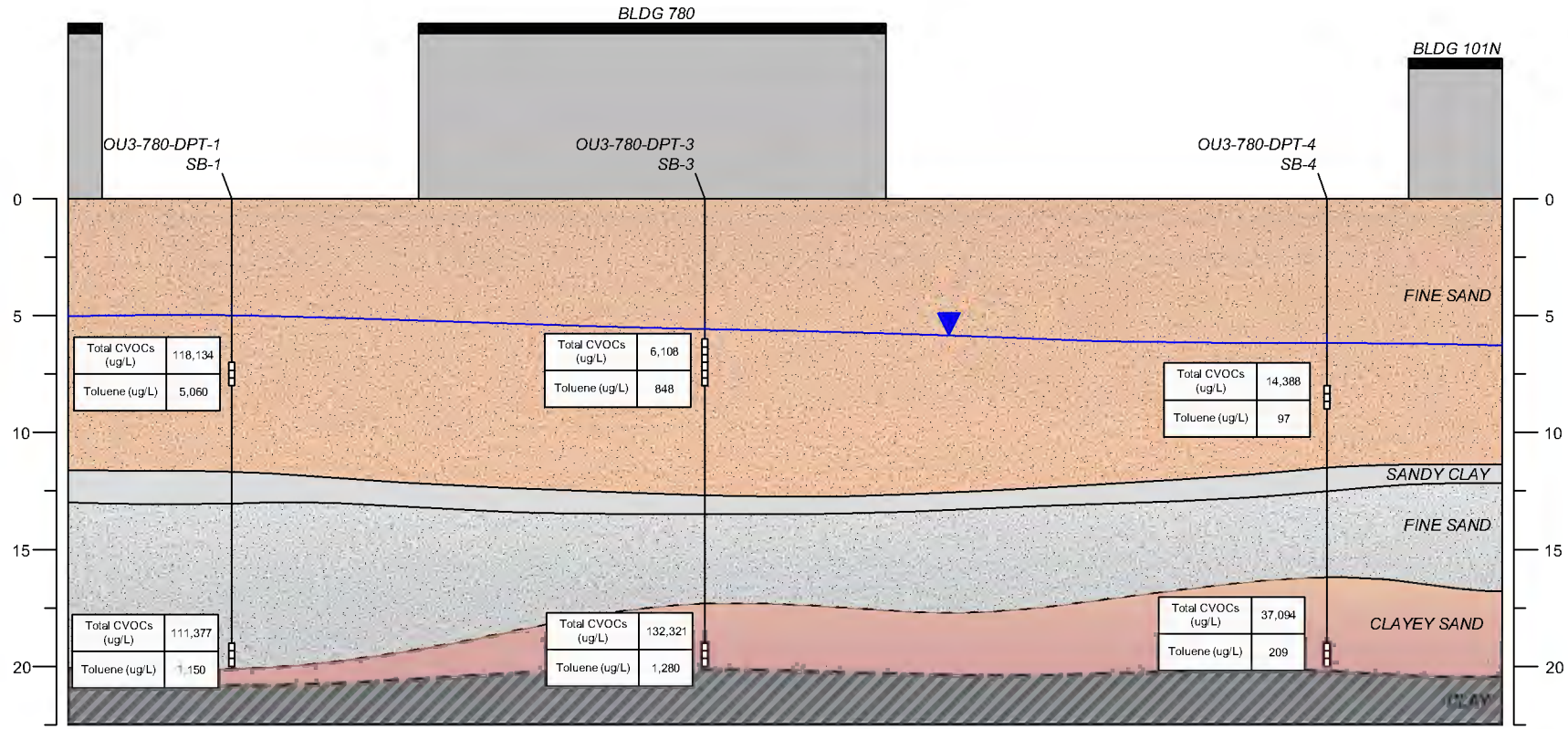

0 15 30

HORIZONTAL SCALE IN FEET

0 7.5 15

VERTICAL SCALE IN FEET

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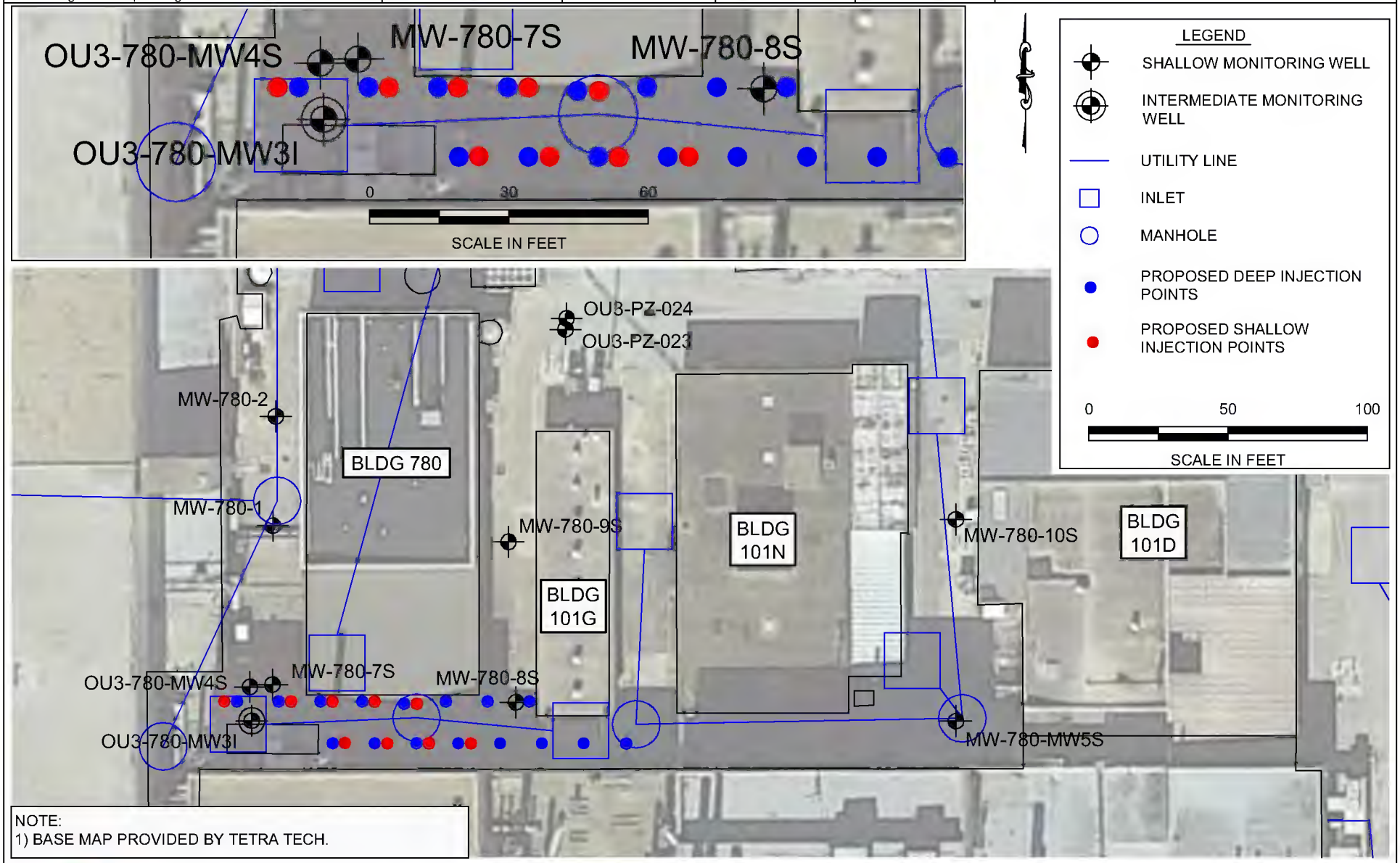
CROSS SECTION
BUILDNG 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

FIGURE:

5

FILE	DATE	PROJECT MANAGER	CHECKED BY	DRAFTER	PROJECT NUMBER
Building 780 Workplan.dwg	2/8/2016	BY	BY	KTS	2014.0033.NAVY



NOTE:
1) BASE MAP PROVIDED BY TETRA TECH.

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PROPOSED INJECTION LAYOUT
BUILDNG 780
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

FIGURE:
6

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TABLES

TABLE 1
SUMMARY OF GROUNDWATER ELEVATION DATA
OU-3 BUILDING 780 BIOREMEDIATION PILOT STUDY
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Well ID	Date	Well Depth (ft bgs)	Screened Interval (ft bgs)	Top of Casing Elevation (ft amsl)	Depth to Water (ft btoc)	Groundwater Elevation (ft amsl)
JAX-OU3-MW-101S-01	12/2/2015	20	10 - 20	10.18	6.15	4.03
JAX-OU3-MW-780-1	12/2/2015	19.2	9.2-19.2	NA	5.69	NA
JAX-OU3-MW-780-2	12/2/2015	19.9	9.9-19.9	NA	5.87	NA
JAX-OU3-780-MW4S	12/2/2015	20	10-20	NA	5.05	NA
JAX-OU3-780-MW5S	12/2/2015	19.4	9-19.4	NA	5.45	NA
JAX-OU3-780-MW7S	12/2/2015	10	5-10	NA	5.24	NA
JAX-OU3-780-MW8S	12/2/2015	20	10-20	NA	6.20	NA
JAX-OU3-780-MW9S	12/2/2015	20	10-20	NA	6.92	NA
JAX-OU3-780-MW10S	12/2/2015	20	10-20	NA	6.00	NA
JAX-OU3-780-PZ-024	12/2/2015	13.5	3.5-13.5	9.04	6.27	3.91
JAX-OU3-780-MW3I	12/2/2015	34	29-34	NA	3.22	NA
JAX-OU3-780-MW6I	12/2/2015	24.2	19-24.2	NA	6.80	NA

Notes:
ft bgs = feet below ground surface
ft amsl = feet above mean sea level (NAVD 1988)
ft btoc = feet below top of casing
NA= Not Available

TABLE 2
SUMMARY OF GROUNDWATER VOC RESULTS
OU-3 BUILDING 780 BIOREMEDIATION PILOT STUDY
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Well ID	Project Task	Sample Date	Depth (ft bgs)	VOCs by 8260B (µg/L)										
				Chloroethane	1,1-DCA	1,1-DCE	1,2-DCA	cDCE	1,2-DCE (total)	1,1,1-TCA	PCE	Toluene	TCE	Vinyl Chloride
			FDEP GCTL	12	70	7	3	70	170[1]	200	3	40	3	1
DPT Points														
JAX -OU3-780-DPT-1	Pre-Injection	10/9/2015	7-8	**4,930**	**14,200**	**12,200**	<40	**11,500**	**11,500**	**56,400**	**5,010**	**5,060**	**1,670**	**724**
		10/9/2015	17-18	**500**	**9,540**	**37,100**	**1230**	**26,400**	**26,400**	**181 I**	**897**	**1,150**	**150 I**	**9,310**
JAX- OU3-780-DPT-3		11/17/2015	8-10	**1,260**	**185**	**600**	**26.5**	**539**	**547**	<6.4	<8.1	**848**	<5.4	**2,950**
		10/9/2015	17-18	<100	**7,990**	**43,900**	**2460**	**34,100**	**34,200**	**201**	**173 I**	**1,280**	<65	**9,470**
JAX-OU3-780-DPT-4		10/9/2015	8-9	<25	**392**	**4,010**	**93.7**	**8,420**	**8,452** [2]	<13	**412**	**97**	<16	**1,060**
		10/9/2015	17-18	<100	**1,400**	**5,170**	**373**	**28,000**	**28,047** [2]	<51	**471**	**209**	<65	**1,680**
JAX-OU3-780-DPT-5		10/9/2015	9-10	**44**	**150**	**793**	**20.8**	**936**	**943**	<1.3	<1.6	<2.0	**259**	**255**
		10/9/2015	18-19	<10	**17 I**	**104**	**36**	**251**	**251**	<5.1	**1,460**	<8.0	**7.3 I**	**14.8 I**
JAX-OU3-780-DPT-6		10/9/2015	19-20	<5.0	<2.0	**73**	**4.9 I**	**177**	**201**	<2.6	**560**	<4.0	<3.3	<2.5
JAX-OU3-780-DPT-7		11/18/2015	8-10	<0.50	**0.41 I**	<0.27	<0.20	<0.22	<0.43	<0.26	<0.33	<0.40	<0.22	<0.25
		11/18/2015	17-20	<13	<5.0	**12.6 I**	<5.0	**1,600**	**1,710**	<6.4	<8.1	<10	**1,220**	**266**
JAX-OU3-780-DPT-8		11/17/2015	8-10	**0.65 I**	**2.0**	**0.84 I**	<0.20	**72.8**	**80.2**	<0.26	<0.33	<0.40	<0.22	**34.0**
		11/17/2015	17-20	<130	<50	<68	<50	**1,500**	**1,500**	<64	<81	<100	**17,700**	**253**
JAX-OU3-780-DPT-9		11/17/2015	8-10	<0.50	**0.42 I**	<0.27	<0.20	**1.0**	**1.7 I**	<0.26	<0.33	<0.40	<0.22	**0.87 I**
		11/17/2015	17-20	<50	<20	**35.5 I**	<20	**4,990**	**5,290**	<26	<33	<40	**9,930**	**243**
JAX-OU3-780-DPT-10		11/18/2015	8-10	<0.50	**0.53 I**	<0.27	<0.20	**0.26 I**	**0.51 I**	<0.26	<0.33	<0.40	<0.22	**0.35 I**
		11/18/2015	17-20	<5.0	<2.0	**20.3**	<2.0	**3,440**	**3,620**	<2.6	<3.3	<4.0	**2,040**	**221**
JAX-OU3-780-DPT-11		11/18/2015	8-10	<0.50	**0.38 I**	<0.27	<0.20	**0.36 I**	**0.60 I**	<0.26	<0.33	<0.40	**0.47 I**	**0.27 I**
		11/18/2015	17-20	<25	<10	**21.6 I**	<10	**3,350**	**3,710**	<13	<16	<20	**2,530**	**250**
Permenant Monitoring Wells														
JAX-OU3-MW-780-1	Baseline	12/1/2015	9.2-19.2	**53.0**	**246**	**33.3**	**3.4**	**274**	**274**	<0.64	<0.81	<1.0	**3.2**	**99.0**
JAX-OU3-780-MW4S	Pre-Injection	10/9/2015	10-20	**951**	**4,620**	**6,360**	**16.4 I**	**2,600**	**2,600**	**6,180**	**1,740**	**4,010**	**260**	**478**
	Baseline	12/2/2015	10-20	**1,720**	**8,960**	**11,400**	**63.8 I**	**7,030**	**7,060**	**17,000**	**449**	**3,320**	**2,220**	**1,260**
			Dup	**1,680**	**8,870**	**10,300**	**52.5 I**	**7,050**	**7,080**	**13,600**	**468**	**3,360**	**2,270**	**1,220**
JAX-OU3-780-MW5S	Baseline	12/2/2015	9-19.4	<0.50	<0.20	<0.27	<0.20	<0.22	<0.43	<0.26	<0.33	<0.40	<0.22	<0.25
JAX-OU3-780-MW7S		12/2/2015	5-10	**3,670**	**10,500**	**7,020**	<20	**8,070**	**8,070**	**39,300**	**349**	**5,970**	**3,430**	**426**
JAX-OU3-780-MW8S		12/2/2015	10-20	<250	**2,980**	**23,700**	**412 I**	**47,100**	**47,100**	<130	<160	**595**	**849**	**8,220**
JAX-OU3-780-MW9S		12/2/2015	10-20	<25	**54.9**	**372**	**37.7 I**	**401**	**401**	<13	**35.6 I**	<20	**2,690**	**63.0**
JAX-OU3-780-MW10S		12/2/2015	10-20	<13	<5.0	**22.7 I**	<5.0	**2,580**	**2,830**	<6.4	<8.1	<10	**1,260**	**317**
JAX-OU3-780-PZ-024		12/2/2015	3.5-13.5	<0.50	<0.20	<0.27	<0.20	**2.4**	**2.4**	<0.26	<0.33	<0.40	<0.22	**0.41 I**

Notes:
ft bgs = feet below ground surface
µg/L = milligrams per liter
FDEP GCTL = Florida Department of Environmental Protection Groundwater Cleanup Target Level
1. Sum of *cis*-1,2-DCE (70 µg/L) and *trans*-1,2-DCE GCTLs (100 µg/L).
Bold results indicate a reported concentration above the laboratory detection limit.
Shaded cells indicate a reported concentration above the FDEP GCTL.
I = Analyte was detected at an estimated concentration
2. 1,2-DCE (total) was calculated using estimated Trans-1,2-DCE results. Lab Report of Analysis did not include estimated value when calculating 1,2-DCE total.

TABLE 3
SUMMARY OF FIELD AND NATURAL ATTENUATION PARAMETERS
OU-3 BUILDING 780 BIOREMEDIATION PILOT STUDY
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Well ID	Sample Date	FIELD PARAMETERS						Field Analysis*				LABORATORY NATURAL ATTENUATION PARAMETERS					
		pH (SU)	Temperature (°C)	Conductivity (mS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Oxidation - Reduction Potential (mV)	Ferrous Fe+ (mg/L)	Alkalinity (mg/L)	DO (mg/L)	Sulfide (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	Total Organic Carbon (mg/L)	Methane (µg/L)	Ethane (µg/L)	Ethene (µg/L)
JAX-OU3-MW-780-1	12/1/2015	6.80	27.19	655	0.26	2.0	-132	5	275	0.2	0	31.1	28.2	8.5	1,460	28.0	8.8
JAX-OU3-780-MW4S	12/2/2015	4.20	25.11	732	0.42	5.7	-69.2	>20	0	0.5	1.5	112	6.5	66.0	3,690	110	202
JAX-OU3-780-MW5S	12/2/2015	7.07	24.57	541	0.45	14.2	-127.2	5	80	0.5	0	18.6	138	1.8	132	0.75 I	<0.43
JAX-OU3-780-MW7S	12/2/2015	5.50	24.80	491	0.45	8.3	-193.4	15	100	0.4	1.5	65.1	6.6	66.5	5,250	43.2	35.1
JAX-OU3-780-MW8S	12/2/2015	6.02	25.48	994	0.32	15.8	-53.6	>20	140	0.4	0	210	22.2	6.5	664	74.4	631
JAX-OU3-780-MW9S	12/2/2015	6.07	26.49	807	0.36	10.7	-55.3	>20	100	0.4	0	189	21.6	2.5	912	2.3	6.0
JAX-OU3-780-MW10S	12/2/2015	5.74	25.75	1,114	0.24	7.0	-12.7	10	100	0.3	1	266	23.5	5.3	1,270	35.2	6.2
JAX-OU3-780-PZ-024	12/2/2015	6.50	26.81	472	0.27	10.9	-89.4	16	70	0.3	0	63.1	0.64 I	2.4	1,940	5.0	<0.43

Notes:
SU - Standard units
°C - Degrees Celsius
mS/cm - MicroSiemens per centimeter
mg/L - Milligrams per liter
µg/L - Micrograms per liter
NTU - Nephelometric turbidity units
mV - Millivolts
* Readings from Chemetrics Kits

TABLE 4
SUMMARY OF MBT DATA
OU-3 BUILDING 780 BIOREMEDIATION PILOT STUDY
NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Well ID	Sample Date	MBT by CENSUS (cells/mL)					
		DHC	TCE Reductase	BVC Reductase	VC Reductase	DHBt	EBAC
JAX-OU3-780-1	12/1/2015	**5.48E+03**	**3.45E+02**	**1.83E+03**	**3.39E+01**	**2.00E-01 J**	**1.24E+05**
JAX-OU3-780-MW-4S	12/2/2015	**4.00E+04**	**2.09E+03**	**4.86E+03**	**7.17E+01**	**2.35E+03**	**1.87E+05**
JAX-OU3-780-MW-5S	12/2/2015	**3.82E+01**	**1.40E+00**	**5.60E+00**	**3.00E-01 J**	**1.48E+01**	**3.25E+05**
JAX-OU3-780-MW-7S	12/2/2015	**9.86E+03**	**6.18E+02**	**3.27E+03**	**4.84E+01**	**4.31E+03**	**9.14E+04**
JAX-OU3-780-MW-8S	12/2/2015	**1.16E+02**	**1.10E+00**	**2.50E+01**	**1.10E+00**	**4.80E+00 J**	**2.10E+04**
JAX-OU3-780-MW-9S	12/2/2015	**3.26E+02**	<5.00E-01	**3.84E+01**	**1.00E+00**	**2.37E+02**	**5.63E+04**
JAX-OU3-780-MW-10S	12/2/2015	**6.42E+01**	**3.00E-01 J**	**3.00E-01 J**	<5.00E-01	**1.67E+03**	**3.35E+05**
JAX-OU3-780-PZ-024	12/2/2015	**2.50E+02**	**3.00E-01 J**	**4.80E+00**	**1.60E+00**	**3.40E+00 J**	**1.37E+05**

Notes:
cells/mL = cells per milliliter
J = Estimated gene copies below PQL but above LQL
Bold results indicate a reported concentration above the laboratory detection limit.

APPENDIX A

WELL CONSTRUCTION DETAILS

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-7S

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/19/2015 / DATE FINISHED: 11/19/2015
DRILLING METHOD: Direct Push / BOREHOLE DIAMETER: 3.25"	TOTAL DEPTH (ft bgs): 10 ft bgs / SCREEN INTERVAL (ft bgs): 5-10 ft bgs
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA / EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA / FINAL DTW: NA
LOGGED BY: Samuel McIntyre / CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID		Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0	No Samples Collected.		NA	PID Readings Not Collected.	Concrete.
1					
2					
3					
4					
5					No material description available.
6					
7					
8					
9					
10					

End of Boring

Traffic rated vault (flush mount completion) with 1" locking well cap.

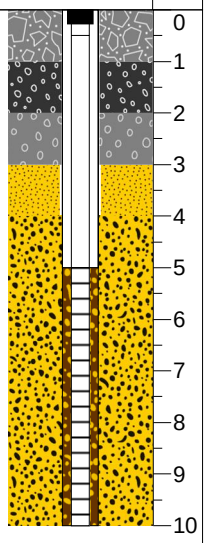
Neat cement grout, 1" diameter schedule 40 PVC casing.

Granular bentonite seal.

30-65 filter sand pack.

20-30 filter sand pack.

1" diameter, 0.010" slot, schedule 40 prepacked PVC screen.



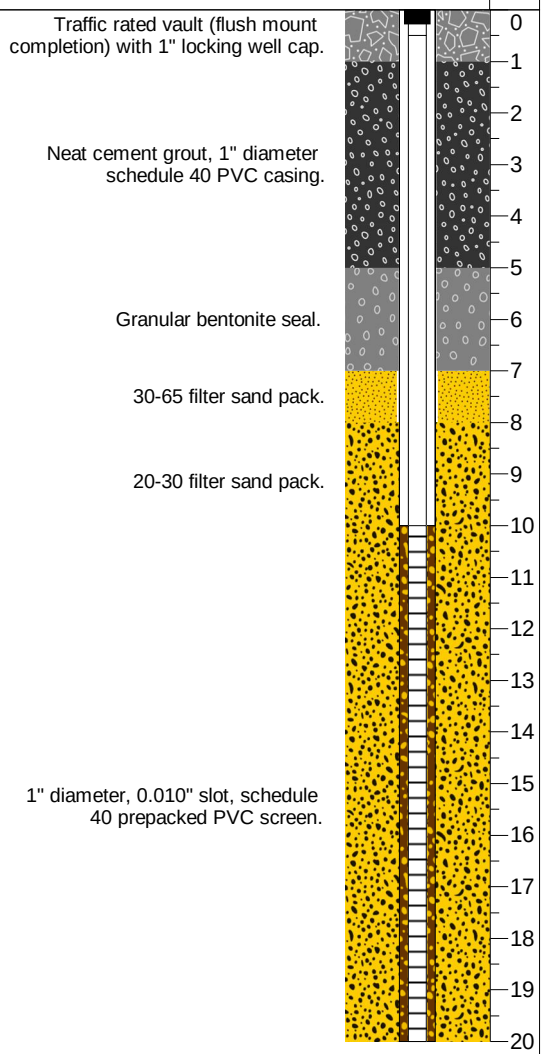
Notes: 1) NA - Not available

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-8S

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/19/2015 — DATE FINISHED: 11/19/2015
DRILLING METHOD: Direct Push — BOREHOLE DIAMETER: 3.25"	TOTAL DEPTH (ft bgs): 20 ft bgs — SCREEN INTERVAL (ft bgs): 10-20 ft bgs
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA — EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA — FINAL DTW: NA
LOGGED BY: Samuel McIntyre — CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID		Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0	No Samples Collected.		NA	PID Readings Not Collected.	Concrete.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					No material description available.
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					End of Boring
22					
23					
24					
25					



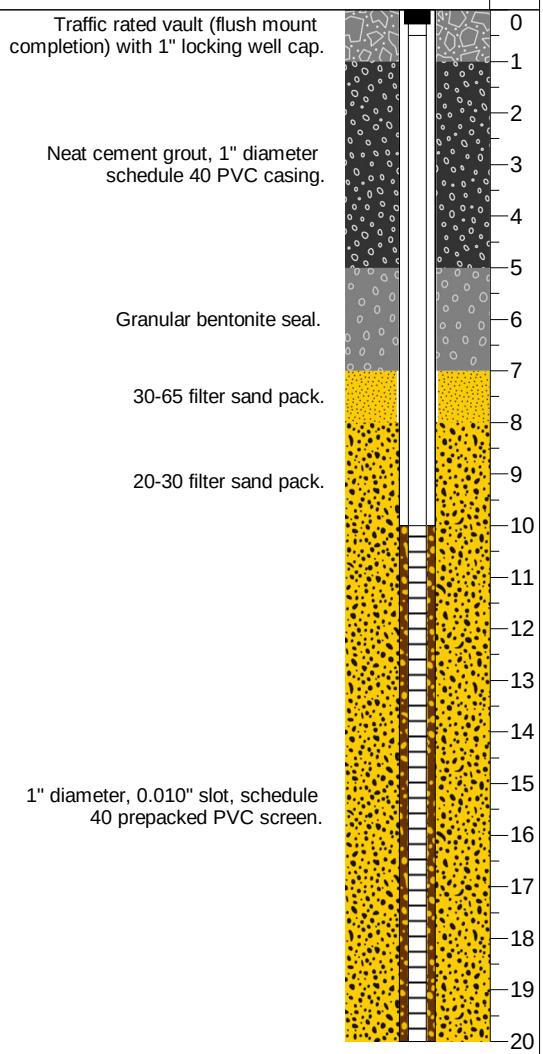
Notes: 1) NA - Not available

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-9S

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/19/2015 — DATE FINISHED: 11/19/2015
DRILLING METHOD: Direct Push — BOREHOLE DIAMETER: 3.25"	TOTAL DEPTH (ft bgs): 20 ft bgs — SCREEN INTERVAL (ft bgs): 10-20 ft bgs
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA — EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA — FINAL DTW: NA
LOGGED BY: Samuel McIntyre — CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID		Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0	No Samples Collected.		NA	PID Readings Not Collected.	Concrete.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					No material description available.
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					End of Boring
22					
23					
24					
25					



Notes: 1) NA - Not available

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-10S

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/19/2015 — DATE FINISHED: 11/19/2015
DRILLING METHOD: Direct Push — BOREHOLE DIAMETER: 3.25"	TOTAL DEPTH (ft bgs): 20 ft bgs — SCREEN INTERVAL (ft bgs): 10-20 ft bgs
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA — EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA — FINAL DTW: NA
LOGGED BY: Samuel McIntyre — CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID		Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0	No Samples Collected.		NA	PID Readings Not Collected.	Concrete.
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					No material description available.
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					End of Boring
22					
23					
24					
25					

Traffic rated vault (flush mount completion) with 1" locking well cap.

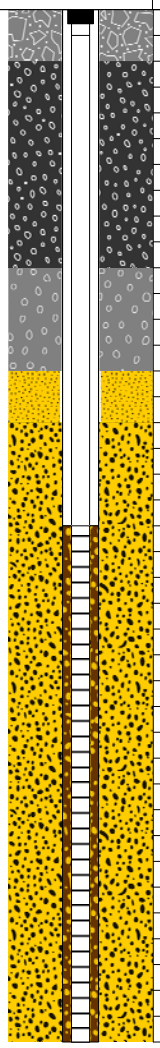
Neat cement grout, 1" diameter schedule 40 PVC casing.

Granular bentonite seal.

30-65 filter sand pack.

20-30 filter sand pack.

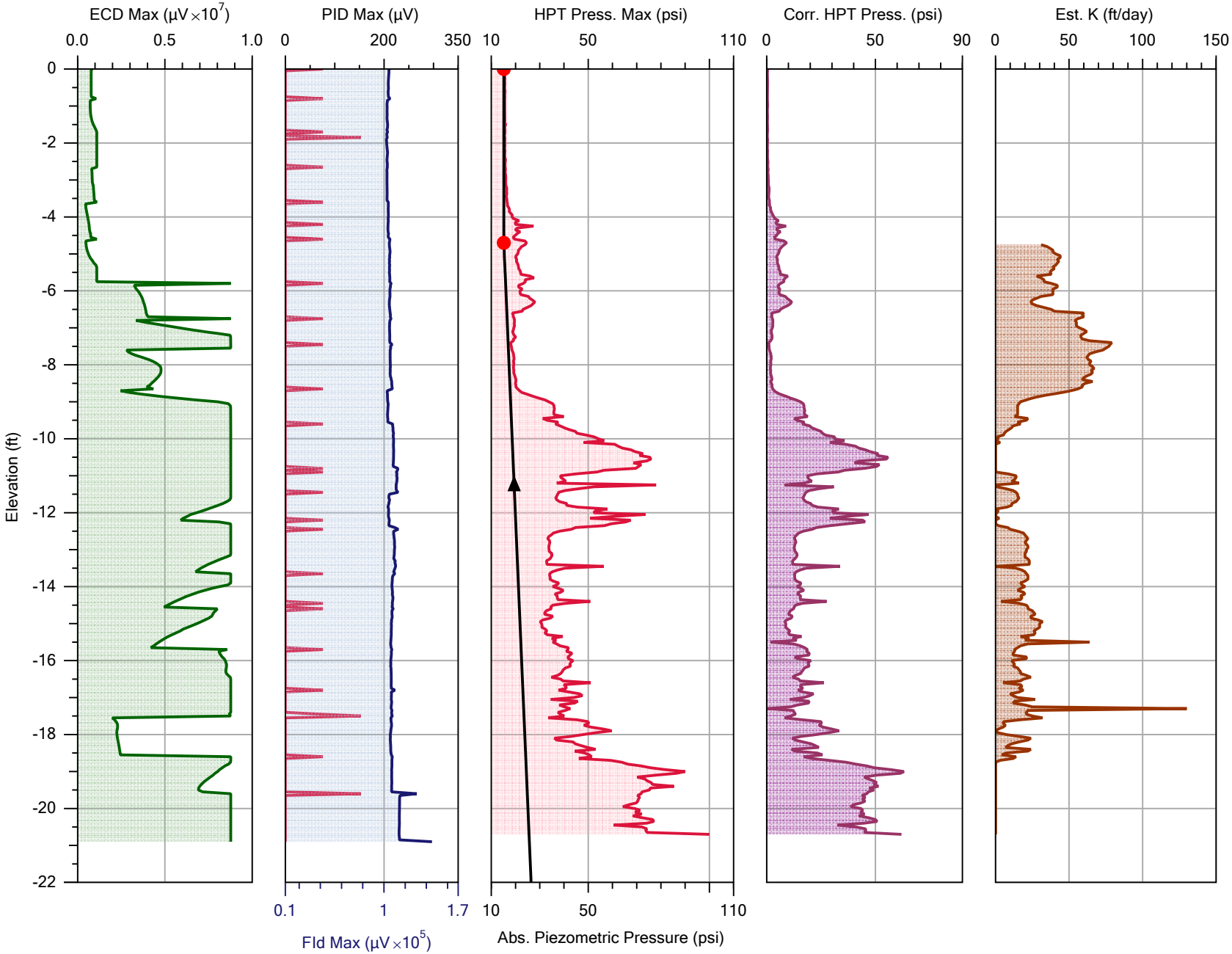
1" diameter, 0.010" slot, schedule 40 prepacked PVC screen.



Notes: 1) NA - Not available

APPENDIX B

MiHPT LOGS



Solutions-IES
Industrial & Environmental Services

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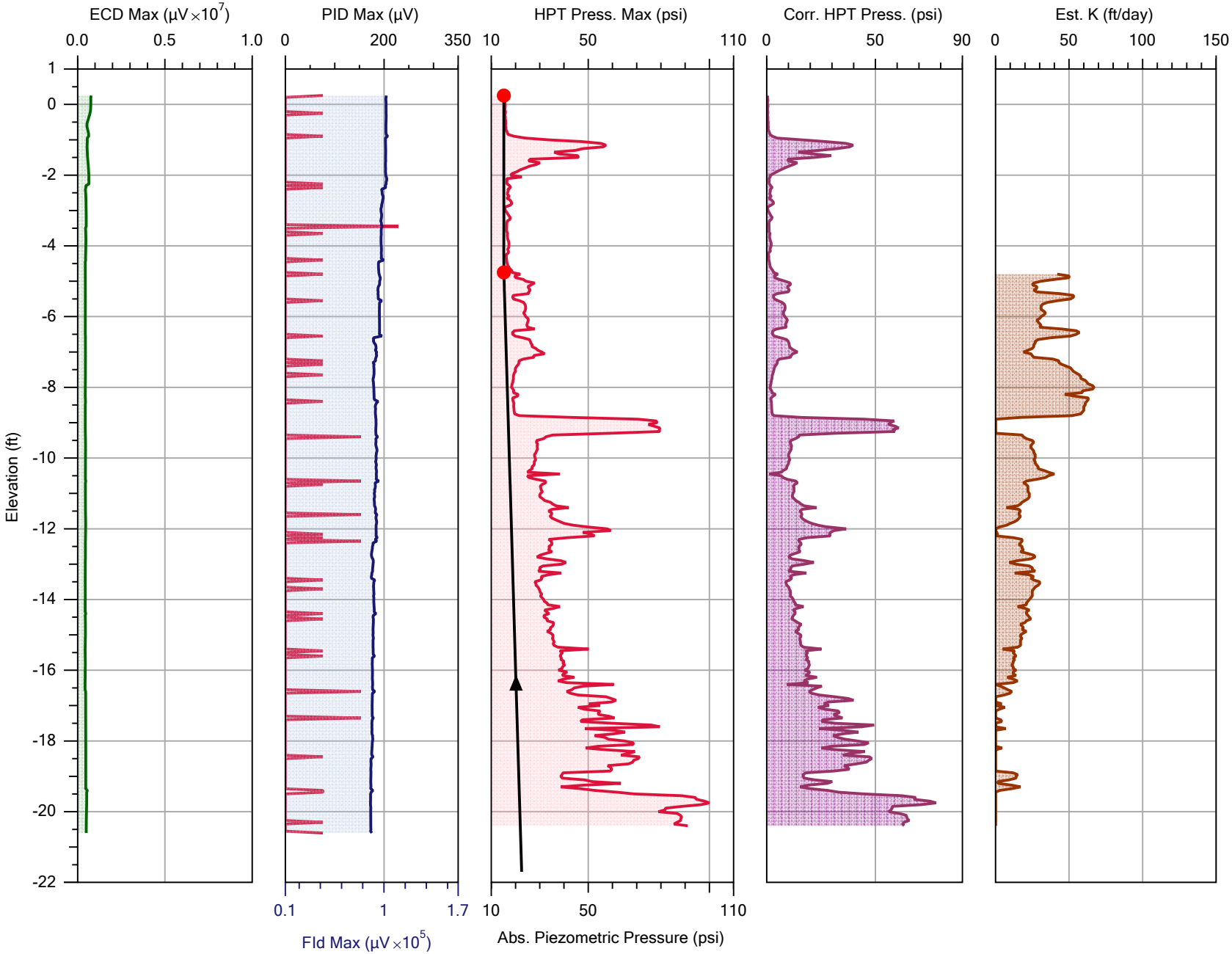
Project ID: NAS JAX Bldg 780	Client: NAVFAC SE	Location:



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Industrial & Environmental Services

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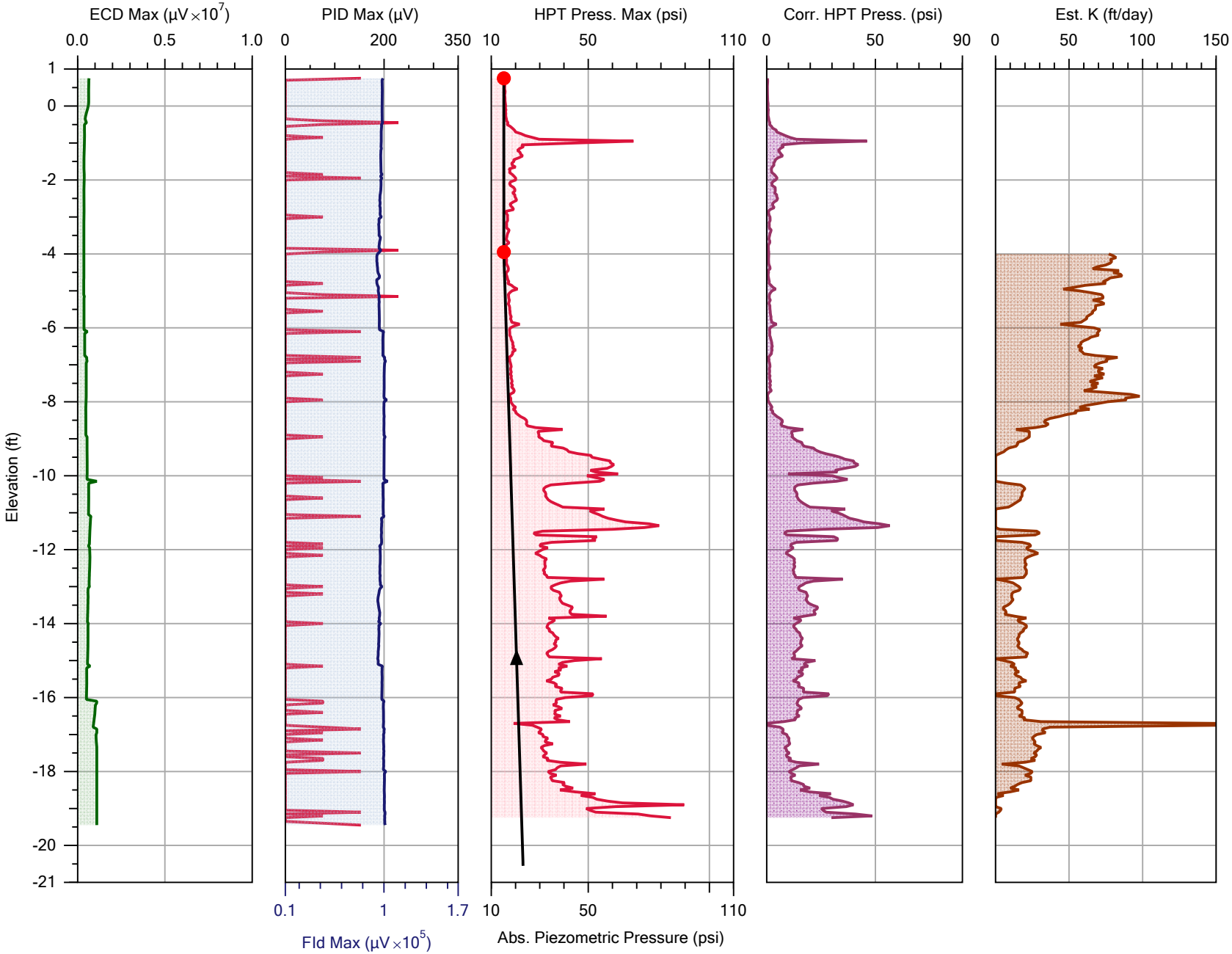

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Industrial & Environmental Services

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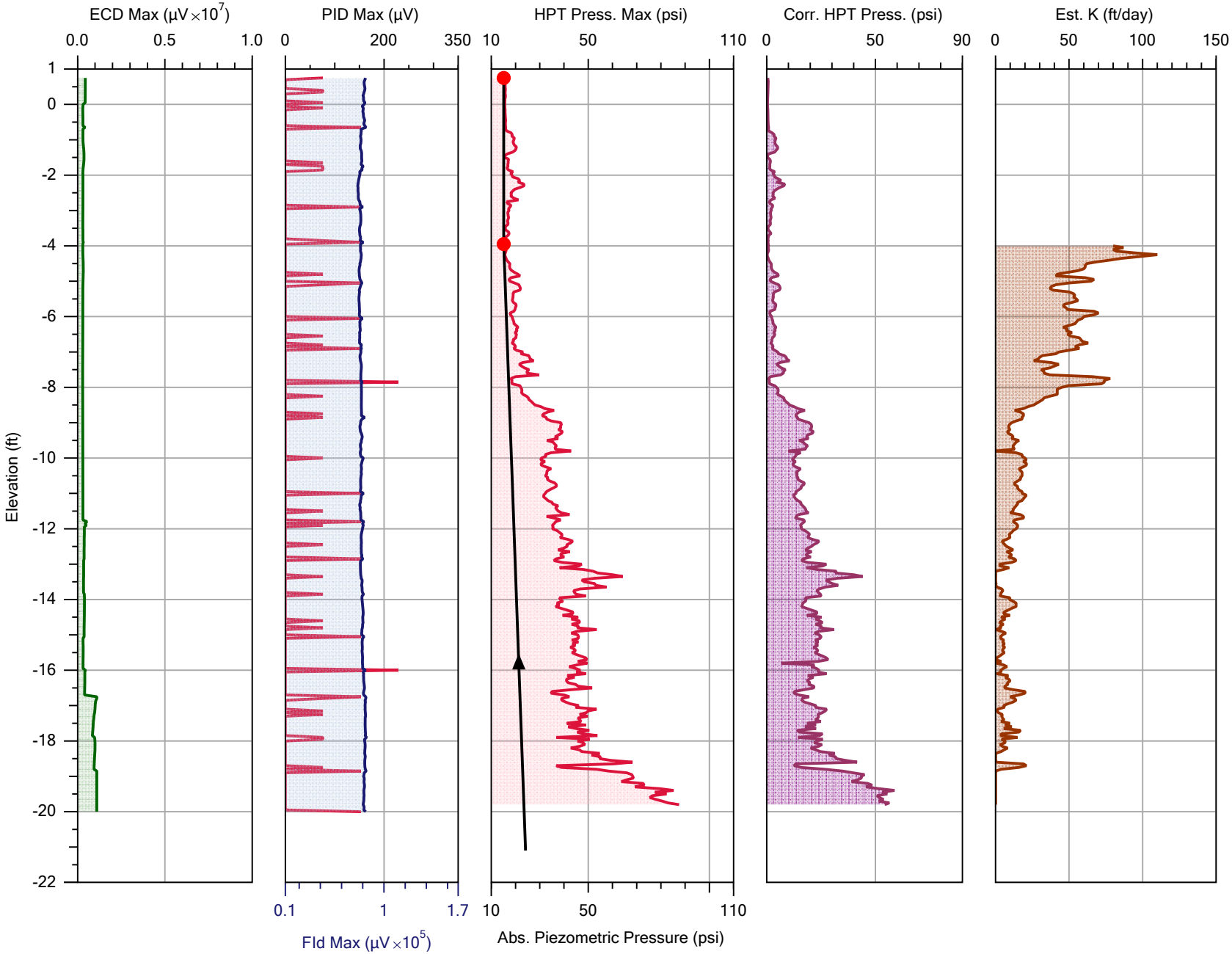
Project ID: NAS JAX Bldg 780	Client: NAVFAC SE	Location:



Solutions-IES
Industrial & Environmental Services

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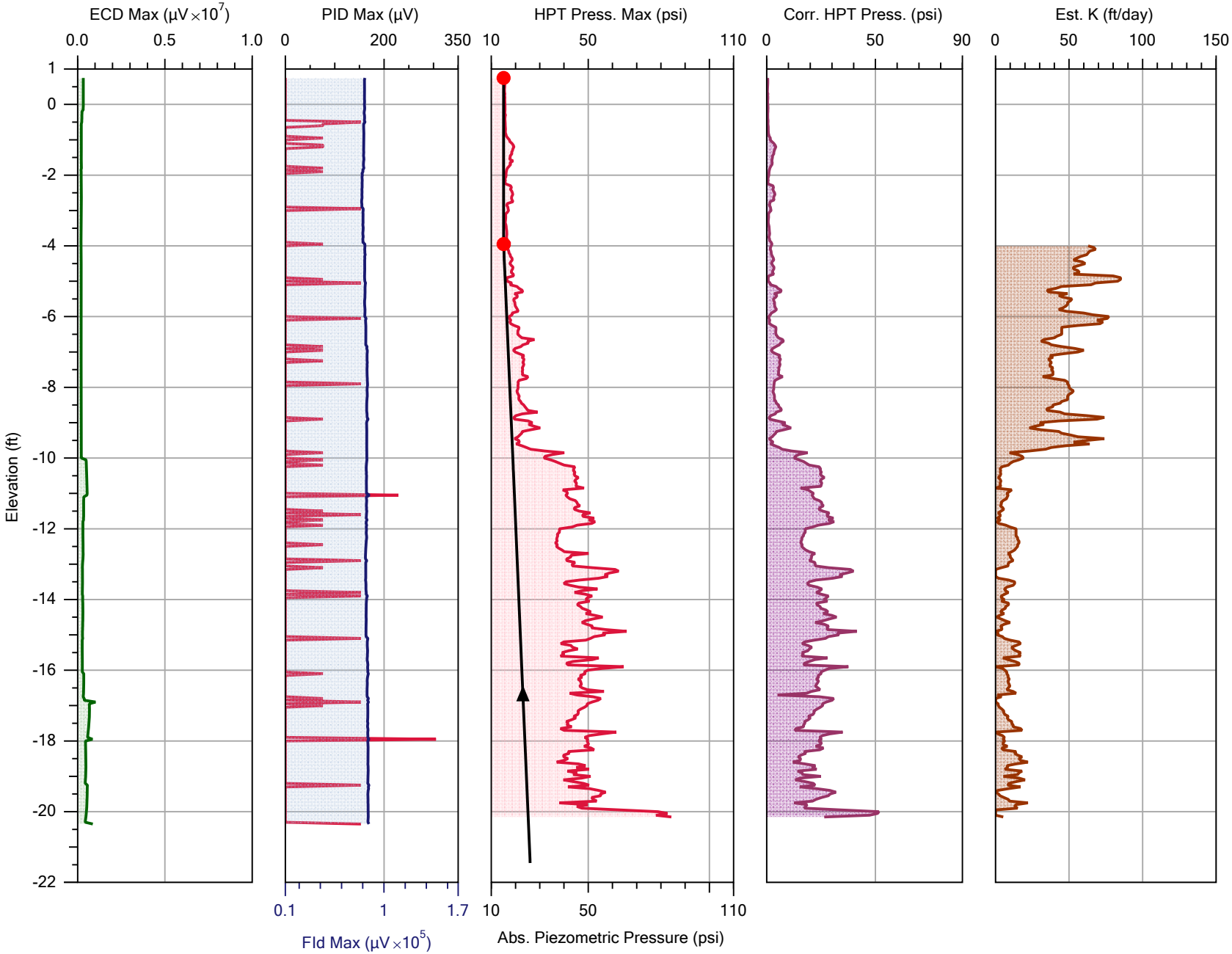

Solutions-IES
Industrial & Environmental Services

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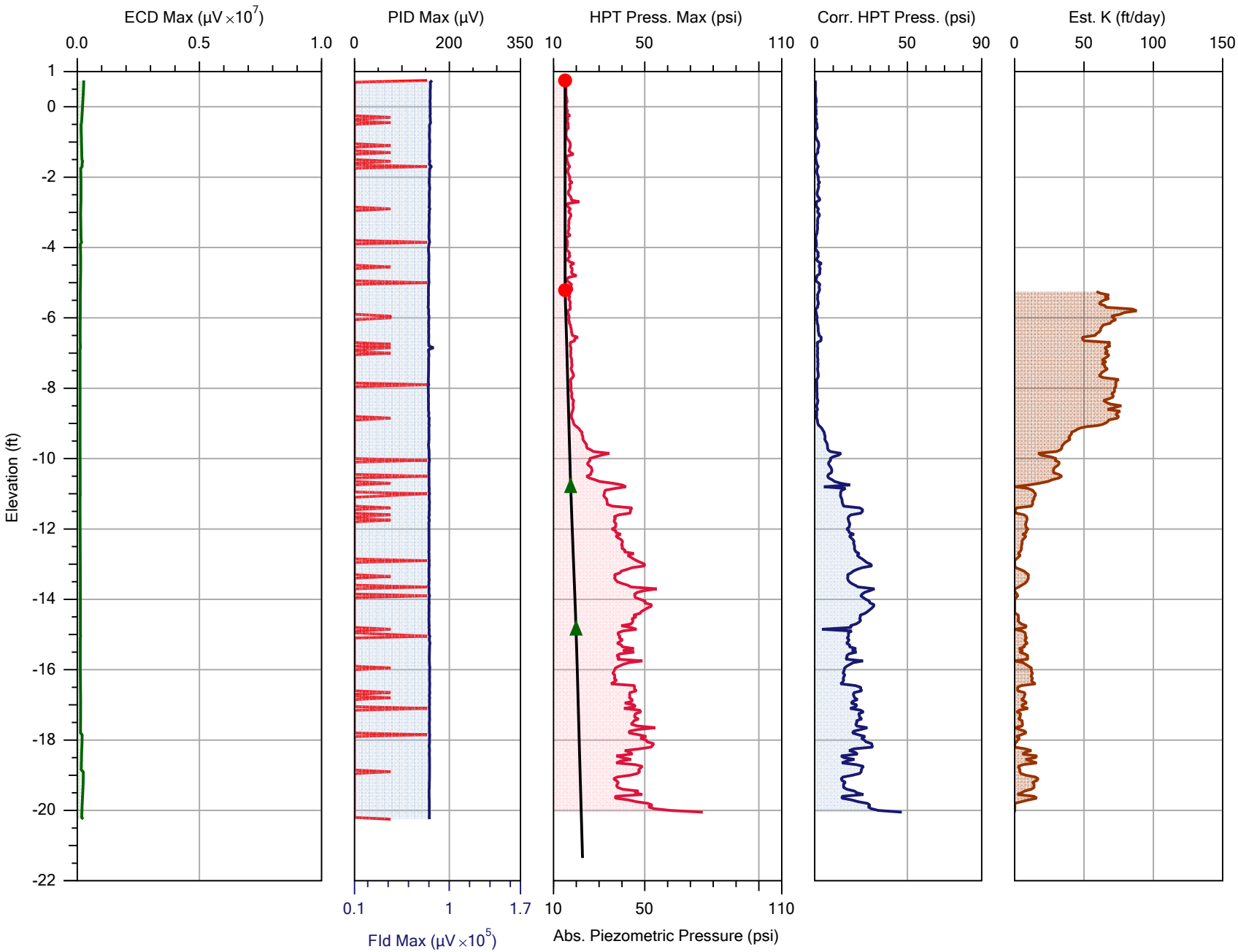
Company: Solutions-IES Inc.	Operator: Zebratech Services	Date: 10/8/2015
Project ID: NAS JAX Bldg 780	Client: NAVFAC SE	Location:



Solutions-IES
Industrial & Environmental Services

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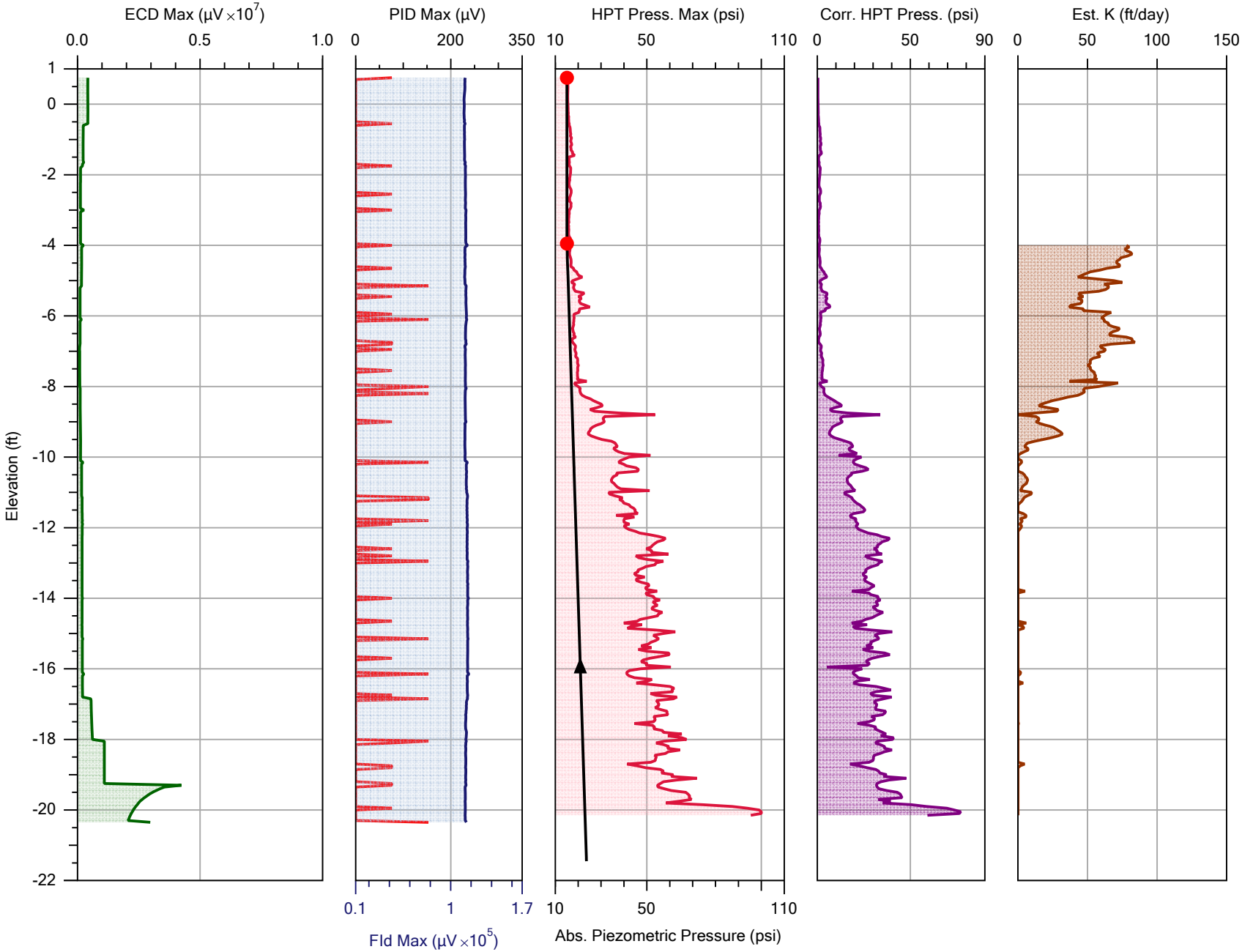

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Industrial & Environmental Services

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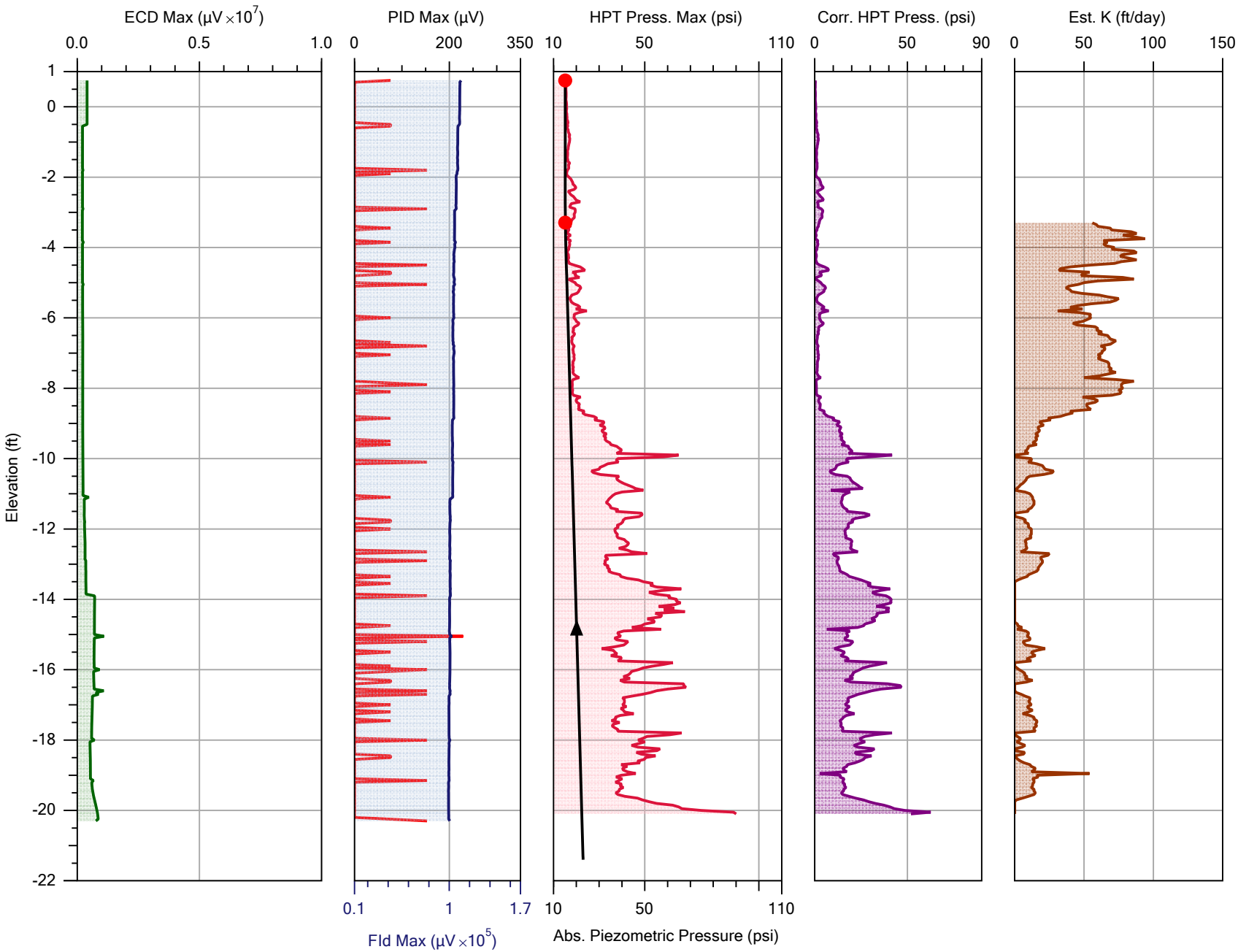
Company: Solutions-IES Inc.	Operator: Zebratech Services	Date: 10/9/2015
Project ID: NAS JAX Bldg 780	Client: NAVFAC SE	Location:



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Industrial & Environmental Services

		File: 780MIHPT8.MHP
Company: Solutions-IES Inc.	Operator: Zebratech Services	Date: 10/9/2015
Project ID: NAS JAX Bldg 780	Client: NAVFAC SE	Location:

APPENDIX C

SOIL BORING LOGS

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-DPT-1

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/17/2015 / DATE FINISHED: 11/17/2015
DRILLING METHOD: Direct Push / BOREHOLE DIAMETER: 2.25"	TOTAL DEPTH (ft bgs): 20 ft bgs / SCREEN INTERVAL (ft bgs): NA
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA / EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA / FINAL DTW: NA
LOGGED BY: Samuel McIntyre / CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID and Interval	SAMPLES: Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0				Concrete.
1–4		NA	PID Readings Not Collected.	Manually cleared with hand auger. Light brown and grey fine sand. Dry with strong odors.
5–6	5'-11'9"	90%		Dark brown fine sand with minor organics (roots). Strong odor, wet.
7–9				Light grey fine sand with strong odors throughout. Minor amounts of clay from 9-10 ft bgs. Damp.
10–11		93%		Light grey fine sand. Saturated, strong odors throughout.
12–13	11'9"-13'3"			Light grey clayey fine sand/fine sandy clay. Damp, strong odors throughout.
14–19	13'3"-19'6"	100%		Light grey fine sand. Damp. Saturated from approximately 15-16 ft bgs. Strong odors through 15 ft bgs.
20				Light grey to brown mottled fine sandy clay. Damp.

End of Boring

Notes: 1) NA - Not available 2) Soil sample ID prefix "*OU3-780-DPT-1-SO-*" not shown for clarity.

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-DPT-3

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/18/2015 — DATE FINISHED: 11/18/2015
DRILLING METHOD: Direct Push — BOREHOLE DIAMETER: 2.25"	TOTAL DEPTH (ft bgs): 25 ft bgs — SCREEN INTERVAL (ft bgs): NA
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA — EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA — FINAL DTW: NA
LOGGED BY: Samuel McIntyre — CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID and Interval	SAMPLES: Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0			PID Readings Not Collected.	Concrete.
1–4		NA		Manually cleared with hand auger. Light brown fine sand. Dry. No obvious odors.
5–7		60%		No recovery 5-7 ft bgs.
7–11	7'-11'3"	60%		Dark black fine sand. Saturated with sheen on standing water in core. Strong odors.
11–12	11'3" -12'10"	100%		Same as above, light grey.
12–13	12'10" -13'10"	100%		Light grey clayey fine sand/fine sandy clay. Wet with strong odors.
13–15	13'10" -15'8"	100%		Light grey fine sand. Saturated with mild odor.
15–19	15'8"-19'9"	100%		Light grey clayey fine sand. Saturated, no obvious odor.
19–20				Light grey and tan mottled fine sandy clay. Damp.

End of Boring

Notes: 1) NA - Not available 2) Sample ID prefix "*OU3-780-DPT-3-SO-*" not shown for clarity.

Solutions-IES
Industrial & Environmental Services

Log of Boring OU3-780-DPT-4

BORING LOCATION: NAS Jacksonville, Jacksonville, Florida	PROJECT NUMBER: 2014.0033.NAVY
DRILLING CONTRACTOR: Zebra Environmental Services	DATE STARTED: 11/18/2015 — DATE FINISHED: 11/18/2015
DRILLING METHOD: Direct Push — BOREHOLE DIAMETER: 2.25"	TOTAL DEPTH (ft bgs): 25 ft bgs — SCREEN INTERVAL (ft bgs): NA
DRILLING EQUIPMENT: Geoprobe 7720	NORTHING: NA — EASTING: NA
SAMPLING METHOD: Macro Core	INITIAL DTW: NA — FINAL DTW: NA
LOGGED BY: Samuel McIntyre — CHECKED BY:	

DEPTH (ft bgs)	SAMPLES: Sample ID and Interval	SAMPLES: Recovery	PID (ppm)	DESCRIPTION OF MATERIALS
0				Concrete.
1–5		NA	PID Readings Not Collected.	Manually cleared with hand auger. Light brown fine sand. Dry. No obvious odors.
5–8		46%		No recovery 5-7 ft 8 in bgs.
8				Light brown fine sand. Dry. No obvious odor, possible sluff from manual clearing.
8–12	8'8"-10'; 10'-11'7"; 11'7"-12'3"			Dark grey to black fine sand with organics (roots). Strong odors, saturated. Low recovery possibly due to final material sliding out of core.
12		100%		Light grey and light brown mottled fine sandy clay/clayey fine sand. Damp with slight odor.
12–15	12'3"-15'			Light grey fine sand. Wet to saturated, slight odor.
15–17		60%		No recovery 15-17 ft bgs.
17–20	17'-20'			Light grey and tan mottled clayey fine sand/fine sandy clay from 17-20 ft bgs. Damp throughout, saturated from 15-16 ft bgs.

End of Boring

Notes: 1) NA - Not available 2) Sample ID prefix "*OU3-780-DPT-4-SO-*" not shown for clarity.

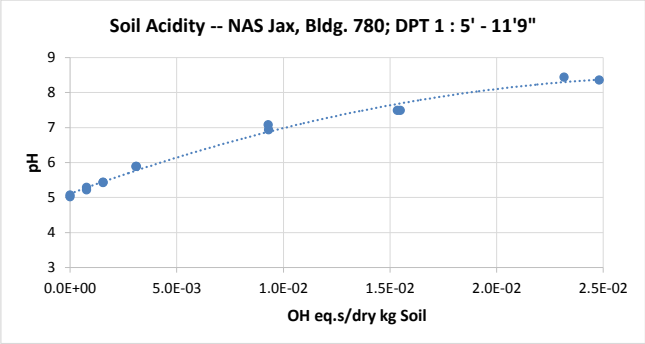
APPENDIX D

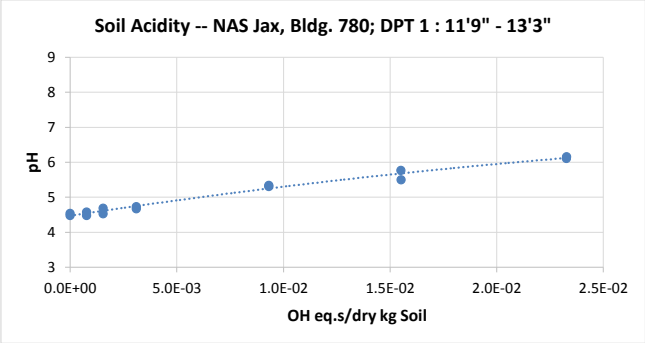
SOIL ACIDITY TITRATION RESULTS

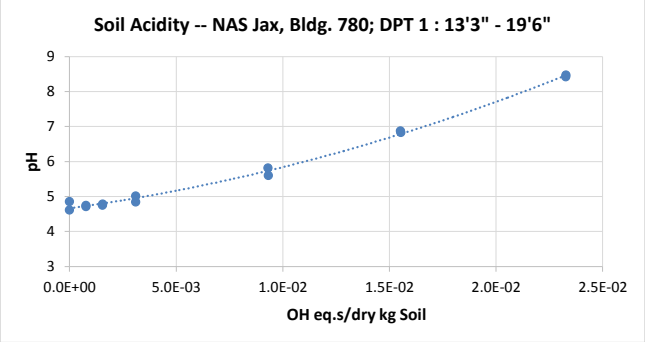
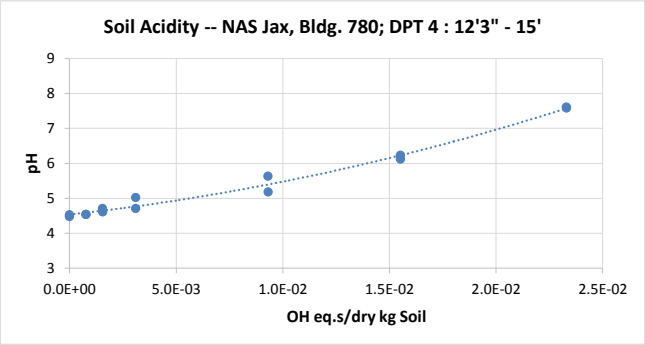
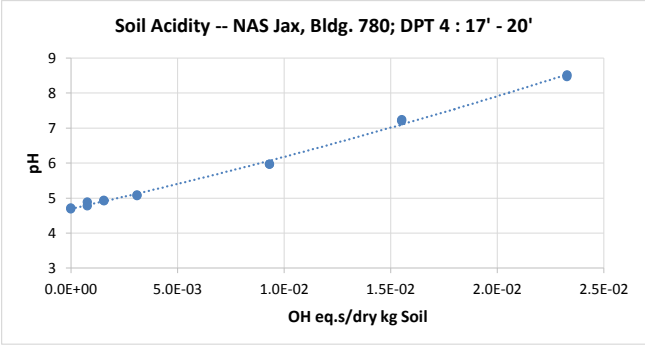
NAS Jax 1/29/2016
Bldg. 780
Soil acidity analysis

Measured **pH** 0.01N NaOH soln. = 11.89 therefore [NaOH] = 0.00776 eq/L = meq/mL
f.w. NaOH = 39.9971 g/mol 310.5 mg NaOH/L
f.w. OH = 17.007 g/mol

Vial (#)	Empty Mass (g)	Boring	Depth	Vial + Soil (g)	Soil (g)	DI Water (mL)	NaOH 0.01 N (mL)	Equi-valents Added	Equi-valents per dry kg	g NaOH /dry kg soil	pH after 3 days
1	6.6545	DPT 1 (SB-1)	5' - 11'9"	11.6851	5.0306	15.0	0.0	0.00E+00	0.00E+00	0.0000	5.07
2	6.6065	DPT 1 (SB-1)	5' - 11'9"	11.5968	4.9903	15.0	0.0	0.00E+00	0.00E+00	0.0000	5.02
3	6.6597	DPT 1 (SB-1)	5' - 11'9"	11.6867	5.0270	14.5	0.5	3.88E-06	7.72E-04	0.0309	5.29
4	6.5627	DPT 1 (SB-1)	5' - 11'9"	11.5638	5.0011	14.5	0.5	3.88E-06	7.76E-04	0.0310	5.22
5	6.6657	DPT 1 (SB-1)	5' - 11'9"	11.6771	5.0114	14.0	1.0	7.76E-06	1.55E-03	0.0620	5.43
6	6.6594	DPT 1 (SB-1)	5' - 11'9"	11.6754	5.0160	14.0	1.0	7.76E-06	1.55E-03	0.0619	5.44
7	6.6456	DPT 1 (SB-1)	5' - 11'9"	11.6691	5.0235	13.0	2.0	1.55E-05	3.09E-03	0.1236	5.89
8	6.6982	DPT 1 (SB-1)	5' - 11'9"	11.6823	4.9841	13.0	2.0	1.55E-05	3.11E-03	0.1246	5.89
9	6.5865	DPT 1 (SB-1)	5' - 11'9"	11.6009	5.0144	9.0	6.0	4.66E-05	9.29E-03	0.3715	7.08
10	6.5935	DPT 1 (SB-1)	5' - 11'9"	11.5963	5.0028	9.0	6.0	4.66E-05	9.31E-03	0.3724	6.94
11	6.5877	DPT 1 (SB-1)	5' - 11'9"	11.5988	5.0111	5.0	10.0	7.76E-05	1.55E-02	0.6196	7.49
12	6.5277	DPT 1 (SB-1)	5' - 11'9"	11.5835	5.0558	5.0	10.0	7.76E-05	1.54E-02	0.6141	7.49
13	6.9290	DPT 1 (SB-1)	5' - 11'9"	11.6211	4.6921	0.0	15.0	1.16E-04	2.48E-02	0.9926	8.36
14	6.6568	DPT 1 (SB-1)	5' - 11'9"	11.6836	5.0268	0.0	15.0	1.16E-04	2.32E-02	0.9265	8.44
15	6.5566	DPT 1 (SB-1)	11'9" - 13'3"	11.5759	5.0193	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.54
16	6.6800	DPT 1 (SB-1)	11'9" - 13'3"	11.6722	4.9922	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.48
17	6.6106	DPT 1 (SB-1)	11'9" - 13'3"	11.6236	5.0130	14.5	0.5	3.88E-06	7.74E-04	0.0310	4.48
18	6.6437	DPT 1 (SB-1)	11'9" - 13'3"	11.6708	5.0271	14.5	0.5	3.88E-06	7.72E-04	0.0309	4.58
19	6.6899	DPT 1 (SB-1)	11'9" - 13'3"	11.6974	5.0075	14.0	1.0	7.76E-06	1.55E-03	0.0620	4.53
20	6.5730	DPT 1 (SB-1)	11'9" - 13'3"	11.5767	5.0037	14.0	1.0	7.76E-06	1.55E-03	0.0620	4.69
21	6.6168	DPT 1 (SB-1)	11'9" - 13'3"	11.6177	5.0009	13.0	2.0	1.55E-05	3.10E-03	0.1242	4.73
22	6.5566	DPT 1 (SB-1)	11'9" - 13'3"	11.5584	5.0018	13.0	2.0	1.55E-05	3.10E-03	0.1241	4.67
23	6.5634	DPT 1 (SB-1)	11'9" - 13'3"	11.5632	4.9998	9.0	6.0	4.66E-05	9.32E-03	0.3726	5.31
24	6.6278	DPT 1 (SB-1)	11'9" - 13'3"	11.6248	4.9970	9.0	6.0	4.66E-05	9.32E-03	0.3728	5.34
25	6.6534	DPT 1 (SB-1)	11'9" - 13'3"	11.6544	5.0010	5.0	10.0	7.76E-05	1.55E-02	0.6208	5.50
26	6.6703	DPT 1 (SB-1)	11'9" - 13'3"	11.6732	5.0029	5.0	10.0	7.76E-05	1.55E-02	0.6206	5.77
27	6.5277	DPT 1 (SB-1)	11'9" - 13'3"	11.5287	5.0010	0.0	15.0	1.16E-04	2.33E-02	0.9312	6.16
28	6.5841	DPT 1 (SB-1)	11'9" - 13'3"	11.5862	5.0021	0.0	15.0	1.16E-04	2.33E-02	0.9310	6.11
29	6.5872	DPT 1 (SB-1)	13'3" - 19'6"	11.5892	5.0020	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.85
30	6.5319	DPT 1 (SB-1)	13'3" - 19'6"	11.5309	4.9990	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.61
31	6.6102	DPT 1 (SB-1)	13'3" - 19'6"	11.6139	5.0037	14.5	0.5	3.88E-06	7.76E-04	0.0310	4.71
32	6.6453	DPT 1 (SB-1)	13'3" - 19'6"	11.6405	4.9952	14.5	0.5	3.88E-06	7.77E-04	0.0311	4.74
33	6.6201	DPT 1 (SB-1)	13'3" - 19'6"	11.6217	5.0016	14.0	1.0	7.76E-06	1.55E-03	0.0621	4.75
34	6.5974	DPT 1 (SB-1)	13'3" - 19'6"	11.5979	5.0005	14.0	1.0	7.76E-06	1.55E-03	0.0621	4.78
35	6.6283	DPT 1 (SB-1)	13'3" - 19'6"	11.622	4.9937	13.0	2.0	1.55E-05	3.11E-03	0.1243	5.01
36	6.6437	DPT 1 (SB-1)	13'3" - 19'6"	11.6492	5.0055	13.0	2.0	1.55E-05	3.10E-03	0.1241	4.84
37	6.7005	DPT 1 (SB-1)	13'3" - 19'6"	11.704	5.0035	9.0	6.0	4.66E-05	9.31E-03	0.3723	5.81
38	6.6895	DPT 1 (SB-1)	13'3" - 19'6"	11.6838	4.9943	9.0	6.0	4.66E-05	9.33E-03	0.3730	5.6
39	6.6343	DPT 1 (SB-1)	13'3" - 19'6"	11.6344	5.0001	5.0	10.0	7.76E-05	1.55E-02	0.6209	6.87
40	6.5696	DPT 1 (SB-1)	13'3" - 19'6"	11.5659	4.9963	5.0	10.0	7.76E-05	1.55E-02	0.6214	6.83
41	6.6967	DPT 1 (SB-1)	13'3" - 19'6"	11.6976	5.0009	0.0	15.0	1.16E-04	2.33E-02	0.9313	8.47
42	6.6655	DPT 1 (SB-1)	13'3" - 19'6"	11.6679	5.0024	0.0	15.0	1.16E-04	2.33E-02	0.9310	8.42







43	6.5684	DPT 4 (SB-4)	12'3" - 15'	11.570	5.0014	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.48
44	6.6990	DPT 4 (SB-4)	12'3" - 15'	11.7009	5.0019	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.53
45	6.5802	DPT 4 (SB-4)	12'3" - 15'	11.5828	5.0026	14.5	0.5	3.88E-06	7.76E-04	0.0310	4.54
46	6.5878	DPT 4 (SB-4)	12'3" - 15'	11.5869	4.9991	14.5	0.5	3.88E-06	7.76E-04	0.0311	4.54
47	6.5173	DPT 4 (SB-4)	12'3" - 15'	11.5147	4.9974	14.0	1.0	7.76E-06	1.55E-03	0.0621	4.61
48	6.6307	DPT 4 (SB-4)	12'3" - 15'	11.638	5.0073	14.0	1.0	7.76E-06	1.55E-03	0.0620	4.71
49	6.7544	DPT 4 (SB-4)	12'3" - 15'	11.7558	5.0014	13.0	2.0	1.55E-05	3.10E-03	0.1242	4.71
50	6.6575	DPT 4 (SB-4)	12'3" - 15'	11.6521	4.9946	13.0	2.0	1.55E-05	3.11E-03	0.1243	5.02
51	6.6689	DPT 4 (SB-4)	12'3" - 15'	11.6678	4.9989	9.0	6.0	4.66E-05	9.32E-03	0.3727	5.18
52	6.6661	DPT 4 (SB-4)	12'3" - 15'	11.6673	5.0012	9.0	6.0	4.66E-05	9.31E-03	0.3725	5.63
53	6.6809	DPT 4 (SB-4)	12'3" - 15'	11.682	5.0011	5.0	10.0	7.76E-05	1.55E-02	0.6208	6.23
54	6.6276	DPT 4 (SB-4)	12'3" - 15'	11.630	5.0022	5.0	10.0	7.76E-05	1.55E-02	0.6207	6.12
55	6.6253	DPT 4 (SB-4)	12'3" - 15'	11.6231	4.9978	0.0	15.0	1.16E-04	2.33E-02	0.9318	7.61
56	6.6098	DPT 4 (SB-4)	12'3" - 15'	11.6038	4.9940	0.0	15.0	1.16E-04	2.33E-02	0.9325	7.58
57	6.6488	DPT 4 (SB-4)	17' - 20'	11.6462	4.9974	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.72
58	6.6002	DPT 4 (SB-4)	17' - 20'	11.6079	5.0077	15.0	0.0	0.00E+00	0.00E+00	0.0000	4.69
59	6.6048	DPT 4 (SB-4)	17' - 20'	11.6017	4.9969	14.5	0.5	3.88E-06	7.77E-04	0.0311	4.89
60	6.6392	DPT 4 (SB-4)	17' - 20'	11.6376	4.9984	14.5	0.5	3.88E-06	7.76E-04	0.0311	4.78
61	6.6065	DPT 4 (SB-4)	17' - 20'	11.6026	4.9961	14.0	1.0	7.76E-06	1.55E-03	0.0621	4.92
62	6.6522	DPT 4 (SB-4)	17' - 20'	11.6525	5.0003	14.0	1.0	7.76E-06	1.55E-03	0.0621	4.94
63	6.5195	DPT 4 (SB-4)	17' - 20'	11.5122	4.9927	13.0	2.0	1.55E-05	3.11E-03	0.1244	5.09
64	6.6586	DPT 4 (SB-4)	17' - 20'	11.6574	4.9988	13.0	2.0	1.55E-05	3.11E-03	0.1242	5.07
65	6.6580	DPT 4 (SB-4)	17' - 20'	11.6554	4.9974	9.0	6.0	4.66E-05	9.32E-03	0.3728	5.97
66	6.6675	DPT 4 (SB-4)	17' - 20'	11.6644	4.9969	9.0	6.0	4.66E-05	9.32E-03	0.3728	5.97
67	6.6702	DPT 4 (SB-4)	17' - 20'	11.6712	5.0010	5.0	10.0	7.76E-05	1.55E-02	0.6208	7.21
68	6.5840	DPT 4 (SB-4)	17' - 20'	11.584	5.0000	5.0	10.0	7.76E-05	1.55E-02	0.6210	7.24
69	6.6405	DPT 4 (SB-4)	17' - 20'	11.6413	5.0008	0.0	15	1.16E-04	2.33E-02	0.9313	8.52
70	6.5701	DPT 4 (SB-4)	17' - 20'	11.5737	5.0036	0.0	15	1.16E-04	2.33E-02	0.9308	8.47