REVISED INTERIM ACTION WORK PLAN

FORMER KOPPERS TAR PLANT
AND WABASH ALLOYS SITE
Oak Creek, WI
FID # 241379050
BRRTS # 02-41-553761
Connell VPLE BRRTS # 06-41-560058

CITY OF OAK CREEK UTILITY CORRIDOR LOT 1
FID # 341074470
BRRTS # 02-41-561425

Prepared for:

Beazer

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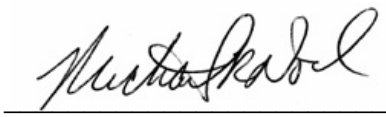
November 2021

CERTIFICATION

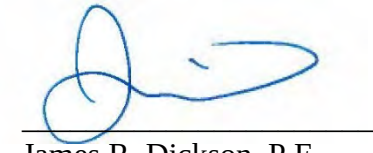
"I, Michael R. Noel, hereby certify that I am a scientist as that term is defined in s. NR 712.03 (3), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."



Michael R. Noel, P.G.
Vice President, Principal Hydrogeologist

November 19, 2021
Date

"I, James R. Dickson, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."



James R. Dickson, P.E.
Principal Engineer

November 19, 2021
Date

"I, Mark A. Manthey, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

Mark A. Manthey, P.G.
Senior Hydrogeologist

November 19, 2021
Date

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1.0 INTRODUCTION

1.1 Purpose

Beazer East, Inc. (Beazer) does not believe the former Koppers Tar Plant Site (Figure 1) located in Oak Creek, WI (Site) is eligible for interim action or immediate action under Wisconsin law and regulations. The Wisconsin Department of Natural Resources (DNR) feels differently and has ordered that Beazer prepare and deliver an interim action work plan for the Site. Beazer submits this document in response to DNR's order, and reserves all rights and defenses under applicable law, including its right to seek an evidentiary, contested case hearing and/or judicial review of any DNR order(s) before implementing the remedial actions described in this Revised Interim Action Work Plan.

This Revised Interim Action Work Plan replaces the Interim Action Work Plan dated September 30, 2021 for the Site. Based on Beazer's understanding of the DNR's concerns and demands raised in their November 19, 2020 correspondence, Beazer submitted a December 20, 2020 interim action work plan which was designed to address DNAPL that could potentially migrate along a preferential migration pathway created by the storm sewer trench in the City of Oak Creek utility corridor. In their March 3, 2021 correspondence, the DNR requested that Beazer revise the work plan to include the entire Site, not just the utility corridor. Beazer submitted a Revised Interim Action Work Plan on May 3, 2021.

The DNR responded on August 31, 2021 with a notice (the "August 31, 2021 Notice"), contending that the May 3, 2021 work plan failed to comply with Wis. Admin. Code chs. NR 708 and 716 Interim Action Requirements. The DNR asserts that the DNAPL source material is migrating and the groundwater contaminant plume is expanding. In its response to comments and work plan submittals, Beazer has repeatedly contested such assertions, including in its September 30, 2021 response letter to the August 31, 2021 Notice, and Beazer has provided compelling technical evidence and scientific evaluation to the contrary, which the DNR continues to ignore. Nonetheless, DNR directed Beazer to further revise its submittal to include the conduct of an interim action to completely remove the DNAPL tar source material or complete a combination of removal with ISS. The DNR has provided no justification for their requests, has ignored the clear guidance of NR708 and NR 722, and continues to refuse to meet with Beazer to engage in a productive dialog to advance remedial efforts at the Site. NR 722.07(4) provides that remedial options must be evaluated based on the criteria of technical feasibility and economic feasibility. The remedy the DNR has ordered – to "completely remove the DNAPL tar source material or complete a combination of removal with ISS" – lacks any evaluation according to the NR 722.07(4) criteria and is made absent any showing that such remedies are the most technically and economically feasible.

In an effort to avoid violating DNR orders, but still advance remedial efforts in connection with the Site, Beazer submitted a revised work plan on September 30, 2021. In the revised work plan, Beazer included an excavation component to the interim action, however Beazer's willingness to implement any such excavation was expressly made conditional on the satisfaction of the following conditions: 1) the City of Oak Creek Water and Sewer Utility (OCWS) approves and consents in writing to excavation work around the sanitary sewer that passes through the area at a depth of 10 to 15 feet below ground surface (approximate elevation of 655 feet mean sea level

(msl)), 2) the DNR approves Beazer's May 29, 2020 request to provide a pre-remediation, non-listed hazardous waste determination for media that might be generated as part of this interim action, 3) the DNR agrees to participate in actual, face-to-face technical dialog with Beazer in an attempt to resolve differences Beazer and the DNR have regarding the site conceptual model, and 4) the DNR agrees to meaningfully participate in actual, face-to-face technical dialog with Beazer regarding completion of Site Investigation activities now that Beazer has withdrawn from the VPLE program[1]. In the absence of full satisfaction of these conditions, Beazer reserves the right to object to and seek administrative and/or judicial review prior to implementing this work plan.

The DNR responded on October 19, 2021 directing Beazer to resubmit a revised IAWP by November 19, 2021 along with the appropriate review fee since Beazer is no longer in the VPLE Program and to incorporate appropriate DNR review times in the schedule. This submittal is intended to address that request.

1.2 Conceptual Plan

1.2.1 DNAPL Conditions/Observations

The former Koppers Tar Plant operations occupied approximately 22 acres of land comprised of an approximately 20-acre Wabash Parcel currently owned by Connell Aluminum Properties LLC (Tax Assessor Parcel Number 8689999001) and an approximately 2-acre portion of the adjacent utility corridor (Tax Assessor Parcel Number 8689001000) currently owned by the City of Oak Creek (City).

The utility corridor was constructed in the early 1970's. These initial construction activities included the installation of a 78-inch diameter stormwater sewer that was built through the former tar lagoon area associated with past tar distillation operations. Other utilities have been installed within the corridor over time including raw water lines, sanitary sewer mains and laterals, natural gas lines, overhead and buried electric lines and fiber optic line. The storm sewer trench is the deepest of the utilities installed along the corridor and, as explained below, may serve as a preferential groundwater migration pathway downhill to the east.

[1] In the August 31, 2021 Notice, DNR informed Beazer that DNR was administratively withdrawing Beazer from the VPLE program. Beazer responded in a letter dated September 29, 2021 informing DNR that it was voluntarily withdrawing from the VPLE program and would not challenge DNR's decision to remove the site from the program. The VPLE program offers persons responding to environmental contamination situations the opportunity to avoid future long term remediation risks in exchange for a higher level of remediation. Because Beazer is no longer participating in the VPLE program at the Site, it will not receive long term liability exemptions. Accordingly, Beazer believes its withdrawal from the VPLE program creates latitude to examine and propose a variety of more flexible remedial approaches which meet ch. NR 700 clean-up standards and are protective of the environment, but which may not have qualified under the VPLE program. The remedial approaches noted herein, and discussed in detail in the Revised RAOR, provide such alternatives to remediating the site while meeting the NR 700 regulatory standards.

The construction of the utilities through the former tar lagoon resulted in disturbance and likely redistribution of coal tar-like material along the corridor. For example, the DNAPL observed at Well MW-130 located within the City's utility corridor, upgradient of the former tar lagoon, is likely due to the redistribution of tar-like material from the former tar lagoon area during prior utility construction work.

Beazer and DNR do not agree on the site conceptual model or on actual conditions at the Site. For example, DNR contends that DNAPL is migrating at the Site, implying that the footprint of the DNAPL plume is expanding and must be halted. Observations of subsurface DNAPL at the Site are defined as potentially mobile[2] because, under ordinary conditions, the capillary pressure of the DNAPL is not high enough to exceed groundwater pore entry pressure. Therefore, under static undisturbed conditions, the DNAPL footprint is stable (not expanding) and is not expected to displace groundwater or migrate. But a change in static conditions, for example a change caused by drilling through or adjacent to an area of potentially mobile DNAPL, may allow the DNAPL to become mobile in an extremely localized area (micro-scale mobility) and begin moving toward any void caused by the disturbance (for example, moving toward a monitoring well's screened interval). Observation of this type of induced DNAPL micro-scale mobility is not immediate. Rather, it requires enough time for the void space in the disturbed area (in the case of a well-installation, the well's sand pack) to first become saturated with DNAPL before the DNAPL can migrate to start accumulating in the well. As can be seen by the table below, the concentrations of the PAH compounds detected in MW-130 and MW-134 from 2015 are well above their respective 10% solubility limit, indicative of the presence of DNAPL, since the wells were installed in 2015.

	Units	Solubility*		MW-130	MW-134
PAH Compounds		Approx. Limit	10%	3/2/2015	10/22/2015
Anthracene	ug/L	73	7.3	17	700
Benzo[a]pyrene	ug/L	3.8	0.38	3	620
Benzo[b]fluoranthene	ug/L	1.5	0.15	5.1	920
Chrysene	ug/L	2	0.2	10	500
Fluoranthene	ug/L	260	26	100	4,000
Fluorene	ug/L	1,900	190	200	2,100
Naphthalene	ug/L	34,400	3,440	4,500	1,400
Pyrene	ug/L	350	35	63	2,700

*Source: Mackay, D., W.Y. Shiu and K.C. Ma (1992), *Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals: Polynuclear Aromatic Hydrocarbons, Polychlorinated Dioxins, and Dibenzofurans*,

The more recent observation of DNAPL in MW-130 and MW-134 is therefore not an indication that the groundwater plume or the DNAPL footprint is expanding horizontally, but rather that the DNAPL capillary pressures were disturbed by the well installations and likely allowed the DNAPL to move in an extremely localized area toward the lower pressure zones created by the wells. It has simply taken 4-5 years for this gradual induced migration of DNAPL from its original, static

[2] An Introduction to Characterizing Sites Contaminated with DNAPLs, Interstate Technology & Regulatory Council (ITRC), September 2003

location to the disturbed sand pack void and then in to the actual well, to occur and, thus, be observed.

DNR raised concern that the January 2020 sampling results from P-110 and P-120 are indicative of migrating contamination and an expanding groundwater contaminant plume because previously reported concentrations were below detection levels in P-110 and below regulatory standards in P-120. While contaminant levels in these wells have fluctuated, they are no higher than when these wells were first installed as can be seen in the table below.

	Units	P-110		P-120	
PAH Compounds		12/21/2011	01/28/20	9/12/2013	01/29/20
Anthracene	ug/L	99	20	0.23	0.3 J
Benzo[a]pyrene	ug/L	12	4.1	<0.059	0.27
Benzo[b]fluoranthene	ug/L	15	3.8	0.24	0.27
Chrysene	ug/L	27	4.4	0.45	0.2
Fluoranthene	ug/L	82	33	1.1	0.67 J
Fluorene	ug/L	160	190	<0.13	0.54 J
Naphthalene	ug/L	4,700	11000	2.5	3
Pyrene	ug/L	48	23	0.77	0.52 J

Well P-110 is located within a former tar lagoon situated adjacent to and within the utility corridor. Until recently, this well had been showing a decreasing trend in contaminant concentrations (see attached P-110 Chart) – concentrations that are believed to have been introduced through the well installation. The recent increase in contaminant levels at P-110 is believed to be related to the integrity of the PVC well and/or borehole seal as the well was installed through a former tar lagoon. Well P-120 is in the area of the former tar plant and has historically shown low level detections of PAH compounds likely related to sediment in the sample and not an increase in contamination (see attached P-120 Chart).

1.2.2 Proposed Interim Action

This revised interim action plan incorporates a variety of remedial measures, including groundwater monitoring, DNAPL removal, limited excavation with off-site disposal, in-situ solidification/stabilization (ISS), and utility trench plugs to contain or stabilize potentially mobile DNAPL in order to minimize any threat to public health, safety, or welfare or the environment. Each of these remedial measures is described in detail in Section 2.0 herein. Excavation will be performed at the former tar lagoon located along the south property boundary and adjacent to the utility corridor to remove and dispose of soil containing visually observable DNAPL. The depth of the excavation will be no deeper than the invert elevation of the 78" diameter storm sewer (approximate elevation of 645 feet msl) and will require working around a sanitary sewer line (approximate elevation of 655 feet msl) that passes through the former tar lagoon area. The targeted area of excavation is shown in Figure 3.

To stabilize and prevent the potential migration of DNAPL in other areas of the Site, ISS will be applied in areas of the Site where potentially mobile DNAPL is present in the upper 6 feet of soil[3]. To prevent the potential migration of DNAPL from the Wabash parcel into the utility corridor, an ISS barrier approximately 320 feet long will be installed to a depth of 20 feet below ground surface along the north property line of the utility corridor in the area where potentially mobilized DNAPL has been observed. At DNR's request, the added ISS barrier wall replaces the previously proposed collection trench. Beazer does not believe that an ISS barrier wall provides any greater protection than the proposed collection trench, but because the ISS equipment will already be on site to implement other components of the interim remedial action, and because the barrier will be just as effective as a collection trench in preventing potential DNAPL migration to the utility corridor from the Site, Beazer has incorporated the barrier wall herein. To prevent the potential for DNAPL and/or potentially contaminated groundwater to migrate along the 78-inch diameter storm sewer, trench plugs will be installed across the utility trench. While Beazer does not believe that interim action is necessary or regulatorily permissible, these interim action elements will contain or stabilize the potential migration of DNAPL and fit into Beazer's overall remedial strategy of containment to address the known concerns at the Site. Beazer has successfully obtained state and/or federal approval and implemented this type of remedial strategy at dozens of DNAPL sites across the U.S.

The targeted areas of ISS implementation are shown in Figures 2, 3, 4 and 5. The areas currently proposed for excavation by Connell to implement the PCB soil removals are also shown in Figures 3, 4 and 5. These activities will require coordination and sequencing to optimize implementation. The areas to be treated through ISS are delineated based on observations of potentially mobile DNAPL from soil boring logs that occur at a depth of 0-6 feet below ground surface. ISS will consist of mixing binding agents into the soil to transform those areas containing potentially mobile DNAPL in the 0-6 foot bgs horizon into a durable, low–hydraulic conductivity material that reduces the DNAPL mobility, provides a barrier to potential surface seeps and reduces potential infiltration and ground water dissolved phase transport. Mixing will be accomplished in-situ using a mechanical mixer to blend in potential binding agents. Binding agents would include a cementitious reagent such as Portland cement and/or a surface adsorption reagent such as bentonite. Bench tests will be performed to determine the optimum blend of binding agents to achieve an unconfined compressive strength of at least 50 pounds per square inch (psi) and a target hydraulic conductivity of $1x10^{-6}$ cm/sec or less.

The targeted area of ISS implementation is shown in Figure 4. The ISS wall will be approximately 3-5 feet wide, 20 feet deep and 320 feet long. The location and depth of the ISS wall is based on observations of potentially mobile DNAPL from soil borings that were 15 to 20 feet deep and which show no potentially mobile DNAPL deeper than 13-14 feet bgs in the utility corridor.

To prevent the potential migration of DNAPL and impacted groundwater along the storm sewer utility trench, trench plugs will be constructed by grouting the bedding surrounding the 78-inch

[3] Consistent with the final remedy described in Beazer's *revised RAOR* dated July 1, 2021, Beazer's *revised RAOR* to be submitted on or before October 30, 2021, and Connell's *Addendum (Revision 2) to the RAOR and Pre-Design Sampling Work Plan* submitted September 28, 2021, the final remedy contemplates that a 2-foot thick soil cover will be installed over the entire Site as part of the final remedy providing at least an 8-foot thick barrier over areas with potentially mobile DNAPL.

storm sewer from the inside of the pipe. The grout will likely consist of a polyurethane based expanding foam that reacts when in contact with water. The actual product to be used will be identified in detail following the inspection of the pipe interior and evaluation of chemical compatibility. The grout plugs will be placed in two locations along the 78-inch storm sewer, one upstream of MW-130 and one downstream of MW-134 (Figures 4 and 6). A nested monitoring well and sump will be installed within the bedding of the storm sewer upstream of each grout curtain and at a distance so as not to be located within the area affected by the utility plug grout. These will be installed using a hydrovac and completed with H-20 rated covers within the road. The sumps will be installed upgradient of each grout plug and will be used to monitor and remove any DNAPL that accumulates within them. Shallow monitoring wells will be nested with each sump to monitor head levels and water quality of water that may build up behind the grout plugs. This monitoring will be used to confirm flow dynamics and document conditions within the trench. Additional monitoring wells will be installed adjacent to both ends of the utility plugs and included in the groundwater sampling plan. These adjacent monitoring wells will be used to confirm that potentially contaminated groundwater is not bypassing the trench plugs.

1.3 Location and Project Information

Site Address:
Former Koppers Tar Plant and Wabash Alloys Site
9100 South Fifth Avenue
Oak Creek, Wisconsin 53154

Site Location (Figure 1):
SW ¼ of the NW ¼, and the NW ¼ of the SW ¼
Section 24, T5N, R22E
Milwaukee County

Site Activity Numbers:
Wabash Parcel
FID # 241379050
BRRTS # 02-41-553761
Connell VPLE BRRTS # 06-41-560058

City Parcel
FID # 341074470
BRRTS # 02-41-561425

Current Property Owners:
Former Koppers Tar Plant and Wabash Alloys Site:
Connell Aluminum Properties, LLC
One International Place
Boston, MA 02110
Project Contact: Mr. Mike Kellogg
(919) 744-7522

City Utility Corridor Parcel:
City of Oak Creek
8040 S. 6th Street
Oak Creek, WI 53154
Project Contact: Mr. Larry Haskins
(414) 762-5105

Consultant:
Tetra Tech, Inc.
175 N. Corporate Drive, Suite 100
Brookfield, WI 53045
Contact: Michael Noel, P.G.
(262) 792-1282

2.0 SCOPE OF WORK

The tasks proposed in this work plan include:

1) Groundwater Monitoring,
2) Quarterly DNAPL Thickness Measurements and Removal,
3) Pre-Design Investigation Activities,
4) Remedial Design: Soil Excavation, ISS and Utility Trench Plugs,
5) Remedial Construction: Soil Excavation and Construction of ISS and Utility Trench Plugs, and
6) Preparation and Submittal of a Construction Documentation Report.

2.1 Task 1. Groundwater Monitoring

Groundwater sampling will be resumed as part of this work plan. Monitoring wells included in the plan are listed below:

MW-1*	MW-111	MW-125	MW-135
MW-2	MW-112*	MW-126	MW-136*
MW-101	**MW-114**	MW-127	P-103*
MW-102	MW-115	MW-128	P-110*
MW-104	MW-116	MW-129	P-113*
MW-105	MW-117	**MW-130**	P-120*
MW-106	MW-118*	MW-131*	P-121*
MW-107	MW-122	MW-132*	
MW-108	**MW-123**	MW-133	
MW-109	**MW-124**	**MW-134***	

Bold = wells with observed DNAPL
* = wells included in quarterly sampling round
Shaded = wells to be abandoned to implement ISS

Groundwater samples will be collected in Q4 2021 from all monitoring wells that contain no DNAPL. Groundwater samples will be collected quarterly, beginning in Q4 2021 from shallow downgradient wells in the utility corridor (MW-1, MW-112, MW-118, MW-131, MW-132, MW-134, and MW-136) and from the deep monitoring wells (P-103, P-110, P-113, P-120, and P-121). Wells located within the areas of excavation and ISS will need to be abandoned to implement the work (MW-106, MW-107, MW-109, MW-114, MW-123, P-110, and P-121). Additionally, well MW-124 will need to be abandoned to implement PCB excavation work planned by Connell. After completion of the excavation and ISS work, new monitoring wells will be installed at representative locations around and beneath the ISS treatment zone for performance monitoring. Locations and specifications for new wells will be provided in the remedial design report.

A low-flow purging and sampling method will be used to collect the groundwater samples from the monitoring wells. The low-flow method is intended to prevent producing fines during the sampling process. Fine-grained sediment in groundwater samples can result in “false positive” detections of SVOCs/PAHs. A peristaltic pump and dedicated polyethylene sample tubing will be

used to collect the groundwater samples. The groundwater samples will be submitted for laboratory analyses of VOCs by EPA Method 8260D and PAHs by EPA Method 8270E.

Sample containers provided by the laboratory subcontractor will be used to collect the groundwater samples. One duplicate groundwater sample will be collected per 20 samples for QA/QC purposes. The duplicate sample will be submitted for laboratory analyses of VOCs and SVOCs. The groundwater samples will be stored at a temperature of approximately 4 degrees Celsius and will be delivered to the laboratory following standard chain-of-custody procedures. Each sample container will have a self-adhesive label attached to it with the sample identification and date and time the sample was collected written on the label. The sample identification will consist of the monitor well identification.

2.2 Task 2. Quarterly DNAPL Thickness Measurements and Removal

On a quarterly basis depth to groundwater measurements and DNAPL thickness measurements will be collected from the monitoring wells. An electronic water level meter will be used to measure the water levels in the monitor wells to the nearest 0.01 foot. An interface probe will be used to determine DNAPL presence and thickness. DNAPL found in wells will be removed to the extent possible using bailers.

2.3 Task 3. Pre-Design Investigation Activities

The following activities will take place in advance of and to support the remedial design task.

2.3.1 Delineation of ISS Areas

The targeted areas of ISS implementation are shown in Figures 2, 3, 4 and 5. Pre-design activities will include installing boreholes around the perimeter of the proposed ISS areas to confirm limits of potentially mobile DNAPL in the upper 6 feet of soil. Proposed borehole locations are shown in Figures 3, 4, and 5. Boreholes will be drilled to a depth of 6 feet using a Geoprobe direct push soil core sampler. Continuous soil samples will be collected to a depth of 6 feet bgs. The soil samples will be logged according to the United Soil Classification System. Observations of potentially mobile DNAPL staining and odor will be noted. Soil samples will be screened for the presence of ionizable VOCs at 2-foot intervals using a photoionization detector (PID) equipped with a 10.6 eV lamp. The ISS boundary at a borehole location will be confirmed if no potentially mobile DNAPL is observed. If potentially mobile DNAPL is observed within the upper 6 feet at a borehole location, additional step out boreholes will be drilled to confirm the ISS boundary at that location. This process will continue until the perimeter for each ISS area is confirmed.

2.3.2 ISS Bench Testing

ISS bench testing will be conducted to define the feasibility of various amendments to provide encapsulation of potentially mobile DNAPL in the Site soils. The objectives of the in-house bench screening will be to determine the following:

- Physical and chemical characteristics of the soil;
- Types and quantity of chemical reagents required to effectively encapsulate potentially mobile DNAPL in soil; and
- Various physical parameters to estimates geotechnical conditions of the treated samples.

Promising mixtures will be tested for the following geotechnical performance objectives after a 28-day cure time by a geotechnical laboratory:

- Target Unconfined compressive strength (UCS) (ASTM D1633) > 50 pounds per square inch (psi) for site constructability; and
- Target hydraulic conductivity (ASTM D5084 falling-head test) $\leq 1x10^{-6}$ centimeters per second (cm/s) to limit migration from stabilized soil.

The process used for execution of this work is described in detail below:

Based on existing boring logs, the subsurface materials within the proposed treatment areas are primarily fill consisting predominantly of clay, silty clay, and clayey silt. Representative soil fill samples containing DNAPL with the potential to migrate along the utility corridor will be collected from the delineated ISS areas from soil borings and consolidated into three (3) 2.5-gallon plastic containers. At the lab, soil samples will be inspected for material type, moisture, and potentially mobile DNAPL content. Composite samples will be prepared by combining an equal mass of each representative soil type biased toward most impacted soils within these samples and mixing to homogenize the soil. The composite samples will be tested for various physical and chemical parameters to better understand the properties of the soil. In-house testing will include:

- Particle size distribution using modified ASTM D422;
- Bulk density using modified ASTM D4380 procedure;
- pH using modified USEPA Method 9045D;
- Moisture content using ASTM D4643; and
- Fraction of organic carbon (foc) using modified Walkley Black procedure.

Bench testing will be conducted to evaluate the potential of multiple soil amendments for the ISS of potentially mobile DNAPL. The results of the soil characterization analyses will be used to determine reagent dosage rates during the bench testing. The primary reagents to be tested include Portland cement and bentonite. It is assumed that initial testing will target 4 Portland dosages, ranging between 2% and 10% on a mass dry weight basis. In addition, two mix recipes combining Portland Cement and bentonite will also be evaluated. Other potential ISS reagents can also be evaluated during this bench screening process at the discretion of the bench testing scientists experience and may include fly ash and cement kiln dust.

The optimal reagent and dosage rates to achieve the geotechnical performance criteria will be identified through in-house screening. Test samples will be prepared at an optimal moisture content (to be determined); pressed into plastic sample containers; and set up for in-house screening of UCS using a pocket penetrometer and shear vane, percent moisture, pH, and density. The in-house test samples will be monitored over a 28-day curing period at frequency of 1, 4, 7, 14, 21, and 28 days. Confirmatory test samples will be prepared simultaneously with the in-house test samples using Shelby tubes. The Shelby tubes will be filled with amended soil using 5 separate lifts. Sample compaction within the Shelby tube will consist of pressing, with moderate effort, in 5 separate “lifts” using a ceramic pestle (2.25-inch diameter x 7.5-inch length) to eliminate any void spaces within the test specimen. When full, the tube will be sealed and allowed to cure for 28 days at room temperature. Upon completion of the curing period, the best

performing in-house test samples, based on observation and inhouse screening discussed above, will be identified, and submitted to Tetra Tech's geotechnical laboratory for confirmatory hydraulic conductivity analyses using ASTM D5084 and UCS using ASTM D1633.

2.3.3 City of Oak Creek Meetings

A 21-inch diameter sanitary sewer is located within the footprint of the proposed excavation of the former tar lagoon and the proposed utility trench plugs are located within the City's utility corridor property. The sewer line is at an elevation of approximately 655 feet msl, or roughly 10-15 feet below ground surface depending on the Site topography. Discussions will be initiated with the OCWS to discuss the nature and purpose of the proposed interim action activities and to determine any issues or concerns the OCWS may have that will need to be addressed. Possible non-conventional construction methods may include ISS, hydrovac excavation, and injecting grout from the interior of the 78-inch diameter stormwater sewer. Tetra Tech will work closely with the OCWS during each step of the design process to ensure that plans and methods are developed and adopted that both can achieve the project objectives and obtain OCWS approval.

2.3.4 Internal Storm Sewer Inspection

An interior inspection of the 78-inch diameter storm sewer will be conducted along the area of the former tar lagoons and observed potentially mobile DNAPL in areas near the sewer. Pipe joints will be inspected to determine the joint construction method and to look for signs of DNAPL seepage. The inspection would identify joints that may require sealing, provide an assessment of the length of the impacted area, and target potential grouting locations. The inspection would be performed under confined space entry protocols and during a period of dry weather with low storm water flow.

2.3.5 Utility Location and Clearance

An on-site utility clearance meeting will be scheduled through Diggers' Hotline to mark the locations of utilities within the proposed work area. The alignment of the proposed ISS and grout plug areas will be marked and staked. The boring locations and procedures will be discussed with and approved by the OCWS prior to conducting any work along the utilities.

2.3.6 ISS Wall and Trench Plug Soil Borings

Five soil borings will be installed along the alignment of the proposed ISS wall. The borings will extend to a depth of 25 feet. The purpose of the borings is to confirm the vertical extent of DNAPL and to confirm the depth of native clay till that the bottom of the ISS wall will key into.

Soil borings will also be installed along the alignment of each of the proposed trench plugs with two borings placed on the north side and two on the south side of the storm sewer at each plug location. The borings will extend to a depth of 25 feet. The main purpose of the borings is to determine the depth and width of the permeable backfill around the storm sewer that needs to be plugged to prevent migration of potentially impacted groundwater.

Soil samples will be collected using a Geoprobe direct push soil core sampler. Continuous soil samples will be collected to a depth of 25 feet bgs. The soil samples will be logged according to the United Soil Classification System. Observations of potentially mobile DNAPL staining and odor will be noted, and all soil cores will be photo-documented. Soil samples will be screened for

the presence of ionizable VOCs at 2-foot intervals using a photoionization detector (PID) equipped with a 10.6 eV lamp. Soil samples will be collected for chemical analysis from the five soil borings proposed along the trench line to delineate vertical contamination in this area. Two soil samples will be collected from each boring, one from the interval with the highest PID reading and one from the 23 to 25-foot interval. If field screening evidence of contamination is present (based on PID readings and/or visual or olfactory evidence) at 25 feet, the borings will be extended to a depth where field evidence no longer indicates the presence of contaminants. If a boring requires extension beyond 40 feet bgs, a third sample will be collected from the ultimate base of the boring. Analysis will include VOCs by EPA Method 8260D and PAHs by EPA Method 8270E. The results of the field screening evidence and analytical data from the borings will be evaluated to determine the base of the proposed ISS wall to contain and prevent the migration of potentially mobile DNAPL. The completed depth of the ISS wall will extend below the base of the potentially mobile DNAPL based on the information provided from field screening and analytical evidence.

WDNR soil boring log information forms, with potentially mobile DNAPL observation notes, will be completed for each soil boring. After borehole completion, the soil borings will be decommissioned in accordance with the procedures outlined in Chapter NR141 of the Wisconsin Administrative Code (WAC). WDNR borehole abandonment forms will be completed for each abandoned soil boring.

2.4 Task 4. Remedial Design: Soil Excavation, ISS and Utility Trench Plugs

Upon completion of the predesign investigation, a design report will be prepared in accordance with NR 724.09 and include:

- A complete and detailed description of the interim action being designed to contain or stabilize DNAPL having the potential to migrate along the utility corridor.
- All engineering criteria, concepts, assumptions, and calculations used in preparing the design, including adequate justification to support the proposed locations of the utility plugs and an evaluation of whether additional plugs along the utility line would be beneficial. A listing of all local and state permits, licenses and approvals required to construct and implement the interim action.
- A brief description of the public health and environmental laws and standards applicable to the contamination and the interim action being implemented.
- A preliminary discussion of the types of, frequency of and schedule for monitoring of the interim action.
- A preliminary discussion of planned operation and maintenance provisions.
- A proposed schedule, including sequencing and coordination with Connell remediation work, for implementation of the interim action,
- Discussion of any other relevant technical factors.

Design plans and specifications will be prepared in accordance with NR 724.11 and include:

- A general correlation between drawings and technical specifications.
- Technical specifications and requirements necessary for all the components of the interim action.

- Detailed drawings of the proposed design, including general component arrangements, process flow diagram, cross sections, sampling locations and instrumentation locations.
- Enough detail for construction.

.

A draft operation and maintenance plan will be prepared in accordance with NR 724.13 and include:

- A description of normal operation and maintenance.
- A contingency plan for any anticipated or potential operation and maintenance problems, including a description of techniques or activities to be conducted to resolve operation and maintenance problems.
- A description of routine monitoring and analysis,
- A description of any site-specific record-keeping and reporting requirements to document operation and maintenance activities,
- A location map that includes the locations and extent of features that need to be maintained, as well as the extent of Site-related constituents.
- Final construction specifications on any engineering control feature.

These documents will be submitted to the WDNR for comment and concurrence prior to implementation of the remedy construction. The final operation and maintenance plan will be provided after construction is complete.

2.5 Task 5. Remedial Construction: Soil Excavation and Construction of ISS and Utility Trench Plugs

The approved design will be used to solicit bids for construction needed to complete the work at the Site. The remedy will be constructed in accordance with the approved schedule. The ISS work is anticipated to be completed first followed by the grouting of trench plugs around the 78-inch storm sewer. The monitoring wells/sumps in the pipe bedding will then be installed.

2.6 Task 6. Preparation and Submittal of a Construction Documentation Report

Upon completion of the remedy construction, the documentation of construction and completion report will be prepared in accordance with NR 724.15 and submitted to the WDNR within 60 days. This report will include copies of any as-built maps, plans, isometric drawings, and cross sections used to document the actual installation. Minor deviations from the remedial design, if any, will be discussed and explained in this report. Certification that the remedy was constructed in accordance with the approved plans and specifications will be incorporated.

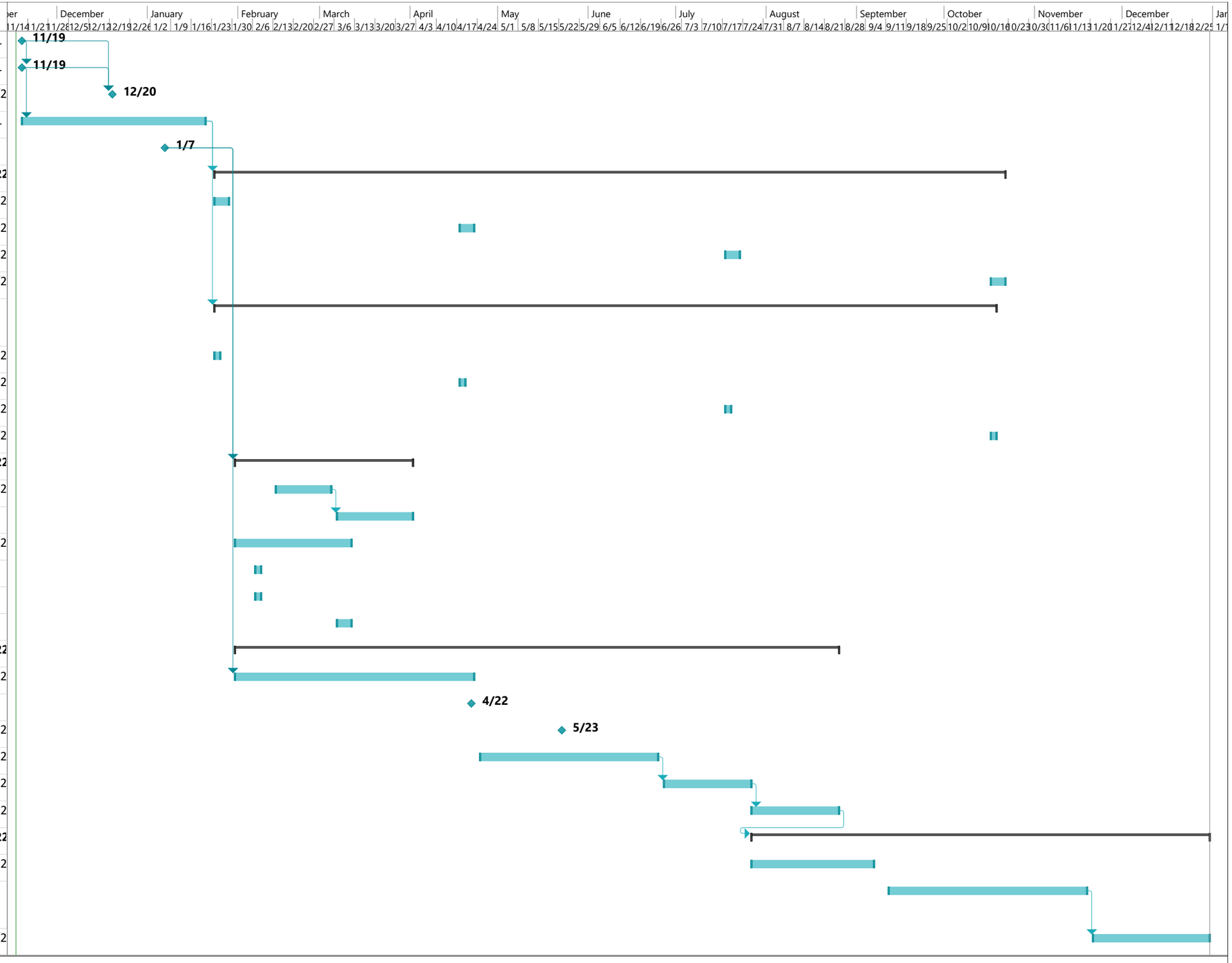
3.0 SCHEDULE

The schedule for implementing the work plan is attached. Key milestones and assumptions include the following:

- Revised Interim Action Work Plan submittal on or before November 19, 2021
- Revised RAOR submittal on or before November 19, 2021
- Virtual meeting between WDNR and Beazer representatives on or before January 7, 2022.
- Quarterly DNAPL removal and pre-design activities will be initiated within one week of WDNR approval of the Revised Interim Action Work Plan.
- The duration of pre-design activities is contingent upon Beazer and OCWS coming to agreement regarding the conceptual plan and the means and methods of implementing the work within the utility corridor.
- The internal storm sewer inspection can only occur during a window of relatively low storm water flow and is therefore weather dependent.
- Remedial Action Design Report submittal 90 days after DNR approval of Interim Action Work Plan
- The schedule includes 60 days for WDNR and OCWS review of the remedial design.
- It is assumed that WDNR and OCWS comments on the remedial design can be addressed and incorporated into a final design within 30 days.
- Bidding and contracting will begin after receipt of WDNR and OCWS comments on remedial design.
- Construction is scheduled to begin during the 2022 construction season.
- The construction documentation report and final O&M plan will be provided within 60 days of construction completion.

SCHEDULE

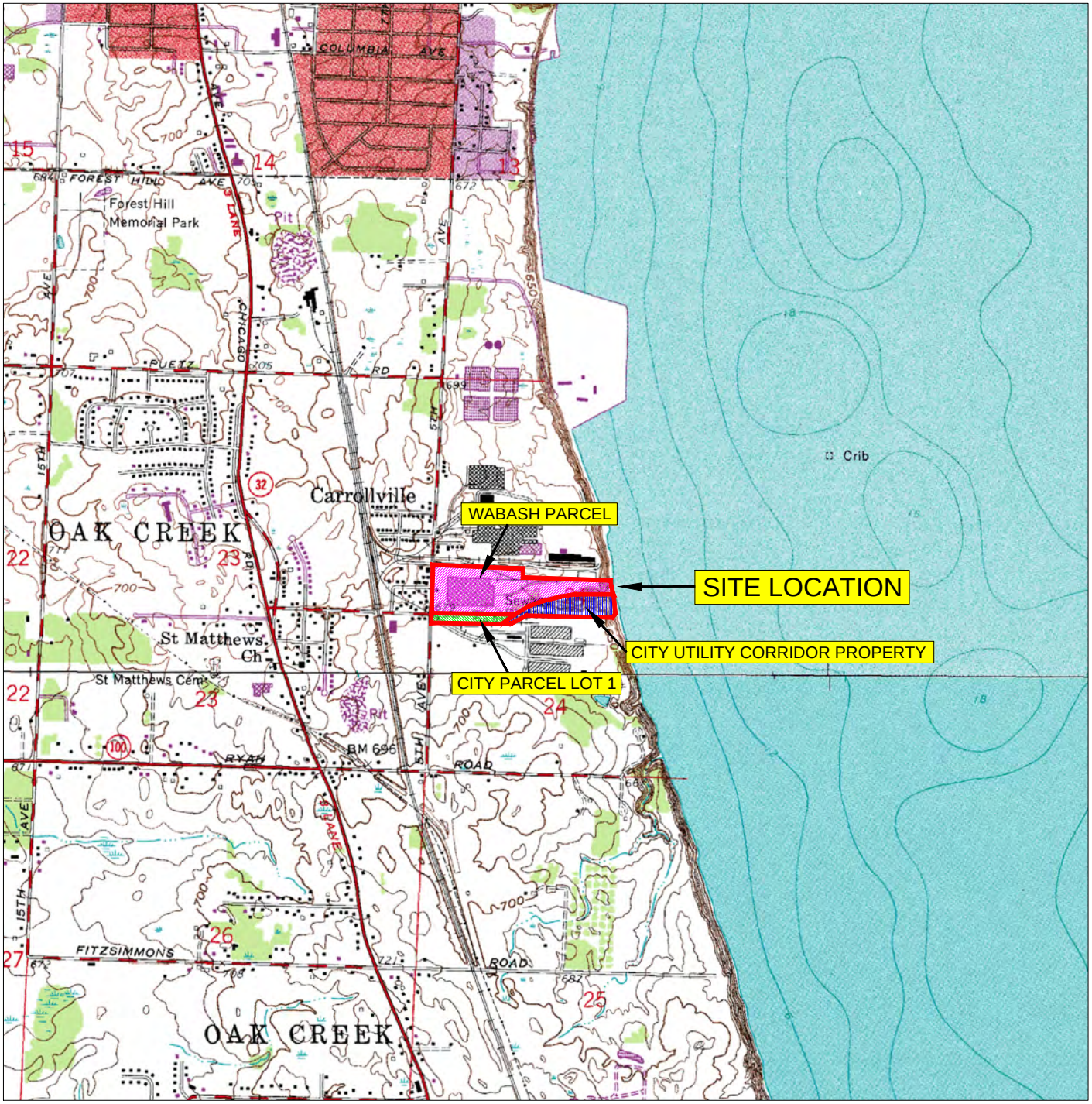
ID	Task Name	Duration	Start
1	Revised Interim Action Work Plan (IAWP) Submitt	0 days	Fri 11/19/21
2	Revised RAOR Submittal	0 days	Fri 11/19/21
3	WDNR Acknowledgement of Receipt	0 days	Mon 12/20/2
4	WDNR Review of IAWP & RAOR	45 days	Fri 11/19/21
5	Meeting to Discuss Revised IAWP & RAOR	0 days	Fri 1/7/22
6	**1. Quarterly Groundwater Monitoring**	**195 days**	**Mon 1/24/22**
7	GW Monitoring Event	5 days	Mon 1/24/22
8	GW Monitoring Event	5 days	Mon 4/18/22
9	GW Monitoring Event	5 days	Mon 7/18/22
10	GW Monitoring Event	5 days	Mon 10/17/2
11	**2. Quarterly DNAPL Thickness Measurements/Removal**	**192 days**	**Mon 1/24/22**
12	DNAPL Removal Event	2 days	Mon 1/24/22
13	DNAPL Removal Event	2 days	Mon 4/18/22
14	DNAPL Removal Event	2 days	Mon 7/18/22
15	DNAPL Removal Event	2 days	Mon 10/17/2
16	**3. Predesign Investigation**	**45 days**	**Mon 1/31/22**
17	3.1 ISS Area Delineation	15 days	Mon 2/14/22
18	3.2 ISS Bench Testing	20 days	Mon 3/7/22
19	3.3 OCWS Meetings & Agreement	30 days	Mon 1/31/22
20	3.4 Internal Storm Sewer Inspection	2 days	Mon 2/7/22
21	3.5 Utility Location and Clearance	2 days	Mon 2/7/22
22	3.6 ISS Wall and Trench Plug Soil Borings	5 days	Mon 3/7/22
23	**Remedial Action Design**	**149 days**	**Mon 1/31/22**
24	4. Remedial Action Design Report (RADR)	60 days	Mon 1/31/22
25	RADR submittal	0 days	Fri 4/22/22
26	WDNR Acknowledgement of Receipt	0 days	Mon 5/23/22
27	WDNR & OCWS Review RADR	45 days	Mon 4/25/22
28	Response to Comments and Final RADR	22 days	Mon 6/27/22
29	WDNR & OCWS Review and Approval	22 days	Wed 7/27/22
30	**5. Remedial Construction**	**113 days**	**Wed 7/27/22**
31	5.1 Bidding & Contracting	30 days	Wed 7/27/22
32	5.2 Construction (schedule dependent on weather & equipment availability)	50 days	Mon 9/12/22
33	5.3 Construction Documentation Report	30 days	Mon 11/21/2



Project: Former Koppers Tar
Date: Wed 11/17/21

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

FIGURES



National Geodetic Vertical Datum of 1929
Contour Interval 10 Feet

SCALE
0 5000
FEET

QUADRANGLE LOCATION

FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OAK CREEK, WISCONSIN

SITE LOCATION and LOCAL TOPOGRAPHY

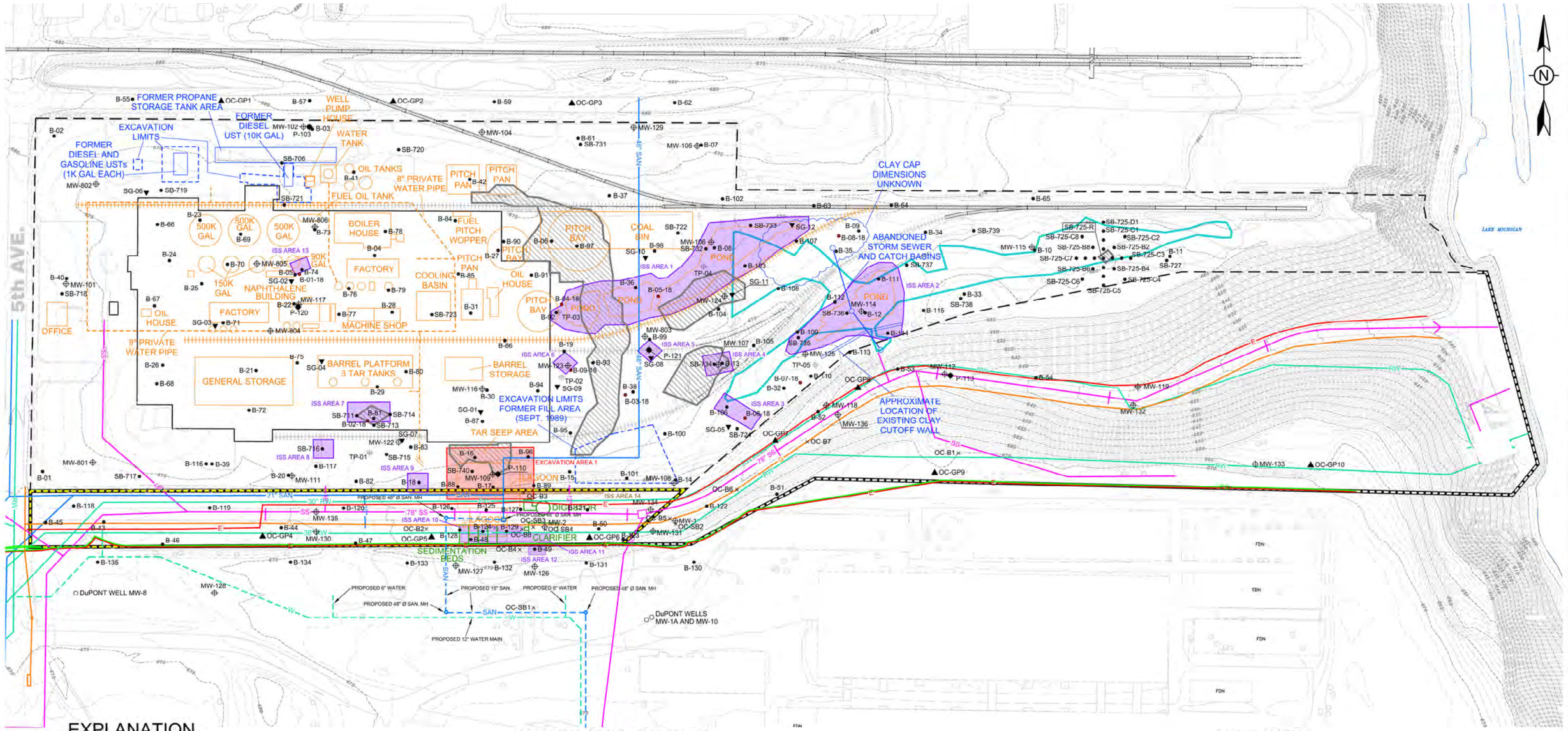
DATE:	09/20/21
DESIGNED:	CMP
CHECKED:	DLM
APPROVED:	DLM
DRAWN:	CMP
PROJ.:	117-2201452

TETRA TECH

Figure 1

Base map from U.S.G.S. 7.5' SOUTH MILWAUKEE, WISCONSIN and RACINE NORTH, WISCONSIN topographic quadrangle map.

S:\CAD\BEAZER\WABASH\SEPTEMBER 2021\SITE LOCATION_09-20-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- TP-01 — TEST PIT
- SG-07 — SOIL GAS PROBE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED 0-15' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED EXCAVATION AREA
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE

- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC

0 160 320

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
SITE LAYOUT

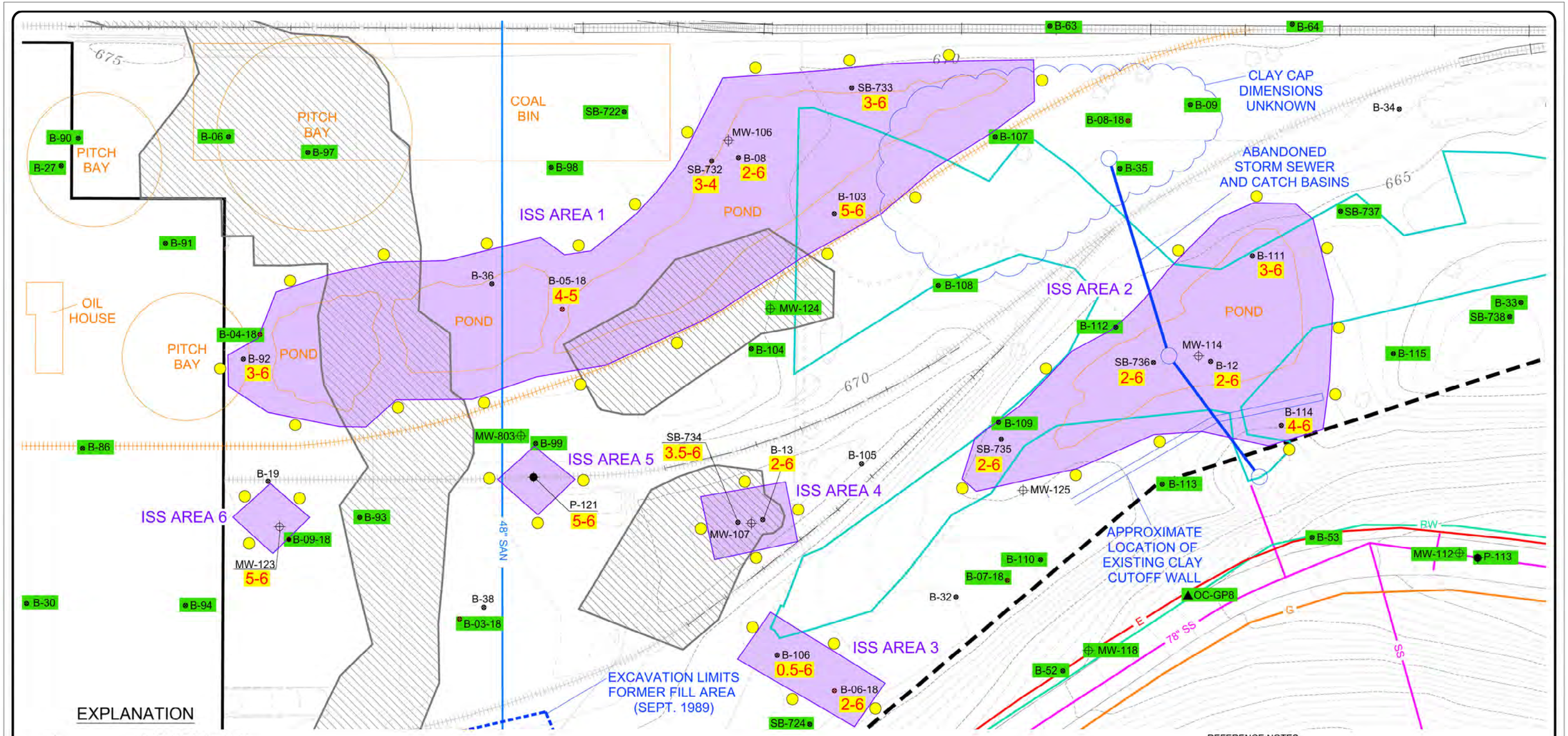
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	09/20/21

FIGURE: 2

S:\CAD\BEAZER\WABASH\SEPTEMBER 2021\FIGURE 2_SITE LAYOUT_09-20-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE

N

- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC

0-6 OBSERVED TAR (0-6' BGS)

B-52 NO OBSERVED TAR

0 50 100

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE:
FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

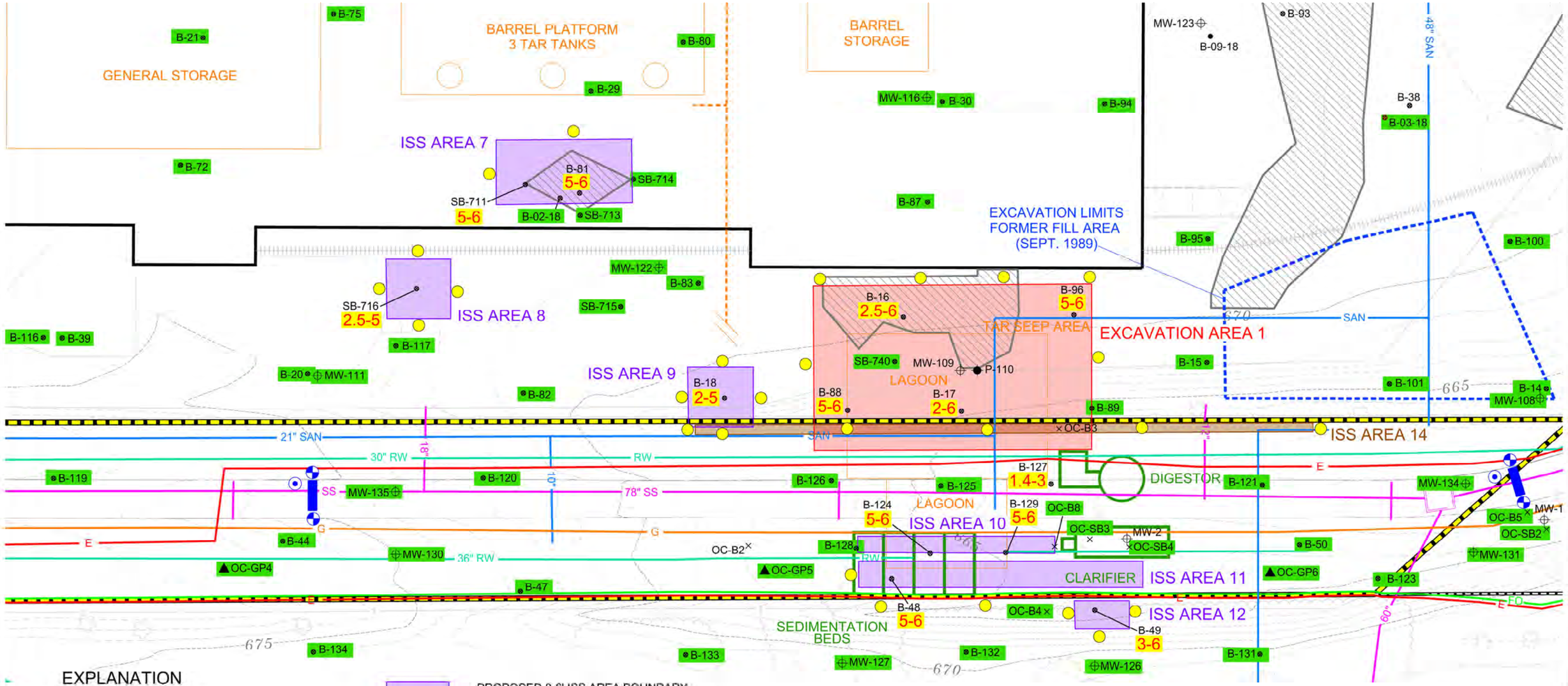
LOCATION:
OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	09/20/21

FIGURE: 3

S:\CAD\BEAZER\WABASH\SEPTEMBER 2021\ISS BLOWUP1 DELINEATION_09-20-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED MONITORING WELL ADJACENT TO TRENCH PLUG
- PROPOSED NESTED PRODUCT RECOVERY / MONITORING WELL
- PROPOSED TRENCH PLUG LOCATION
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED 0-15' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED EXCAVATION AREA
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE

N

- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC

0-6 OBSERVED TAR (0-6' BGS)

B-14 NO OBSERVED TAR

0 50 100

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE:
FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

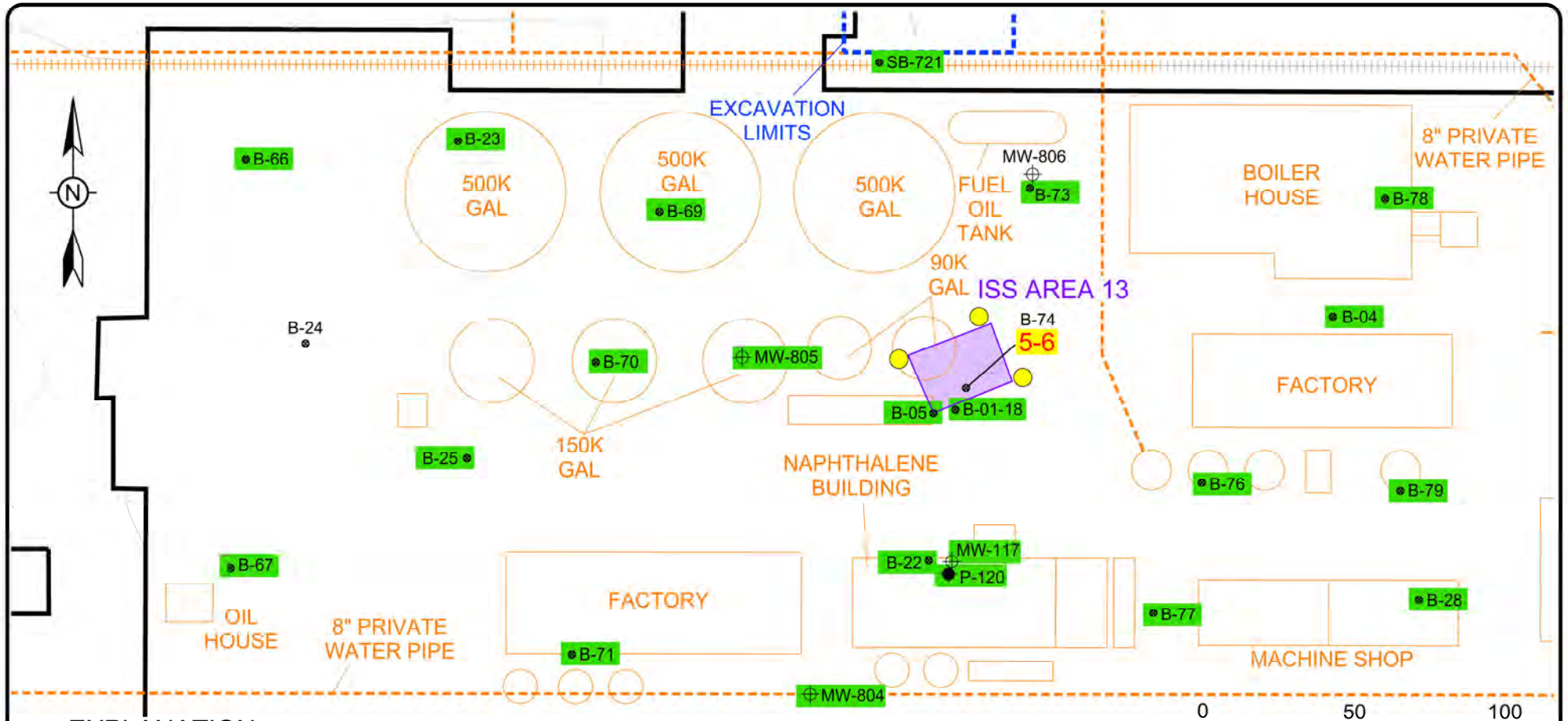
LOCATION:
OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	09/20/21

FIGURE: 4

S:\CAD\BEAZER\WABASH\SEPTEMBER 2021\ISS BLOWUP2 DELINEATION_09-20-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE
- 0-6 — OBSERVED TAR (0-6' BGS)
- B-77 — NO OBSERVED TAR

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE

OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

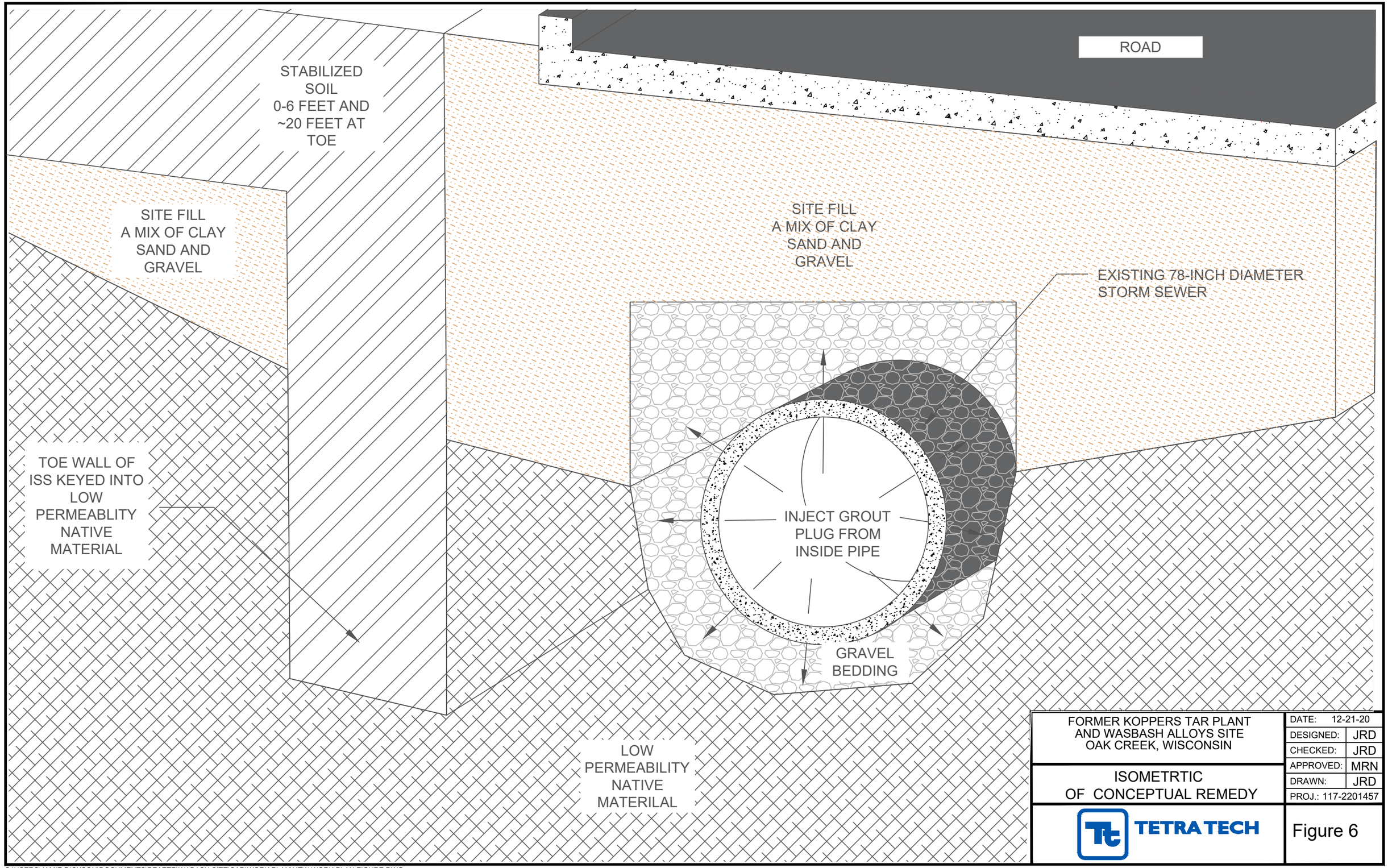
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	09/20/21

FIGURE: 5

S:\CAD\BEAZER\WABASH\SEPTEMBER 2021\ISS BLOWUP3 DELINEATION_09-20-21.DWG



FORMER KOPPERS TAR PLANT
AND WASBASH ALLOYS SITE
OAK CREEK, WISCONSIN

ISOMETRTIC
OF CONCEPTUAL REMEDY

TETRA TECH

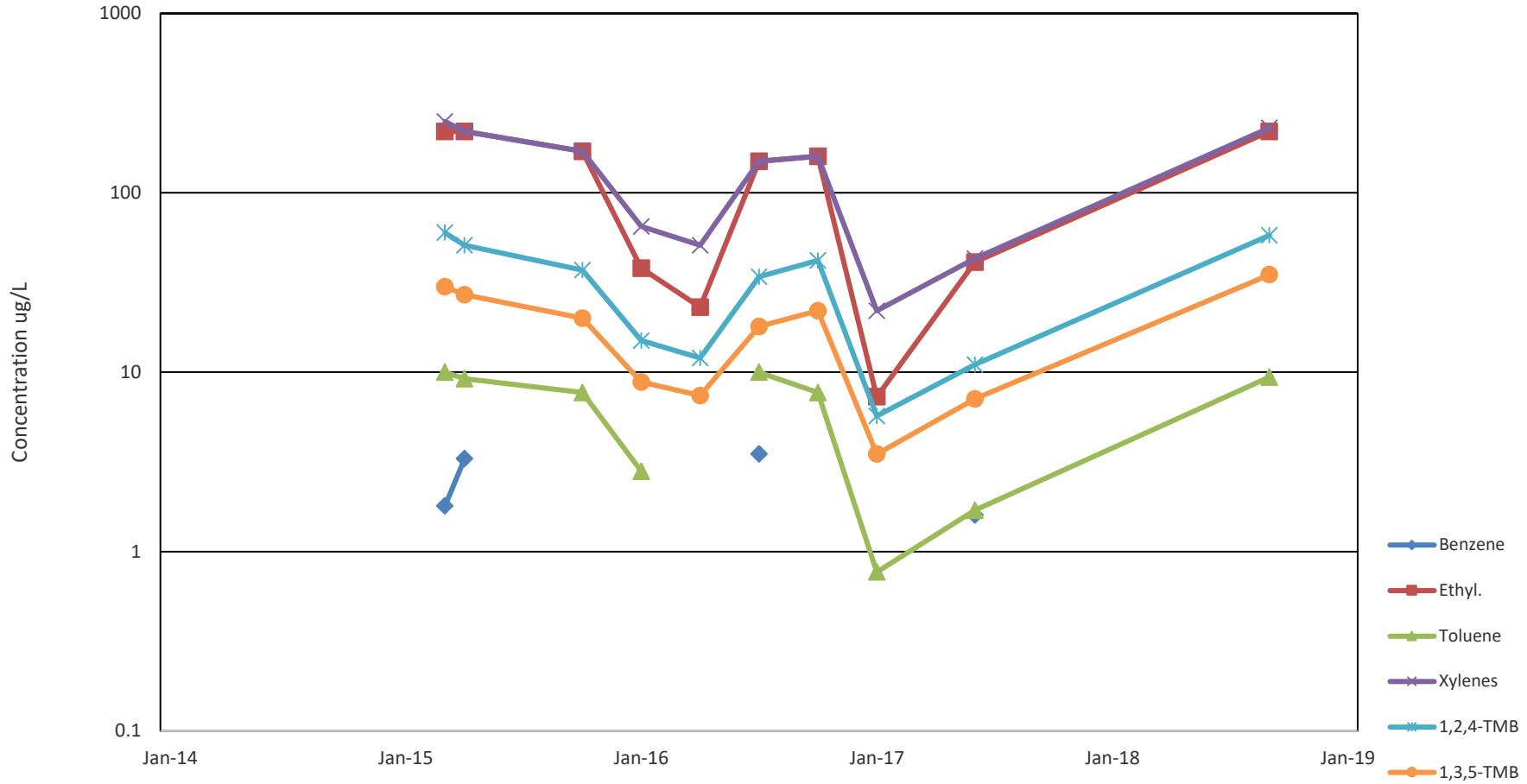
DATE:	12-21-20
DESIGNED:	JRD
CHECKED:	JRD
APPROVED:	MRN
DRAWN:	JRD
PROJ.:	117-2201457

Figure 6

C:\USERS\JAMIE.DICKSON\DOCUMENTS\BEAZER\WABASH SITE\CAD\WORK PLAN\NEW WORK PLAN FIGURE.DWG

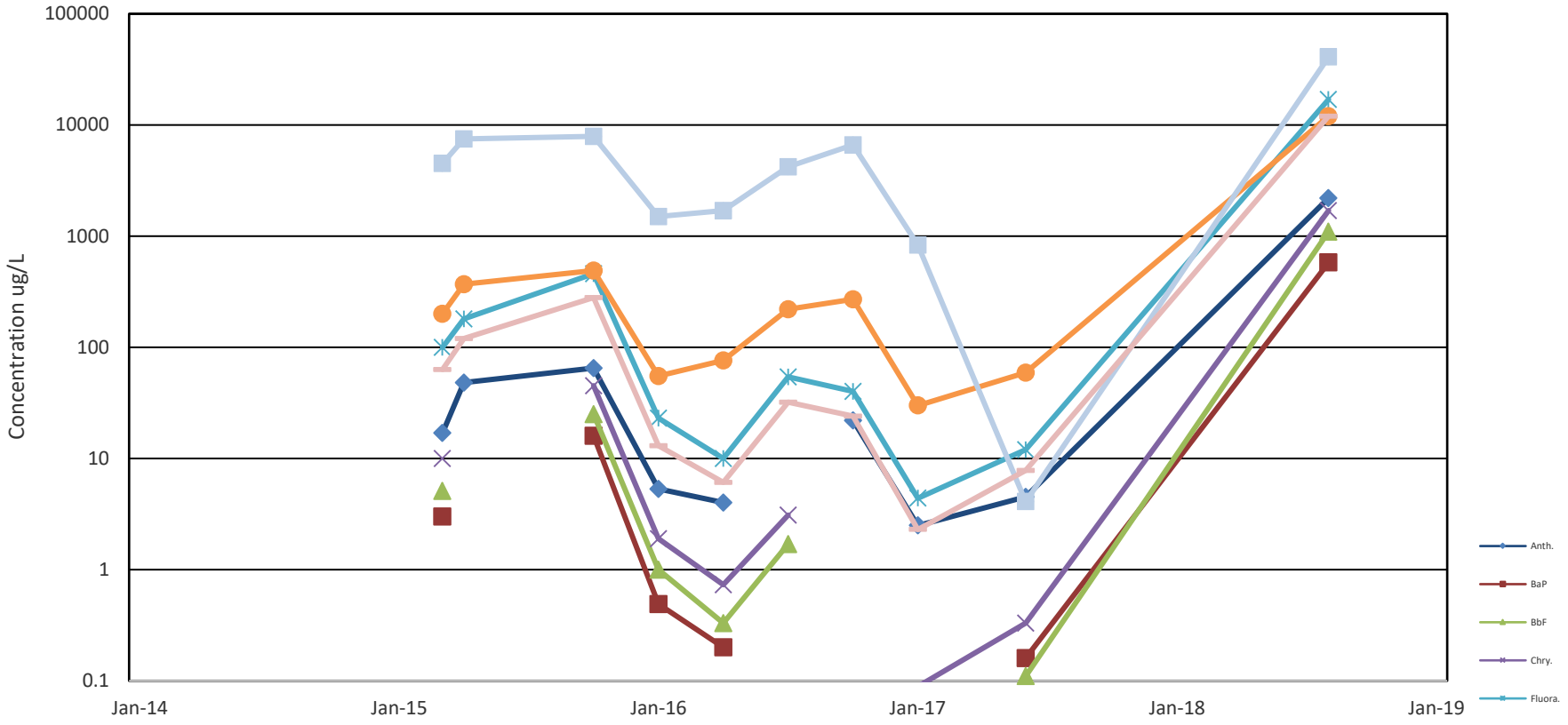
CHARTS

MW-130 - VOC



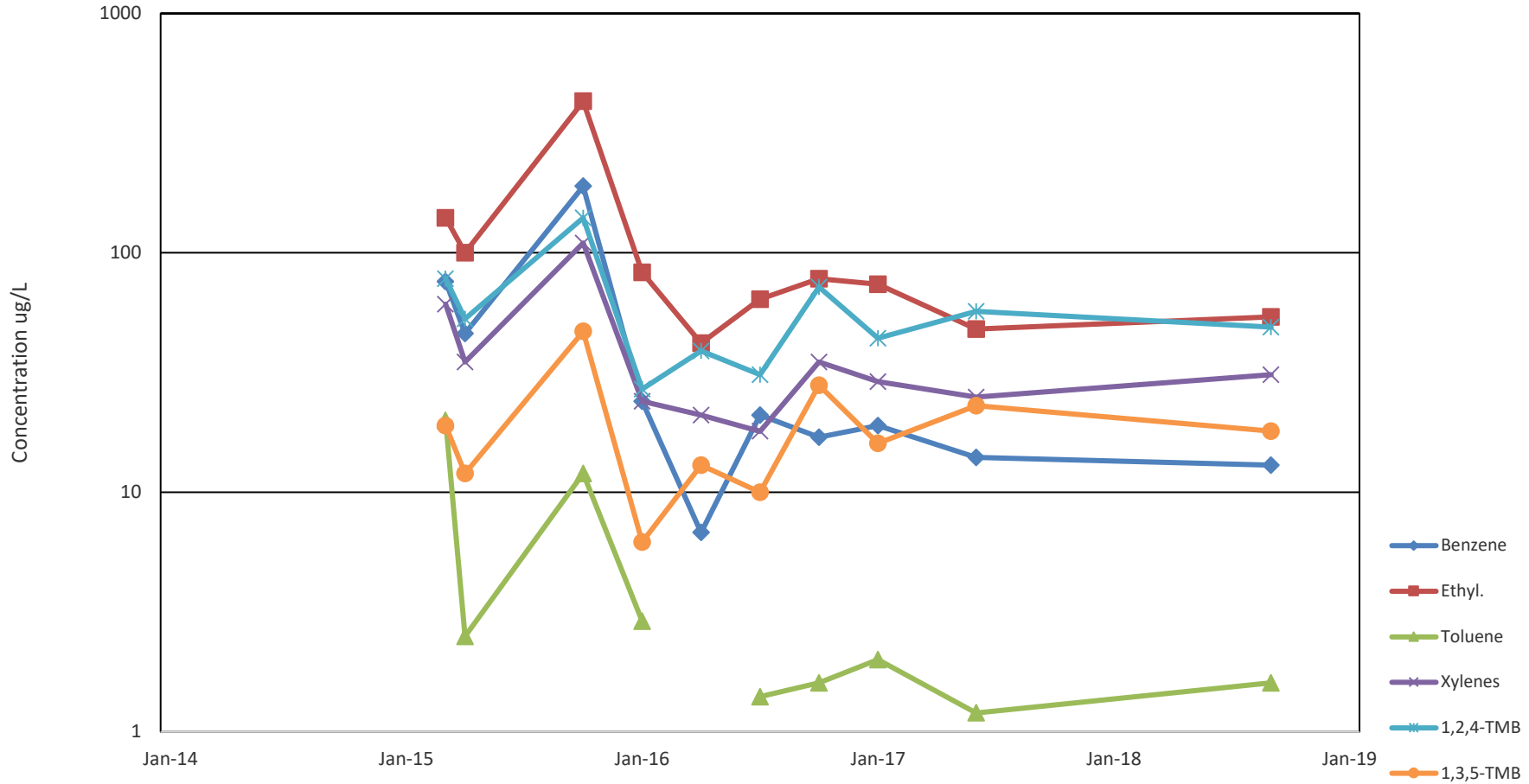
	03/02/15	04/08/15	10/22/15	01/07/16	04/07/16	07/27/16	10/31/16	01/09/17	06/16/17	09/04/18	
Benzene	1.8	3.3	0	0	0	3.5	0	0	1.6	0	
Ethyl.	220	220	170	38	23	150	160	7.3	41	220	
Toluene	10	9.2	7.7	2.8	0	10	7.7	0.77	1.7	9.4	
Xylenes	250	220	170	65	51	150	160	22	43	230	
1,2,4-TMB	60	51	37	15	12	34	42	5.7	11	58	
1,3,5-TMB	30	27	20	8.8	7.4	18	22	3.5	7.1	35	

MW-130 - PAH



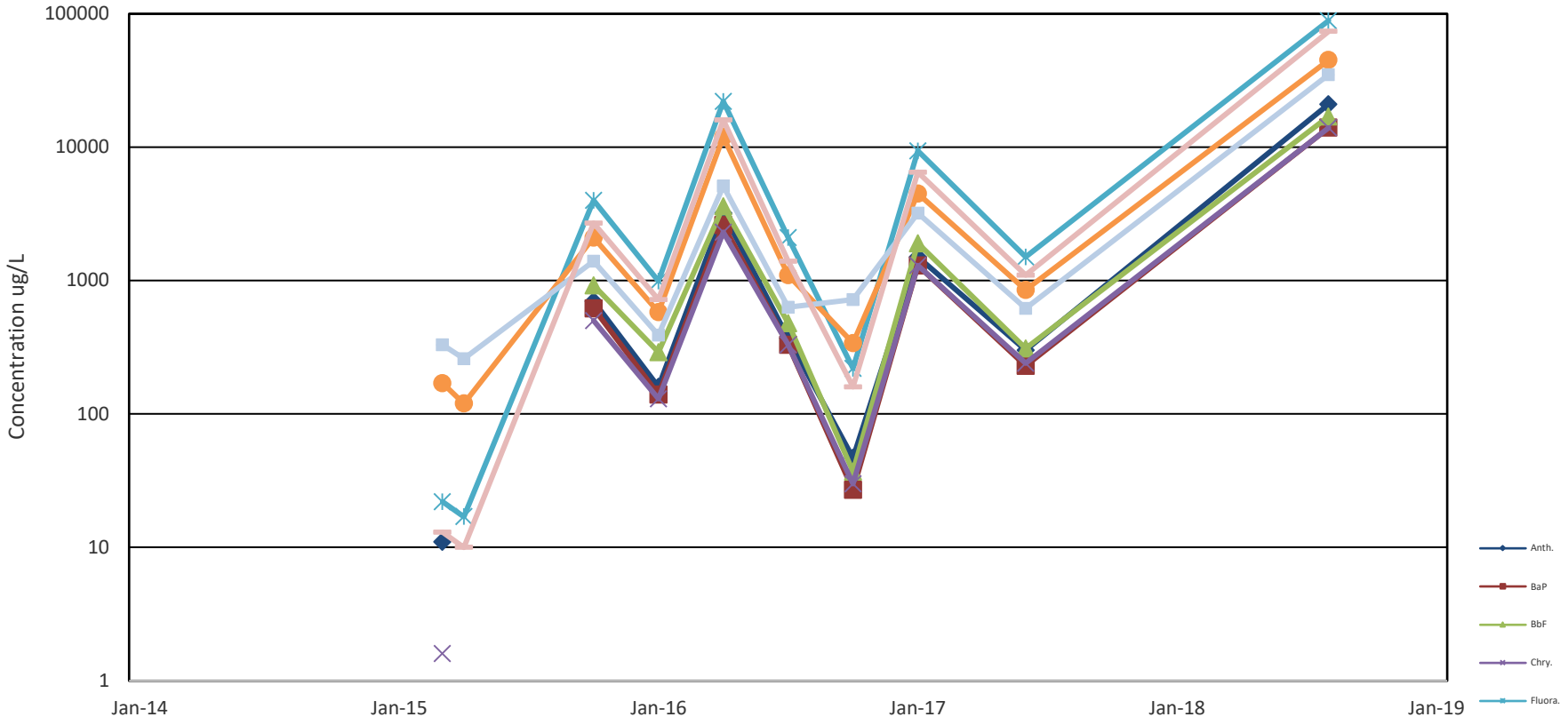
	03/02/15	04/08/15	10/22/15	01/07/16	04/07/16	07/27/16	10/31/16	01/09/17	06/16/17	08/27/18
Anth.	17	48	65	5.3	4	0	22	2.5	4.5	2200
BaP	3	0	16	0.49	0.2	0	0	0	0.16	580
BbF	5.1	0	25	1	0.33	1.7	0	0	0.11	1100
Chry.	10	0	45	1.9	0.73	3.1	0	0.089	0.33	1700
Fluora.	100	180	460	23	10	54	40	4.4	12	17000
Fluore.	200	370	490	55	76	220	270	30	59	12000
Naph.	4500	7500	7900	1500	1700	4200	6600	830	4.1	41000
Pyrene	63	120	280	13	6.1	32	24	2.3	7.8	12000

MW-134 - VOC



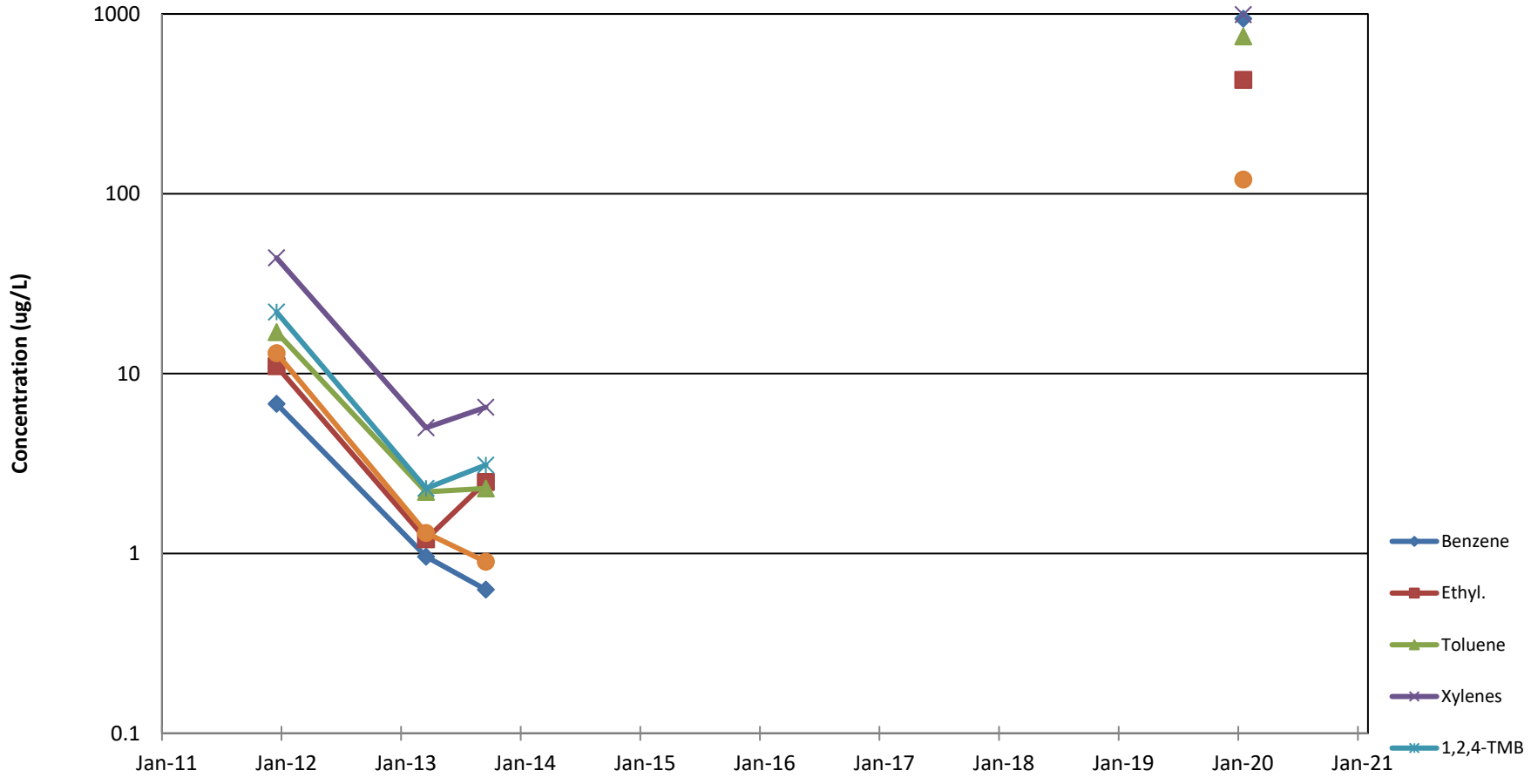
	03/02/15	04/07/15	10/22/15	01/07/16	04/07/16	07/27/16	10/31/16	01/09/17	06/20/17	09/05/18
Benzene	76	46	190	24	6.8	21	17	19	14	13
Ethyl.	140	100	430	83	42	64	78	74	48	54
Toluene	20	2.5	12	2.9	0	1.4	1.6	2	1.2	1.6
Xylenes	61	35	110	24	21	18	35	29	25	31
1,2,4-TMB	78	53	140	27	39	31	72	44	57	49
1,3,5-TMB	19	12	47	6.2	13	10	28	16	23	18

MW-134 - PAH



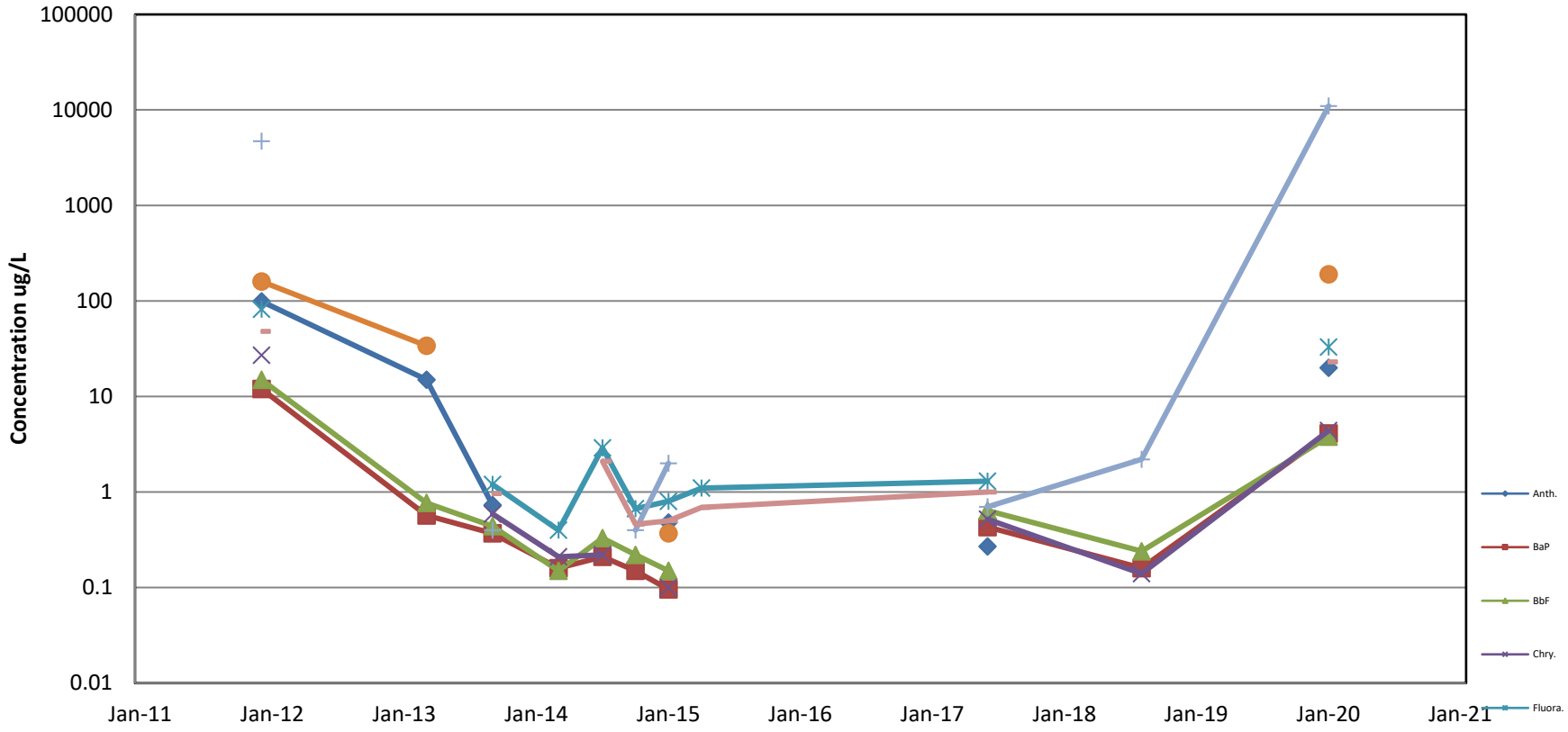
	03/02/15	04/07/15	10/22/15	01/07/16	04/07/16	07/27/16	10/31/16	01/09/17	06/20/17	08/28/18
Anth.	11	0	700	160	3200	370	47	1500	300	21000
BaP	0	0	620	140	2600	330	27	1300	230	14000
BbF	0	0	920	290	3600	480	37	1900	310	17000
Chry.	1.6	0	500	130	2300	330	30	1300	240	14000
Fluora.	22	17	4000	990	22000	2100	220	9400	1500	89000
Fluore.	170	120	2100	580	12000	1100	340	4500	850	45000
Naph.	330	260	1400	390	5100	630	720	3200	620	35000
Pyrene	13	10	2700	720	16000	1400	160	6500	1100	74000

P-110 - VOC



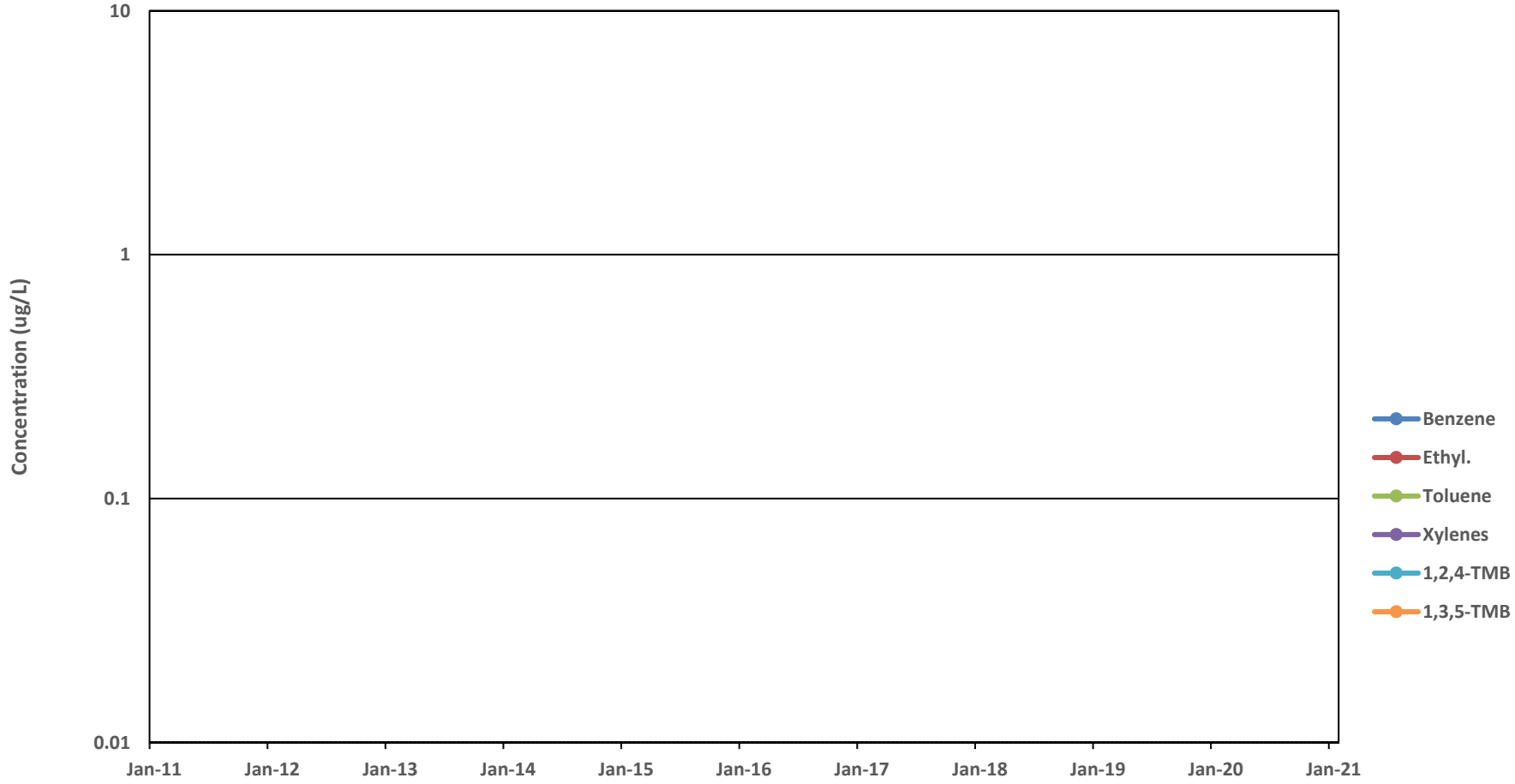
	12/21/11	03/07/13	09/12/13	03/27/14	07/11/14	10/15/14	01/21/15	04/07/15	06/22/17	08/31/18	01/28/20
Benzene	6.8	0.96	0.63	0	0	0	0	0	0	0	940
Ethyl.	11	1.2	2.5	0	0	0	0	0	0	0	430
Toluene	17	2.2	2.3	0	0	0	0	0	0	0	750
Xylenes	44	5	6.5	0	0	0	0	0	0	0	990
1,2,4-TMB	22	2.3	3.1	0	0	0	0	0	0	0	0
1,3,5-TMB	13	1.3	0.9	0	0	0	0	0	0	0	120

P-110 - PAH



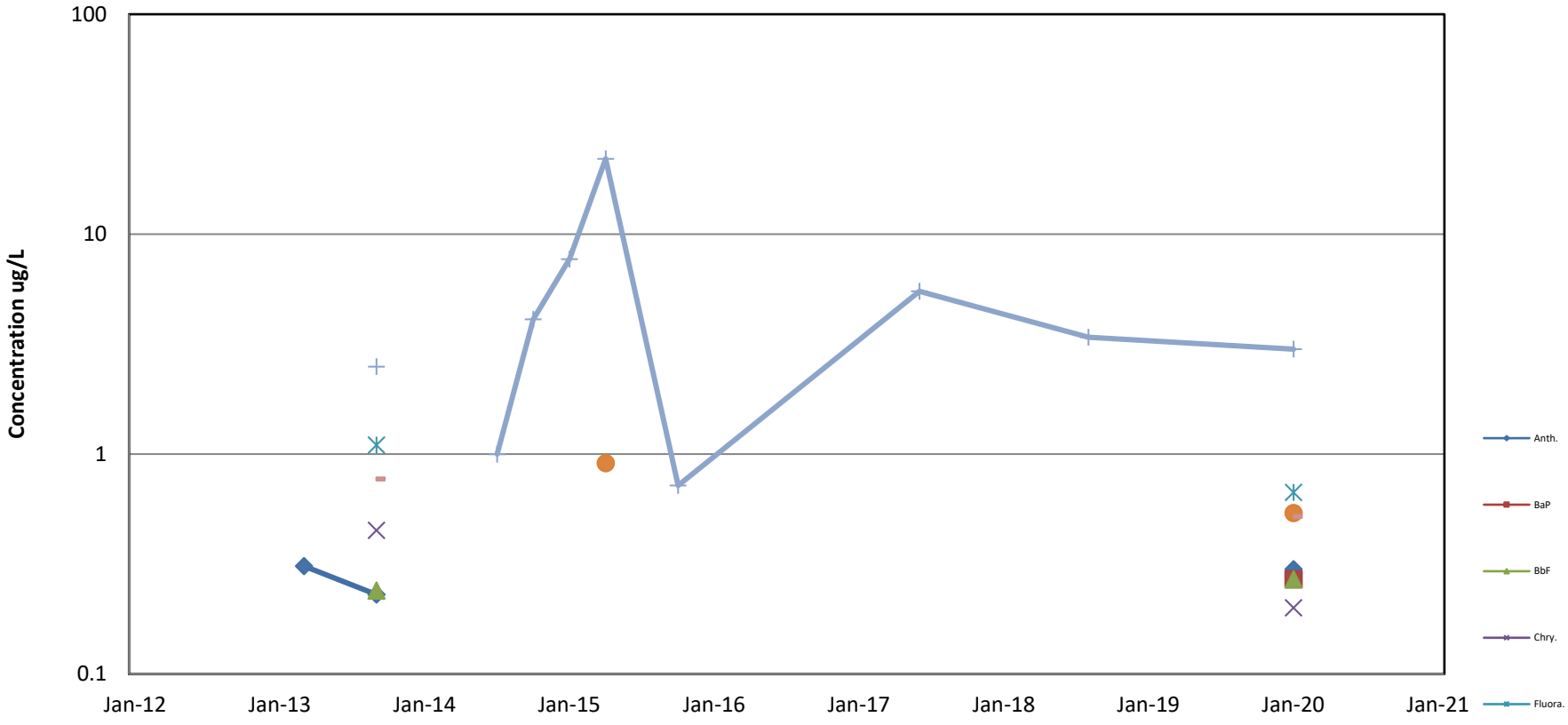
	12/21/11	03/07/13	09/12/13	03/27/14	07/11/14	10/15/14	01/21/15	04/07/15	06/22/17	08/22/18	01/28/20
Anth.	99	15	0.73	0	0.27	0	0.48	0	0.27	0	20
BaP	12	0.57	0.37	0.16	0.21	0.15	0.096	0	0.43	0.16	4.1
BbF	15	0.77	0.44	0.15	0.33	0.22	0.15	0	0.64	0.24	3.8
Chry.	27	0	0.59	0.21	0.22	0	0.1	0	0.52	0.14	4.4
Fluora.	82	0	1.2	0.4	2.9	0.67	0.8	1.1	1.3	0	33
Fluore.	160	34	0	0	0	0	0.37	0	0	0	190
Naph.	4700	0	0.4	0	0	0.4	2	0	0.7	2.2	11000
Pyrene	48	0	0.96	0	2.1	0.46	0.5	0.69	1	0	23

P-120 - VOC



	03/13/13	09/12/13	03/27/14	07/11/14	10/16/14	01/21/15	04/08/15	10/22/15	06/22/17	09/04/18	01/29/20
Benzene	0	0	0	0	0	0	0	0	0	0	0
Ethyl.	0	0	0	0	0	0	0	0	0	0	0
Toluene	0	0	0	0	0	0	0	0	0	0	0
Xylenes	0	0	0	0	0	0	0	0	0	0	0
1,2,4-TMB	0	0	0	0	0	0	0	0	0	0	0
1,3,5-TMB	0	0	0	0	0	0	0	0	0	0	0

P-120 - PAH



	03/13/13	09/12/13	03/27/14	07/11/14	10/15/14	01/21/15	04/08/15	10/22/15	06/22/17	08/21/18	01/29/20
Anth.	0.31	0.23	0	0	0	0	0	0	0	0	0.3
BaP	0	0	0	0	0	0	0	0	0	0	0.27
BbF	0	0.24	0	0	0	0	0	0	0	0	0.27
Chry.	0	0.45	0	0	0	0	0	0	0	0	0.2
Fluora.	0	1.1	0	0	0	0	0	0	0	0	0.67
Fluore.	0	0	0	0	0	0	0.91	0	0	0	0.54
Naph.	0	2.5	0	1	4.1	7.7	22	0.72	5.5	3.4	3
Pyrene	0	0.77	0	0	0	0	0	0	0	0	0.52

APPENDICES

APPENDIX A

Field Forms

TETRA TECH FIELD WATER LEVEL DATA SHEET

Project Number:_____ Project Name:_____

Location:_____ Instrument:_____

Personnel:_____

Monitor Well/ Sample Port Identification	Date	Time	Depth to Groundwater (feet below top of casing)	Comments

TETRA TECH

TETRA TECH FIELD WATER QUALITY SAMPLING AND ANALYSIS FORM

PROJECT INFORMATION		INSTRUMENTS	
PROJECT		Temp. & pH	Hanna
PROJECT NO.		Conductivity	Hanna
LOCATION		ORP	Not Measured
PERSONNEL		DO	Not Measured

SAMPLE POINT ID					
WATER TYPE	Groundwater	Groundwater	Groundwater	Groundwater	Groundwater
DATE (month/day/year)					
CLOCK TIME (Military)					
DEPTH TO WATER (ft)*					
MEASURED WELL DEPTH (ft)*					
CASING VOLUME (gallons)					
PURGE VOLUME (gallons)					
DEPTH SAMPLE TAKEN (ft)*					
SAMPLING DEVICE					
FIELD TEMPERATURE (^{O}C)					
pH					
ELEC. COND. (uS/cm) Measured					
ELEC. COND. (uS/cm) at 25^{o} C					
ORP (mV)					
DISSOLVED OXYGEN (ppm)					
DISSOLVED OXYGEN (% Sat.)					
COLOR					
ODOR					
CLARITY					
SAMPLING PARAMETERS	# OF CONTAINERS & VOLUME; CONTAINER TYPE (A = AMBER GLASS; G = GLASS; P = PLASTIC); PRESERVATIVE TYPE (L = LAB ADDED; F = FIELD ADDED) OR NEUTRAL; FILTERED (YES or NO)				
NAME OF LABORATORY					
DATE SENT TO LAB					
SAMPLER=S NAME					

***Measured from top of well casing.**

TETRA TECH LOW-FLOW METHOD FIELD WATER QUALITY SAMPLING AND ANALYSIS FORM

PROJECT INFORMATION		INSTRUMENTS	
PROJECT		Temp., pH,	
PROJECT NO.		Conductivity	
LOCATION		ORP	
PERSONNEL		DO	

MONITOR WELL ID									
WATER TYPE	Groundwater			Groundwater			Groundwater		
DATE (month/day/year)									
WELL DEPTH (feet)*									
PUMP INLET DEPTH (feet)*									
STATIC WATER LEVEL (ft)*/TIME									
ENDING WATER LEVEL (ft)*/TIME									
START PURGE TIME (Military)									
END PURGE TIME (Military)									
PURGE VOLUME (gallons)									
SAMPLE TIME (Military)									
INDICATOR PARAMETERS	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
TIME (minutes)									
TEMPERATURE (^{o} C)									
pH									
ELEC. COND. (uS/cm) at 25^{o} C									
ORP (mV)									
DISSOLVED OXYGEN (ppm)									
DISSOLVED OXYGEN (% Sat.)									
COLOR									
ODOR									
CLARITY									
SAMPLING PARAMETERS	# OF CONTAINERS & VOLUME; CONTAINER TYPE (A=AMBER; G=GLASS; P=PLASTIC); PRESERVATIVE TYPE (L=LAB ADDED; F=FIELD ADDED) OR NEUTRAL; FILTERED (YES or NO)								
NAME OF LABORATORY									
DATE SENT TO LAB									
SAMPLER′S NAME									

***Measured from top of well casing.**

TETRA TECH EQUIPMENT CALIBRATION FORM

Equipment Make	
Equipment Model	
Instrument Identification	

DATE	TIME	CALIBRATION MEDIA	RESULTS	COMMENTS

TETRA TECH

TETRA TECH WELL DEVELOPMENT/PURGE SUMMARY FORM

WELL ID. _____

PROJECT INFORMATION		WELL INFORMATION		INSTRUMENTS	
PROJECT	Beazer Oak Creek Former Koppers Tar Plant & Wabash Alloys Property	WELL COORDINATES		TEMPERATURE	Hanna
		CASING ELEVATION		CONDUCTIVITY	Hanna
PROJECT NO.		GROUND LEVEL ELEVATION		pH METER	Hanna
LOCATION	Oak Creek, WI	CONSTRUCTED WELL DEPTH		WATER LEVEL PROBE	Heron
PERSONNEL		WELL CASING INSIDE DIAMETER		OTHER	

Date	Time (Military)	Purge Method	Water Level* (Feet)	Measured Well Depth* (Feet)	Total Volume Purged** (Gallons)	APPEARANCE Color / Odor / Clarity	pH (s.u.)	Temp (^{O}C)	Elec. Cond. (umhos/cm) Measured	 at 25^{O}C	COMMENTS

One Well Volume = _____ **Can Well be purged dry? Yes No**

*** Depth below top of well casing. Record both initial and final measurements when using as Well Development Summary.**

**** Purge three to four well casing volumes, if possible, prior to sampling.**

TETRA TECH

TETRA TECH FIELD WATER LEVEL AND FREE PRODUCT DATA SHEET

Project Number:	Project Name: Beazer, Oak Creek, Former Koppers Tar Plant & Wabash Alloys Property	Location: 9100 South Fifth Ave., Oak Creek, WI
Instrument:	Personnel:	

Monitor Well Identification	Date	Time	Depth to LNAPL (ft btoc)	Depth to Groundwater (ft btoc)	Depth to DNAPL (ft btoc)	Well Depth (ft btoc)	Comments

Note: ft btoc = feet below top of casing. LNAPL = Light Non-Aqueous Phase Liquid. DNAPL = Dense Non-Aqueous Phase Liquid.

TETRA TECH

TETRA TECH FIELD PID DATA FORM

Project Number:	Date(s):
Project Name: Beazer Oak Creek, Former Koppers Tar Plant & Wabash Alloys Property	Personnel:
Site Location: 9100 South Fifth Ave. Oak Creek, WI	Meter Number: Probe eV:

Sample Number	Location	Depth (feet)	Sample Media (1)	Moisture (2)	Time Sample Collected	Time Sample Analyzed	Volatilization Period Air Temp. (^{O}C)	PID Readings (Instrument Units)			Comments
								Background	Peak Response	After 15 sec.	

(1) SO – Soil SD – Sediment GW – Groundwater SW – Surface Water WS – Waste (Solid) WL – Waste (Liquid)

(2) D - Dry M - Moist W - Wet

TETRA TECH

APPENDIX B

Standard Operating Procedures

STANDARD OPERATING PROCEDURE

SAMPLE IDENTIFICATION

1.0 PURPOSE

Locations for collection of samples are affixed alpha-numeric codes which are used to track affixed laboratory results and enable presentation of data on maps and drawings. Each plan view location where a sample is collected is issued a unique numeric code (number) which corresponds to a specific map location at a site. An alpha-code (letter) is used to describe the type of sampling activity performed at the specific numeric location. The date of sample collection will be listed and used to delineate sampling events.

The alpha-numeric codes used to identify existing wells and sample locations will be used to identify samples collected from existing wells or sample locations. The following alpha codes will be used to identify new sample locations:

B:	Borehole (no monitoring well installed)
EW or EX:	Extraction well for remediation of groundwater
MW:	Water table monitor well
P:	Piezometer well
PW:	Private residential well or Public water supply well
TP:	Test pit
SS:	Surface soil
SW:	Surface water sampling station
A:	Air sampling station
SD:	Sediment

Each number used at a site should correspond to one, and only one, location. A typical series of alpha numeric codes for a site might include test pit locations T-1 through T-12; borings B-13, B-14, B-15; monitor wells MW-16, MW-17, MW-18, etc. A borehole drilled with the intent of installing a monitor well or piezometer will be identified as MW or P. There should not be a borehole log B-1 for monitor well MW-1.

If previous work has been performed at a site, the alpha-numeric code should continue with previous successive numbers. If there is any potential for conflict with identified sample number identifiers, the proposed sample number should begin with series 101, 10001, or other appropriate system.

2.0 CONTAINER LABELING

Each sample container, tag, and/or label will contain the following information:

- Project number and/or project name
- Sample type identification code and number
- Date and time of collection
- Sampler's initials
- Preservative

The sample identification code will be an alpha-numeric code used to specify the material type, location, and sampling interval (i.e., depth), where appropriate, for each sample. For example: SB110-3 to 5 refers to a soil sample from borehole location 110 over the 3 to 5-foot depth interval, and MW-203 refers to a groundwater sample from monitor well location 203. The date of sample collection will be listed and used to delineate sampling events.

Listed below are the standard codes to identify the type of material to be sampled. To an extent, these codes also identify the sampling location.

SB: Sample from a soil borehole

WB: Water sample from a borehole with no monitor well

MW: Water table monitor well (soils and groundwater)

P: Piezometer well (soils and groundwater)

PW: Private residential well water samples

ST: Trench or test pit (soil)

WT: Trench or test pit (water)

SS: Surficial soil

SW: Surface water

SD: Sediment

A: Air

If a sample is a composite, the letter "C" should follow the depth intervals over which the composite was collected. An appropriate description of the sample should be recorded on the chain-of-custody record and field notebook.

3.0 SAMPLE INDENTIFICATION – MULTI SITE PROJECTS

For project situations where a number of sites are being investigated concurrently for an individual client, each site should be assigned a series of numbers for use in identifying sampling locations. An example is given below:

Site	Environmental Samples	QA Samples
# 1	101 to 119	11 to 19
# 2	201 to 299	21 to 29
# 3	301 to 399	31 to 39
# 4	401 to 499	41 to 49
# 5	501 to 599	51 to 59

# 6	601 to 699	61 to 69
# 7	701 to 799	71 to 79
# 8	801 to 899	81 to 89

For example; SD301 refers to a sediment sample collected at sampling location 301 at the number 3 site; and MW-21 refers to a QA (trip blank, field blank, duplicate) groundwater sample from a monitoring well at the number 2 site.

Samples collected for matrix spike and matrix spike duplicates analysis will be identified with the code MSD (e.g., MW-21-MSD).

STANDARD OPERATING PROCEDURE

GEOPROBE SAMPLING

1. PURPOSE

The purpose of this procedure is to obtain samples of saturated and unsaturated unconsolidated geologic materials from below grade. This procedure requires a weight-driven hydraulic rig to advance the GeoProbe sampled to the required sampling depth.

2. PROCEDURE

2.1 FIELD PREPARATION

Call for utility clearance more than 72 hours in advance to arrange utility staking in any subsurface boring or exploration area.
Notify client, property owner, and Regulatory agency if required

2.1.1 Forms

Soil boring and Monitoring Well Logs
Daily Report Sheets
Tailgate Health and Safety
Field Service Request

2.1.2 Equipment

- 1-inch diameter by 1-foot length or 2-inch diameter by 4 or 5 foot length GeoProbe macrosamplers and 4-foot long clear acetate liners (provided by probe contractor)
- Hooked razor knife for cutting sample tube liners into sections
- Latex or nitrile sampling gloves - sufficient quantity to provide one change for each sample collection interval
- Notebook and/or field record sheet to record boring information and observations
- A stainless steel (must be decontaminated between samples), disposable plastic, or wooden spatulas for cutting soil samples and transferring them to containers
- Pint (sandwich size) or quart size "zip-lock" plastic bags for soil sample field screening
- 1- or 2-gallon size zip lock bags for storage of filled sample bottles, chain-of-custody documents, and for separation of ice
- Large plastic trash bags
- Laboratory containers, labels, tamper protection security seals, and chain of custody sheets for appropriate type and number of samples
- Personal protective equipment as described within the Site Health and Safety Plan
- Laboratory cleaned cooler, ice or refrigerant gel packs, packaging and padding material (bubble wrap or foam), shipping labels, and packing tape

If needed:

- Photoionization detector(s) with 10.6 eV and/or 11.7 eV lamps
- DOT approved sealable 55-gallon drums, roll-off boxes, or other appropriate containers for storage of soil cuttings and discarded samples

•Field preservation (methanol or sodium bisulfate) and electronic scale

2.1.3 Documents
Field Service Request
Health and Safety Plan
Work Plan
Maps

2.1.4 Other
Cellular telephone
First aid kit
Fire extinguisher
Personal comfort items
Decontamination items and tools

2.2 FIELD ACTIVITIES

GeoProbe soil samples are generally retrieved from continuous intervals from the ground surface to the boring terminus using the 2-inch diameter by 4 or 5-foot long macrosampler, or at selected intervals using the 1-inch diameter by 1-foot long sampler. The sampling tool is hydraulically driven to collect continuous, relatively undisturbed soil samples in 4 or 5 foot long, clear, acetate liners. The 1-inch diameter by 1-foot length GeoProbe sampling tool can be hydraulically driven to collect continuous or discreet, relatively undisturbed soil samples within 1" acetate liners. Geologic logs are typically completed for each GeoProbe boring.

As each GeoProbe sampler is retrieved and opened, the on-site geologist will conduct the following activities using the procedures described.

2.2.1 Sample Collection
Don a new pair of disposable latex or nitrile gloves prior to handling each new sample interval.

Upon opening the acetate liner (using a hooked razor knife), describe and characterize the soil per the "Geologic Descriptions" SOP, or another acceptable method described in the project work plan or field sampling plan. Record this description on the soil boring log sheet and/or field notes form.

If using the 4 or 5-foot sampler with the clear acetate liner, identify the portions of the sample tube that will be used for geotechnical analyses, analytical evaluation, and for later biological and special chemical analysis.

Using either a decontaminated stainless steel implement, or a disposable plastic or wooden implement, place a portion of the sample into a zip-lock plastic bag for later field screening if necessary (per SOP – PID Screening).

At the sample depth intervals designated for laboratory analysis, proceed as follows: distribute the portion of the sample remaining in the sampler to laboratory supplied containers, preserving if necessary first. Place samples in the appropriate containers in order of decreasing volatility (ex.

purgeable halocarbons, aromatic hydrocarbons, semi-volatile hydrocarbons, and lastly metals and inorganics). If there is insufficient sample volume to provide all sampling needs, the balance of the sample will be obtained from the same depth interval in an adjacent boring drilled for additional sample volume.

Groundwater samples may be collected from saturated intervals using a temporary 1" well of using expendable point screens and a peristaltic pump.

2.2.2 Laboratory Sample Handling

To the extent possible, complete labels for laboratory containers (using permanent ink) in advance of sample collection. Place the appropriate label on the laboratory containers prior to filling with the sample. Add the sample to the container as described above, tightly cap the container, and place the tamper protection seal (if applicable) over the container cap. Then record the date, time of collection, and any other missing information, onto the label and chain of custody.

Wrap all glass laboratory containers in bubble wrap or foam, then place into large 1-2 gallon zip-lock bags, label the outside of the bag, and place into the coolers. Periodically add crushed ice to the coolers to maintain all collected samples under chilled conditions (refrigerant gel packs are an acceptable alternative). Ice should first be placed into separate large zip-lock bags to further isolate melt water from the samples. Ice should be distributed evenly through out the cooler.

Complete the sample Chain of Custody documentation, seal in a water tight zip-lock bag, and attach to the underside of the cooler lid with packaging tape. Ship coolers or arrange delivery to the laboratory as soon as practical and before the sample holding time limit expires.

Ensure the ground surface has been restored to acceptable conditions and all GeoProbe borings have been properly abandoned.

2.2.3 Decontamination and Clean Up

Decontaminate all sampling equipment and tools that will be reused between samples as follows: 1) Between samples within the same boring - Rinse with clean water, wash and scrub in an Alconox solution, rinse again with clean water, and allow to air dry. 2) Between borings - spray wash all sample tools and drilling rods, bits, and augers using a high pressure steam cleaner.

Drill cuttings, PVC liners, gloves, and other disposable sampling waste generated during the field investigation will be containerized using Department of Transportation- (DOT) approved 55-gallon drums if necessary. Removal and proper off-site disposal of the drill cuttings follow characterization analyses of the containerized soil.

3. QUALITY ASSURANCE

A field blank should be provided by the laboratory and kept with all soils collected from the site to insure sample integrity.

STANDARD OPERATING PROCEDURE

SOIL DESCRIPTIONS

1. PURPOSE

The purpose of this procedure is to describe and classify soil samples in the field during soil boring advancement.

2. PROCEDURE

2.1 FIELD PREPARATION

Call for utility clearance at least 72 hours in advance to arrange utility staking in any subsurface boring or exploration area.
Notify client, property owner, and Regulatory agency if necessary.

2.1.1 Forms

Soil Boring and Monitoring Well Logs
Tailgate Health and Safety
Daily Report Sheets

2.1.2 Equipment

Knife or spatula.
Ruler, tape measure, or scale.
Latex or nitrile gloves.
Sand gauge and geotechnical gauge, if necessary.
Pens, pencils and permanent markers.
Paper towels.
Small bottle of water.
Garbage bags.

2.1.3 Documents

Health and Safety Plan
Workplan
Maps
Site access agreements

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items

2.2 FIELD ACTIVITIES

The following sections provide guidance for how proper field visual descriptions of soils and rock samples should be conducted. These methods may not be applicable to every soil or rock sample found, but should provide enough guidance to allow accurate and defensible descriptions by a variety of field geologists.

The following section provides a description of the procedures that should be used when describing soils.

2.2.1 General Considerations for Description of Soils

The most popular soil classification method that is based on grain size and other properties, is the Unified Soil Classification System (USCS). This system was initially developed by A. Casagrande in 1948 and was then called the Airfield Classification System. It was adopted with minor modifications by the U.S. Bureau of Reclamation and the U.S. Corps of Engineers in 1952. In 1969, the American Society for Testing and Materials (ASTM) adopted the system. This system is designated currently by ASTM as D-2488-90 and will be used as a guideline for classifying and describing lithology. It requires certain information (e.g. liquid limit, plastic limit moisture content and plasticity index) about the soil which can only be obtained in a laboratory.

The USCS is based on grain size and response to physical manipulation at various water contents. This system is often used for classifying soils encountered in boreholes, test pits, and surface sampling. The following properties form the basis of USCS soil classification:

- Percentage of gravel, sand, and fines;
- Shape of the grain size distribution curve; and
- Plasticity and compressibility characteristics.

Four soil fractions are recognized. They are cobbles, gravel, sand, and fines (silt or clay). The soils are divided as coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils contain 50 percent of grains coarser than a number 200 sieve (approximately 0.08 mm). Fine grained soils contain more than 50 percent of material smaller than the number 200 sieve. Organic soils contain particles of leaves, roots, peat, etc.

2.2.2 Soil Description Procedures

The following will be used as a guideline for logging lithology from subsurface activities (i.e. borehole drilling, trenching, etc.).

The USCS recognizes 15 soil groups and uses names and letter symbols to distinguish between these groups. The coarse grained soils are subdivided into gravels (G) and sands (S). Both the gravel and sand groups are divided into four secondary groups. Fine grained soils are subdivided into silts (M) and clays (C).

Soils are also classified according to their plasticity and grading. Plastic soils are able to change shape under the influence of applied stress and to retain the shape once the stress is removed. Soils are referred to either low (L) or high (H) plasticity. The grading of a soil sample refers to the particle size distribution of the sample. A well graded (W) sand or gravel has a wide range of particle sizes and substantial amounts of particles sized between the coarsest and finest grains. A poorly graded (P) sand o gravel consists predominately of one size or has a wide range of sizes with some intermediate sizes missing.

Soils which have characteristics of two groups are given boundary classifications using the names that most nearly describe the soil. The two groups are separated by a slash. The same is true when a soil could be well or poorly graded. Again the two groups are separated by a slash.

Soil description should be concise and stress major constituents and characteristics for fine-grained, organic, or coarse-grained soils. Tables 1 and 2 are checklists for descriptions of fine-

grained, organic soils, and coarse-grained soils, respectively. Field descriptions should include as a minimum:

- Soil name: The basic name of the predominant constituent and a single-word modifier indicating the major subordinate constituent.

- Particle Size Distribution: An estimate of the percentage and grain-size range of each of the soil's subordinate constituents with emphasis on clay-particle constituents. This description may also include a description of angularity. This parameter is critical for assessing hydrogeology of the site and should be carefully and fully documented.

Criteria for grain size (Wentworth Scale):

Particle Size (mm)	Individual Particle Term
>256	Boulder Gravel
64 - 256	Cobble Gravel
32 - 64	Very Coarse Pebble Gravel
16 - 32	Coarse Pebble Gravel
8 - 16	Medium Pebble Gravel
4 - 8	Fine Pebble Gravel
2 - 4	Granule Gravel
1 - 2	Very Coarse Sand
0.5 - 1	Coarse Sand
0.25 - 0.5	Medium Sand
0.125 - 0.25	Fine Sand
0.0625 - 0.125	Very Fine Sand
0.004 - 0.0625	Silt
<0.004	Clay

Criteria for Amounts

Term	%
Trace	0 – 5
Few	5 - 10
Little	10 - 20
Some	20 - 35
With	35 - 50
And	50 i.e. equal parts

- Gradation or Plasticity. For granular soil (sands or gravels) that should be described as wellgraded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soil (silts or clays) should be described as non-plastic, low plastic, medium plastic, or highly plastic.

Criteria for Describing Plasticity

Descriptive item	Criteria
Nonplastic	A 1/8 inch (3 mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times close to the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

- Dry Strength. Dry strength describes the crushing characteristics of a dry soil crumb about ¼ inch (5 mm) in diameter. If a crumb of dry soil is not available, after removing particles larger than No. 40 sieve size, mold at least three balls of soil about ¼ inch (5 mm) in diameter to the consistency of putty, adding water if necessary. Allow the balls to dry completely by oven, sun, or air drying, and then test their strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

Criteria for Describing Dry Strength

Descriptive item	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure.
Medium	The dry specimen breaks into pieces and crumbles with considerable finger pressure.
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface.
Very high	The dry specimen cannot be broken between the thumb and a hard surface.

- Dilatancy. Dilatancy describes the soils reaction to shaking. After removing particles larger than No. 40 sieve size, prepare a ball of moist soil about ½ inch (15 mm) in diameter. Add enough water, if necessary, to make the soil soft but not sticky. Place the ball in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the ball which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the ball stiffens, and finally cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Criteria for Describing Dilatancy

Descriptive item	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear, or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

- Toughness. Toughness is the consistency of the soil near the plastic limit. After removing particles larger than the No. 40 sieve size, mold a ball of soil about ½ inch (15 mm) in diameter to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. The specimen is then rolled out by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. The thread is folded and rerolled repeatedly. During this manipulation, the moisture content is gradually reduced and the specimen stiffens, finally loses it plasticity, and crumbles when the plastic limit is reached.

Criteria for Describing Toughness

Descriptive item	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
Medium	Medium pressure is required to roll the thread to near the plastic limit. The lump and thread have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness.

- Color. The basic color of the soil (refer to Munsell soil color charts).

Criteria for Mottling:

Contrast Term	Description
Faint	indistinct
Distinct	easily seen
Prominent	outstanding

- Odor. Odor is described from a warm, moist sample. The odor should only be described if it is organic or unusual. An organic odor will have distinctive decaying vegetation smell. Unusual odors, petroleum product, chemical, and the like should be described.

- Soil Texture and Structure. Description of particle size distribution, arrangement of particles into aggregates, and their structure. This description includes joints, fissures, slicked sides, bedding, veins, root holes, debris, organic content, and residual or relict structure, as well as other characteristics that may influence the movement or retention of water or contaminants.

Structure (for description of soils only)

Descriptive item	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
Laminated	Alternating layers of varying material or color with layers less than 6 mm (1/ 4 inch) thick; note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout.

Additional descriptors for bedding or laminations

Term	Thickness (feet/meters)
Very Thickly Bedded	> 3.3’ (1 m)
Thickly Bedded	1’- 3.3’ (30 - 100 cm)
Medium Bedded	4” - 1’ (10 - 30 cm)
Thinly Bedded	1” - 4” (3 - 10 cm)
Very Thinly Bedded	0.4” - 1” (1 - 3 cm)
Thickly Laminated	0.12” - 0.4” (0.1 - 1 cm)
Thinly Laminated	<0.12” (<0.3 cm)

- Moisture Content. The amount of soil moisture described as dry, moist, or wet/saturated.

Criteria for Describing Moisture

Descriptive item	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet/saturated	Visible free water, usually soil is below water table.

- Relative Density or Consistency. An estimate of density of a fine-grained soil or consistency of a cohesive soil, usually based on standard penetration tests.

Criteria for Describing Consistency

Descriptive item	Criteria
Very soft	Thumb penetrates soil more than 1 inch
Soft	Thumb penetrates about 1 inch
Firm	Thumb indentation up to ¼ inch
Hard	No indentation with thumb, readily indented with thumbnail
Very Hard	Not indented with thumbnail

Density, based upon blow counts:

Sand or Gravel	Blows per foot	Silt or Clay	Blows per foot	Thumb Penetration
Very loose	0 - 4	Very soft	0 - 2	Very easily
Loose	4 - 10	Soft	2 - 4	Easily
Medium dense	10 - 30	Medium stiff	4 - 8	Moderate effort
Dense	30 - 50	Stiff	8 - 15	Indented easily
Very dense	>50	Very stiff	15 - 30	Indented by nail
		Hard	>30	Difficult by nail

- Cementation. An estimate of cementation of a coarse-grained soil.

Criteria for Describing Cementation

Descriptive item	Criteria
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

- Relative Permeability. An estimate of the permeability based on visual examination of materials (e.g., high permeability for course sand and gravel verses low permeability for silty clay). The estimate should address presence and condition of fractures (open, iron-stand, calcite-filled, open but claylined, etc.), as well as fracture density and orientation;

- Local Geologic Name. Any specific local name or generic name (i.e., alluvium, loess).

- Group Symbol. USCS of symbols.

The soil logs should also include a complete description of any tests run in the borehole; placement and construction details of piezometers, wells, and other monitoring equipment; abandonment records; geophysical logging techniques used; and notes on readings obtained by air monitoring instruments.

Examples of soil descriptions:
Fine to coarse **SAND**, and medium to coarse **GRAVEL**
Fine **GRAVEL**, some fine to coarse Sand, little Silt, trace Clay
Medium to coarse **SAND**, trace fine Gravel, trace fine Sand
Gray, wet, medium dense, fine to coarse **SAND**, some fine Gravel
Brown with distinct gray mottling, moist, soft, interbedded **SILT** and **CLAY**, trace fine Sand, very thinly bedded.

Notes:
-Always use capital letters for primary constituents, or both primary constituents if you use "and". The first letter of each subsequent component of soil content is capitalized.
-Describe grain size small to large (ex. fine to coarse Gravel).
-Within one percentage category, list in decreasing grain-size (ex. trace fine Gravel, trace fine Sand).

STANDARD OPERATING PROCEDURE

SOIL SCREENING USING A PID

1. PURPOSE

The purpose of this procedure is to screen soil samples while in the field for the presence of volatile organic vapors using a photoionization detector (PID).

2. PROCEDURE

2.1 FIELD PREPARATION

Charge and calibrate the instrument.

2.1.1 Forms

Daily Report Sheets
Tailgate Health and Safety
Field PID Screening Data Form

2.1.2 Equipment

PID with 10.6 eV lamp for lighter (molar mass) organic compounds, and an 11.7 eV lamp for heavier organic compounds.
Either a stainless steel (must be decontaminated between samples) or a disposable plastic or wooden spatula for cutting soil samples and transferring them to containers.
Latex or nitrile sampling gloves - sufficient quantity to change for each sample collection event.
Self-locking plastic bags for field screening
Watch or clock.
Permanent fine point markers.
DOT-approved sealed drums for storage of excess soil (if required).
Personal protective equipment as described within the Site Health and Safety Plan.

2.1.3 Documents

Health and Safety Plan
Workplan
Maps

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items
Bubble wrap for samples
Distilled water
Paper towels

2.2 FIELD ACTIVITIES

Select and install the lamp with the appropriate ionization energy for the objective of the field screening. See the PID instruction manual for proper lamp selection for various compounds.

2.2.1 Calibration

Calibrate the PID by following the calibration procedure described in the PID instruction manual. Be sure to use the appropriate calibration gas as identified within the manual.

2.2.2 Sample collection

After retrieving a soil sample from the sample location, segregate the portion of the sample identified for screening either a decontaminated stainless steel implement, or a disposable plastic or wooden implement. Place the soil sample into the zip-lock plastic bag and seal the bag. Set the plastic bag and sample aside for later PID screening. A new pair of disposable latex or nitrile gloves must be worn for each soil screening event.

After being placed into the self-locking plastic bag, the sample will be clearly labeled using permanent ink, and allowed to equilibrate with ambient air temperature (minimum wait of 15 minutes). If the ambient temperature is below 32 degrees Fahrenheit (0 degress Celsius), the sample should be placed in a heated vehicle or a building for 15 minutes prior to analysis.

Note and record the background PID response on the field PID data form, then slightly open the seal on the self-locking plastic bag, insert the PID probe tip, and observe and record the response. Do not allow the probe tip to come into contact with the soil sample to prevent the uptake of soil particles into the PID. If the vapor concentrations rise quickly and then subside, record the maximum reading indicated. If the vapor readings increase slowly, observe the readings and record the concentration response after one minute.

Record the observed vapor concentrations on the field PID data form, *and* the rate of response, as this provides useful information about the relative volatility of the vapor-emitting compounds. Record descriptions of the soil type and relative moisture content and note any visual or olfactory impacts.

Allow the monitoring equipment to return to zero before initiating the next sample screening.

3. QUALITY ASSURANCE

Always calibrate the instrument prior to use. Telephone the project manager prior to leaving the site at the completion of each day.

STANDARD OPERATING PROCEDURE

GROUNDWATER ELEVATIONS

1. PURPOSE

The purpose of this procedure is to obtain groundwater level measurements from wells and piezometers to assist in defining site hydrogeologic conditions.

2. PROCEDURE

2.1 FIELD PREPARATION

Notify client, property owner, and regulatory angency as necessary.

2.1.1 Forms

Water Level Data Sheet
Daily Report Sheets
Tailgate Health and Safety
Field Service Request

2.1.2 Equipment

Well keys
Electronic water level indicator
Calculator
Latex or nitrile gloves
Tools to access wells
Metal detector, turkey baster or plastic cup
Pens and permanent markers.
Decontamination equipment including deionized or distilled water, Alconox, and paper towels.
Garbage bags.

2.1.3 Documents

Well Construction Log, or total well depth and previous water level measurements
Well location map/site map
Work Plan
Health and Safety Plan
Signed site access agreement, as applicable

2.1.4 Other

Cellular phone
Replacement locks
Writing implements and an indelible marker
First aid kit
Personal comfort items
Machete or other vegetation-clearing tool

2.2 FIELD ACTIVITIES

Don a new pair of latex or nitrile gloves and open the well with a socket set if it is a flush grade manhole cover or a key if it is an above grade cover.

Beware of insects (particularly wasps and bees) that may be nesting within the protective casing. Bail out any standing water with a turkey baster or cup in flush-grade manholes. Note on presence and appearance of standing water, insects, and well condition.

Unlock, loosen, and carefully remove locking expandable well cap.

Well may be under pressure. Always face away from well when removing well cover. Allow groundwater elevation to stabilize for a minimum of five minutes prior to measuring depth to groundwater. When working on smaller sites, it may be appropriate to open all of the wells first, and then gauge them.

2.2.1 Identify the Monitoring Point for the Well

The well monitoring point may be the north side of the riser casing and marked with an indelible marker, or on the highest side of the top of casing. The top of an above-grade protector or flush-grade manhole should never be used as a reference point due to frost heave and settling. Note the reference point used on the *Water Level Data Sheet.*

2.2.2 Obtain the Water Level Measurement

Water levels will be measured from suspected cleanest (up-gradient) well to the suspected most contaminated (down-gradient or near source) well.

Use a consistent sensitivity setting for all wells.

Lower the decontaminated probe into the well until a "beep" sound is heard. The probe should be raised and lowered to confirm the exact water level. NOTE: condensation inside the well casing can result in a premature sounding and contaminants can result in incorrect confirmatory measurements. Refer to previous depths to groundwater recorded on the *Field Groundwater Sample Form* to verify measurement, if available. When a false reading is suspected, gently shake the tape of the electronic water level indicator until the audible sound stops. Then proceed to lower the probe to confirm.

Read the tape at the monitoring point and recorded the measurement to the nearest 0.01-foot on the *Water Level Data* Sheet.

Lower probe to bottom of well and record total depth on *Field Groundwater Sample Form,* if necessary.

Complete all information on the *Water Level Data* Sheet.

2.2.4 Decontamination

The measuring device shall be decontaminated immediately after each use. The decontamination procedure should be initiated while reeling in the tape and probe: wipe tape with clean paper towel soaked with deionized or distilled water and Alconox solution, rinse probe with deionized or distilled water and Alconox solution, rinse tape and probe with deionized or distilled water, and dry probe with clean paper towel. Apply decontamination fluids with a labeled spray bottle.

3. QUALITY ASSURANCE

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

STANDARD OPERATING PROCEDURE

MONITORING WELL DEVELOPMENT

1. PURPOSE

This procedure describes development procedures for wells and piezometers in unconsolidated and consolidated (rock) materials. Adherence to this procedure will ensure that wells and piezometers installed as part of a groundwater impact investigation will be adequate for the collection of groundwater quality samples and water level measurements. Wells or piezometers may be installed to determine one or more of the following: 1) water table or piezometric elevations and their fluctuation over time; 2) the presence or absence of light non-aqueous phase liquids (LNAPLs) on the water surface, or dense non-aqueous phase liquids (DNAPLs) at depth; and 3) the presence or absence of specific contaminant compounds in the groundwater.

2. PROCEDURE

2.1 FIELD PREPARATION

Call for utility clearance more than 72 hours in advance of field activity commencement to identify buried utilities in the area of subsurface activity.
Notify the client, property owner, and Regulatory agency as necessary.

2.1.1 Forms

Field notebook
Field well development forms
Tailgate Health and Safety form
Daily Report Sheets

2.1.2 Equipment

Extra well caps (expanding, locking) to replace missing or damaged caps.
Extra locks (keyed alike) to replace missing or broken well locks.
Well keys
Bailers (disposable or dedicated) and/or submersible pump, discharge hose and generator.
Graduated bucket.
Tools to open flush-mount wells.
Latex or nitrile gloves.
Pens, pencils and permanent markers.
Water quality meter (temperature-pH-conductivity)

2.1.3 Documents

Site Access Agreements (if necessary)
Site maps
Workplan
Health and Safety Plan

2.1.4 Other

Cellular telephone
First aid kit
Personal comfort items
Drum(s) or polyethylene tank(s) if groundwater needs to be contained.

2.2 Well Development

Wells and monitor wells will be developed using either a pump or a bailer or a combination of the two to remove the effects of drilling and installation operations. If a monitor well can be purged dry, development will consist of slowly purging the well dry to limit agitation. Development is complete when ten well volumes have been removed, or sediment-free water is produced. If a monitor well cannot be purged dry, it will be developed by alternately surging and purging the well for a minimum of 30 minutes and then pumping or bailing until ten well volumes are removed or until sediment free water is produced.

The well casing volume is determined as follows:

- Using the electronic water level indicator, determine the depth to the top of the water table surface (H_1).
- Determine the depth to the bottom of the well (H_2) using the *Well Construction Log* if verified, or by using the water level indicator. Measure the total well depth during your first visit to a site.
- Calculate the height of the column of water (H) as the difference between the two measurements ($H = H_2 - H_1$).
- Calculate the volume of water occupying the well casing using the formula to calculate the volume of a cylinder:

$$\mathbf{V = \pi r^2 H}$$

where:
V = volume of water in the casing, in gallons
π = the constant "Pi", approximately equal to 3.14
r = radius of the well casing, in feet
H = height of the initial column of water in the casing, in feet

It is imperative that all units are compatible; i.e., do not use inches for **r**, meters for **H**, and gallons for **V.**
A simplified version of this formula is provided using the well casing diameter in inches:

Well Casing Diameter (inches)	Equation
1	V= H (0.0408)
2	V= H (0.1632)
4	V=H (0.6528)
6	V=H (1.4688)

where:
V = volume of water in the casing, in gallons
H = height of the initial column of water in the casing, in feet

Multiply the casing volume by three or five to determine the minimum volume of water that should be purged from the well prior to collecting a water sample.

Periodic measurements and observations of field parameters including temperature, specific conductance, pH, visual appearance and odor will be made and recorded on well development/purge summary form as each well is developed. In addition, time expended in development, volume of water removed, and any sedimentation present in the bottom of each well before and after development will be noted. Water level measurements will be obtained prior to and following development, and following water level stabilization.

3. QUALITY ASSURANCE

There are no specific quality assurance (QA) activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks/notebooks.
2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

STANDARD OPERATING PROCEDURE

LOW-FLOW (MINIMUM DRAWDOWN) GROUNDWATER SAMPLING

1. PURPOSE

This standard operating procedure (SOP) provides a general framework for collecting ground water samples that are indicative of mobile organic and inorganic loads at ambient flow conditions (both the dissolved fraction and the fraction associated with mobile particulates). The SOP emphasizes the need to minimize stress by low water-level drawdowns, and low pumping rates (usually less than 1 liter/min) in order to collect samples with minimal alterations to water chemistry. This SOP is aimed primarily at sampling monitoring wells that can accept a submersible pump and have a screen, or open interval length of 10 feet or less (this is the most common situation). However, this procedure is flexible and can be used in a variety of well construction and ground-water yield situations. Samples thus obtained are suitable for analyses of ground water contaminants (volatile and semi-volatile organic analytes, pesticides, PCBs, metals and other inorganics), or other naturally occurring analytes.

This procedure does not address the collection of samples from wells containing light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). For this the reader may wish to check: Cohen, R.M. and J.W. Mercer, 1993, DNAPL Site Evaluation; C.K. Smoley (CRC Press), Boca Raton, Florida and U.S. Environmental Protection Agency, 1992, RCRA Ground-Water Monitoring: Draft Technical Guidance; Washington, DC (EPA/530-R-93-001).

The screen, or open interval of the monitoring well should be optimally located (both laterally and vertically) to intercept existing contaminant plume(s) or along flowpaths of potential contaminant releases. It is presumed that the analytes of interest move (or potentially move) primarily through the more permeable zones within the screen, or open interval.

Proper well construction and development cannot be overemphasized, since the use of installation techniques that are appropriate to the hydrogeologic setting often prevents "problem well" situations from occurring. It is also recommended that as part of development or redevelopment the well should be tested to determine the appropriate pumping rate to obtain stabilization of field indicator parameters with minimal drawdown in shortest amount of time. With this information field crews can then conduct purging and sampling in a more expeditious manner.

The mid-point of the saturated screen length (which should not exceed 10 feet) is used by convention as the location of the pump intake. However, significant chemical or permeability contrast(s) within the screen may require additional field work to determine the optimum vertical location(s) for the intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permealability and/or high(er) chemical concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help insure that the low stress procedure will not underestimate contaminant concentrations. The Sampling and

Analysis Plan must provide clear instructions on how the pump intake depth(s) will be selected, and reason(s) for the depth(s) selected.

Stabilization of indicator field parameters is used to indicate that conditions are suitable for sampling to begin. Achievement of turbidity levels of less than 5 NTU and stable drawdowns of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the remaining criteria in this procedure are met. If after 4 hours of purging indicator field parameters have not stabilized, one of 3 optional courses of action may be taken: a) continue purging until stabilization is achieved, b) discontinue purging, do not collect any samples, and record in log book that stabilization could not be achieved (documentation must describe attempts to achieve stabilization) c) discontinue purging, collect samples and provide full explanation of attempts to achieve stabilization (note: there is a risk that the analytical data obtained, especially metals and strongly hydrophobic organic analytes, may not meet the sampling objectives).

2. PROCEDURE

2.1 FIELD PREPARATION

Notify client, property owner, and Regulatory agency as necessary.

2.1.1 Forms

- Water Level Data Sheet
- Daily Report Sheets
- Chain of Custodies
- Water Quality Data Sheet
- Field Service Request
- Tailgate Health and Safety
- Well Construction Log
- Well location map/site map
- Work Plan
- Health and Safety Plan
- Signed site access agreement

2.1.2 Equipment

- Extraction device - Adjustable rate, submersible pumps are preferred (for example, centrifugal or bladder pump constructed of stainless steel or Teflon). Adjustable rate, peristaltic pumps (suction) may be used with caution. Note that EPA guidance states: "Suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds" (EPA/540/P-87/001, 1987, page 8.5-11). The use of inertial pumps is discouraged. These devices frequently cause greater disturbance during purging and sampling and are less easily controlled than the pumps listed above. This can lead to sampling results that are adversely affected by purging and sampling operations, and a higher degree of data variability.

- Tubing - Teflon or Teflon lined polyethylene tubing are preferred when sampling is to include VOCs, SVOCs, pesticides, PCBs and inorganics. PVC, polypropylene or polyethylene tubing may be used when collecting samples for inorganics analyses. However, these materials should be used with caution when sampling for organics. If these materials are used, the equipment blank (which includes the tubing) data must show that these materials do not add contaminants to the sample. Stainless steel tubing may be used when sampling for VOCs, SVOCs, pesticides, and PCBs. However, it should be used with caution when sampling for metals. The use of 1/4 inch or 3/8 inch (inner diameter) tubing is preferred. This will help ensure the tubing remains liquid filled when operating at very low pumping rates. Pharmaceutical grade (Pharmed) tubing should be used for the section around the rotor head of a peristaltic pump, to minimize gaseous diffusion.
- Water level measuring device(s), capable of measuring to 0.01 foot accuracy (electronic "tape", pressure transducer). Recording pressure transducers, mounted above the pump, are especially helpful in tracking water levels during pumping operations, but their use must include check measurements with a water level "tape" at the start and end of each record.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Interface probe, if needed.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at least 30 feet from the well so that the exhaust fumes do not contaminate the samples.
- Indicator field parameter monitoring instruments - pH, Eh, dissolved oxygen (DO), turbidity, specific conductance, and temperature. Use of a flow-through-cell is required when measuring all listed parameters, except turbidity. Standards to perform field calibration of instruments. Analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW-846. For Eh measurements, follow manufacturer's instructions.
- Decontamination equipment including deionized or distilled water, Alconox, graduated cylinders, and paper towel
- Logbook(s), and other forms (for example, well purging forms).
- Laboratory provided containers and labels
- Laboratory-cleaned cooler
- Ice to keep the samples cold
- Well construction data, location map, field data from last sampling event.
- Well keys.
- Site specific Sample and Analysis Plan/Quality Assurance Project Plan.
- PID or FID instrument (if appropriate) to detect VOCs for health and safety purposes, and provide qualitative field evaluations.
- Calculator
- Latex or nitrile gloves
- Tools to access wells
- Knife, or scissors
- Garbage bags
- Two graduated 5-gallon pails to collect purge water

- Cellular phone
- Replacement locks
- Writing implements and an indelible marker

If needed:

- DOT-approved sealed drums for storage of purged well water, or a suitable location to disperse of liquid (i.e., on-site treatment system)
- Quantab ™ and Hach™ Titration kits
- Bubble wrap if required to protect samples during shipment to the laboratory.
- Machete or other vegetation-clearing tool

2.2 FIELD ACTIVITIES

2.2.1 Preliminary Site Activities

Check well for security damage or evidence of tampering, record pertinent observations.

Lay out sheet of clean polyethylene for monitoring and sampling equipment.

Remove well cap and immediately measure VOCs at the rim of the well with a PID or FID instrument and record the reading in the field logbook.

If the well casing does not have a reference point (usually a V-cut or indelible mark in the well casing), make one. Describe its location and record the date of the mark in the logbook.

A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. It is recommended that water level depth (to 0.01 ft.) and total well depth (to 0.1 ft.) be measured the day before, in order to allow for re-settlement of any particulates in the water column. If measurement of total well depth is not made the day before, it should not be measured until after sampling of the well is complete. All measurements must be taken from the established referenced point. Care should be taken to minimize water column disturbance.

Check newly constructed wells for the presence of LNAPLs or DNAPLs before the initial sampling round. If none are encountered, subsequent check measurements with an interface probe are usually not needed unless analytical data or field head space information signal a worsening situation. Note: procedures for collection of LNAPL and DNAPL samples are not addressed in this SOP.

2.2.2 Well Purging and Sampling Procedure

Sampling wells in order of increasing chemical concentrations (known or anticipated) is preferred.

1. Install Pump – Lower pump, safety cable, tubing and electrical lines slowly (to minimize disturbance) into the well to the midpoint of the zone to be sampled. The Sampling and Analysis Plan should specify the sampling depth, or provide criteria for selection of intake depth for each well (see Section I). If possible keep the pump intake at least two feet above the bottom of the well, to minimize mobilization of particulates present in the bottom of the well. Collection of turbid free water samples may be especially difficult if there is two feet or less of standing water in the well.
2. Measure Water Level – Before starting pump, measure water level. If recording pressure transducer is used-initialize starting condition.
3. Purge Well
    a. Initial Low Stress Sampling Event – Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level. Adjust pump speed until there is little or no water level drawdown (less than 0.3 feet). If the minimal drawdown that can be achieved exceeds 0.3 feet but remains stable, continue purging until indicator field parameters stabilize.

        Monitor and record water level and pumping rate every three to five minutes (or as appropriate) during purging. Record any pumping rate adjustments (both time and flow rate). Pumping rates should, as needed, be reduced to the minimum capabilities of the pump (for example, 0.1 - 0.4 l/min) to ensure stabilization of indicator parameters. Adjustments are best made in the first fifteen minutes of pumping in order to help minimize purging time. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" as pump flow adjustments are made. Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Do not allow the water level to fall to the intake level (if the static water level is above the well screen, avoid lowering the water level into the screen). The final purge volume must be greater than the stabilized drawdown volume plus the extraction tubing volume.

        Wells with low recharge rates may require the use of special pumps capable of attaining very low pumping rates (bladder, peristaltic), and/or the use of dedicated equipment. If the recharge rate of the well is lower than extraction rate capabilities of currently manufactured pumps and the well is essentially dewatered during purging, then the well should be sampled as soon as the water level has recovered sufficiently to collect the appropriate volume needed for all anticipated samples (ideally the intake should not be moved during this recovery period). Samples may then be collected even though the indicator field parameters have not stabilized.

        NOTE: If well goes dry before at least 3 well volumes can be purged from the well, allow groundwater to recharge, then collect sample.

    b. Subsequent Low Stress Sampling Events – After synoptic water level measurement round, check intake depth and drawdown information from previous sampling event(s) for each well. Duplicate, to the extent practicable, the intake

depth and extraction rate (use final pump dial setting information) from previous event(s). Perform purging operations as above.

4. Monitor Indicator Field Parameters – During well purging, monitor indicator field parameters (turbidity, temperature, specific conductance, pH, Eh, DO) every three to five minutes (or less frequently, if appropriate). Note: during the early phase of purging emphasis should be put on minimizing and stabilizing pumping stress, and recording those adjustments. Purging is considered complete and sampling may begin when all the above indicator field parameters have stabilized. Stabilization is considered to be achieved when three consecutive readings, taken at three (3) to five (5) minute intervals, are within the following limits:
   - turbidity (10% for values greater than 1 NTU),
   - DO (10%), specific conductance (3%),
   - temperature (3%),
   - pH (± 0.1 unit),
   - ORP/Eh (± 10 millivolts).

   All measurements, except turbidity, must be obtained using a flow-through-cell. Transparent flow-through-cells are preferred, because they allow field personnel to watch for particulate build-up within the cell. This build-up may affect indicator field parameter values measured within the cell and may also cause an underestimation of turbidity values measured after the cell. If the cell needs to be cleaned during purging operations, continue pumping and disconnect cell for cleaning, then reconnect after cleaning and continue monitoring activities.

   The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. When the pump is turned off or cycling on/off (when using a bladder pump), water in the cell must not drain out. Monitoring probes must be submerged in water at all times. If two flow-through-cells are used in series, the one containing the dissolved oxygen probe should come first (this parameter is most susceptible to error if air leaks into the system).

5. Collect Water Samples – Water samples for laboratory analyses must be collected before water has passed through the flow-through-cell (use a by-pass assembly or disconnect cell to obtain sample).

   VOC samples should be collected first and directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.

   During purging and sampling, the tubing should remain filled with water so as to minimize possible changes in water chemistry upon contact with the atmosphere. It is recommended that 1/4 inch or 3/8 inch (inside diameter) tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, use one of the following procedures to collect samples:

- add clamp, connector (Teflon or stainless steel) or valve to constrict sampling end of tubing;
- insert small diameter Teflon tubing into water filled portion of pump tubing allowing the end to protrude beyond the end of the pump tubing, collect sample from small diameter tubing;
- collect non-VOC samples first, then increase flow rate slightly until the water completely fills the tubing, collect sample and record new drawdown, flow rate and new indicator field parameter values.

Add preservative, as required by analytical methods, to samples immediately after they are collected if the sample containers are not pre-preserved. Check analytical methods (e.g. EPA SW-846, water supply, etc.) for additional information on preservation. Check pH for all samples requiring pH adjustment to assure proper pH value. For VOC samples, this will require that a test sample be collected during purging to determine the amount of preservative that needs to be added to the sample containers prior to sampling.

If determination of filtered metal concentrations is a sampling objective, collect filtered water samples using the same low flow procedures. The use of an in-line filter is required, and the filter size (0.45 um is commonly used) should be based on the sampling objective. Pre-rinse the filter with approximately 25 - 50 ml of ground water prior to sample collection. Preserve filtered water sample immediately. Note: filtered water samples are not an acceptable substitute for unfiltered samples when the monitoring objective is to obtain chemical concentrations of total mobile contaminants in ground water for human health risk calculations.

Label each sample as collected. Samples requiring cooling (volatile organics, cyanide, etc.) will be placed into a cooler with ice or refrigerant for delivery to the laboratory. Metal samples after acidification to a pH less than 2 do not need to be cooled.

6. Post Sampling Activities – If recording pressure transducer is used, remeasure water level with tape.

   After collection of the samples, the pump tubing may either be dedicated to the well for resampling (by hanging the tubing inside the well), decontaminated, or properly discarded.

   Before securing the well, measure and record the well depth (to 0.1 ft.), if not measured the day before purging began. Note: measurement of total well depth is optional after the initial low stress sampling event. However, it is recommended if the well has a “silting” problem or if confirmation of well identity is needed.

   Secure the well.

2.2.3 Decontamination

Decontaminate sampling equipment prior to use in the first well and following sampling of each subsequent well. Pumps will not be removed between purging and sampling operations. The pump and tubing (including support cable and electrical wires which are in contact with the well) will be decontaminated by one of the procedures listed below.

Procedure 1
The decontaminating solutions can be pumped from either buckets or short PVC casing sections through the pump or the pump can be disassembled and flushed with the decontaminating solutions. It is recommended that detergent and isopropyl alcohol be used sparingly in the decontamination process and water flushing steps be extended to ensure that any sediment trapped in the pump is removed. The pump exterior and electrical wires must be rinsed with the decontaminating solutions, as well. The procedure is as follows:

- Flush the equipment/pump with potable water.
- Flush with non-phosphate detergent solution. If the solution is recycled, the solution must be changed periodically.
- Flush with potable or distilled/deionized water to remove all of the detergent solution. If the water is recycled, the water must be changed periodically.
- Flush with isopropyl alcohol (pesticide grade). If equipment blank data from the previous sampling event show that the level of contaminants is insignificant, then this step may be skipped.
- Flush with distilled/deionized water. The final water rinse must not be recycled.

Procedure 2
Steam clean the outside of the submersible pump. Pump hot potable water from the steam cleaner through the inside of the pump. This can be accomplished by placing the pump inside a three or four inch diameter PVC pipe with end cap. Hot water from the steam cleaner jet will be directed inside the PVC pipe and the pump exterior will be cleaned. The hot water from the steam cleaner will then be pumped from the PVC pipe through the pump and collected into another container. Note: additives or solutions should not be added to the steam cleaner.

Pump non-phosphate detergent solution through the inside of the pump. If the solution is recycled, the solution must be changed periodically.

Pump potable water through the inside of the pump to remove all of the detergent solution. If the solution is recycled, the solution must be changed periodically.

Pump distilled/deionized water through the pump. The final water rinse must not be recycled.

2.2.4 Disposal

Dispose of all gloves, bailers, rope/string, tubing, and filters used to collect the sample prior to accessing the next well. Empty purge water onto the ground, away from the well, or in the event containerizing is required, transfer purged water from the pail into the appropriate storage container for storage until disposal/treatment is arranged.

3. QUALITY ASSURANCE

Quality control samples are required to verify that the sample collection and handling process has not compromised the quality of the ground water samples. All field quality control samples must be prepared the same as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples shall be collected for each batch of samples (a batch may not exceed 20 samples). Trip blanks are required for the VOC samples at a frequency of one set per VOC sample cooler.

- Field duplicate.
- Matrix spike.
- Matrix spike duplicate.
- Equipment blank.
- Trip blank (VOCs).
- Temperature blank (one per sample cooler).

Equipment blank shall include the pump and the pump's tubing. If tubing is dedicated to the well, the equipment blank will only include the pump in subsequent sampling rounds.

Collect samples in order from wells with lowest contaminant concentration to highest concentration. Collect equipment blanks after sampling from contaminated wells and not after background wells.

Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect duplicate for each analyte group in consecutive order (VOC original, VOC duplicate, SVOC original, SVOC duplicate, etc.).

If split samples are to be collected, collect split for each analyte group in consecutive order (VOC original, VOC split, etc.). Split sample should be as identical as possible to original sample.

All monitoring instrumentation shall be operated in accordance with EPA analytical methods and manufacturer's operating instructions. EPA analytical methods are listed in 40 CFR 136, 40 CFR 141, and SW- 846 with exception of Eh, for which the manufacturer's instructions are to be followed. Instruments shall be calibrated at the beginning of each day. If a measurement falls outside the calibration range, the instrument should be re-calibrated so that all measurements fall within the calibration range. At the end of each day, check calibration to verify that instruments remained in calibration. Temperature measuring equipment, thermometers and thermistors, need not be calibrated to the above frequency. They should be checked for accuracy prior to field use according to EPA Methods and the manufacturer's instructions.

Avoid cross-contamination of wells with the water level indicator, and sampling equipment by conducting proper decontamination procedures described above. Take care in labeling the samples, and the corresponding *Chain-of-Custody* with the correct sample date, time and well identification. All labeling must be consistent between sample labels and the *Chain of Custody*. Keep samples on ice following collection, and be conscience of "hold-times" for the samples. It is imperative that samples are submitted to the laboratory prior to the exceedence of hold times.

4. FIELD LOG BOOK

A field log shall be kept to document all ground water field monitoring activities (see attached example matrix), and record all of the following:

- Well identification.
- Well depth, and measurement technique.
- Static water level depth, date, time and measurement technique.
- Presence and thickness of immiscible liquid (NAPL) layers and detection method.
- Pumping rate, drawdown, indicator parameters values, and clock time, at the appropriate time intervals; calculated or measured total volume pumped.
- Well sampling sequence and time of each sample collection.
- Types of sample bottles used and sample identification numbers.
- Preservatives used.
- Parameters requested for analysis.
- Field observations during sampling event.
- Name of sample collector(s).
- Weather conditions.
- QA/QC data for field instruments.
- Any problems encountered should be highlighted.
- Description of all sampling equipment used, including trade names, model number, diameters, material composition, etc.

STANDARD OPERATING PROCEDURE

CHAIN-OF-CUSTODY PROCEDURES

1.0 PURPOSE

Chain-of-custody procedures are established to provide sample integrity. Sample custody protocols will be based on procedures as described in "NEIC Policies and Procedures", EPA-330/9-78-DD1-R, Revised June, 1985. This custody is in two parts: sample collection and laboratory analysis. A sample is under a person's custody if it meets the following requirements:

- It is in the person's possession;
- It is in the person's view, after being in the person's possession;
- It was in the person's possession and it was placed in a secured location; or
- It is in a designated secure area.

2.0 FIELD SPECIFIC CUSTODY PROCEDURES

The sample packaging and shipment procedures summarized below will assure that the samples will arrive at the laboratory with the chain-of-custody intact.

Field procedures are as follows:

(a) The field sampler is personally responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples.

(b) All bottles should be tagged with sample numbers and locations.

(c) Sample tags should be filled out using waterproof ink for each sample.

(d) The Project Manager should review all field activities to determine whether proper custody procedures were followed during the field work and decide if additional samples are required.

Transfer of Custody and Shipment Procedures are as follows:

(a) Samples should be accompanied by a properly completed chain-of-custody form (Attachment A). The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

(b) Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample

box or cooler. Shipping containers will be locked and secured with strapping tape in at least two locations for shipment to the laboratory. Custody seals will be used for samples shipped to laboratories. When custody seals are used, two printed, numbered custody seals will be placed on each cooler and the numbers will also appear on the chain-of-custody forms, or two signed and dated seals will be placed on the cooler. Clear tape will be placed over the seals.

(c) Whenever samples are split with a source or government agency, a separate Sample Receipt is prepared for those samples and marked to indicate with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.

(d) If the samples are sent by common carrier, a bill of lading should be used. Receipts of bills of lading will be retained as part of the permanent documentation. If sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler. Air bill information will be recorded on chain-of-custody forms.

STANDARD OPERATING PROCEDURE

CALIBRATION OF FIELD INSTRUMENTS

Note: Taken from "Standard Operating Procedure Calibration of Field Instruments" (U.S. EPA January 19, 2010, Revision Number 2).

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide a framework for calibrating field instruments used to measure water quality parameters for groundwater and surface water. Water quality parameters include temperature, pH, dissolved oxygen, specific conductance, oxidation/reduction potential [ORP], and turbidity.

This SOP is written for instruments that measure temperature, pH, dissolved oxygen, specific conductance, turbidity, and/or oxidation/reduction potential [ORP] and the probe readings for pH, dissolved oxygen, and specific conductance are automatically corrected for temperature.

For groundwater monitoring, the instrument must be equipped with a flow-through-cell. Turbidity is measured using a separate instrument. It must not be measured in a flow-through-cell because the flow-through-cell acts as a sediment trap.

2.0 HEALTH AND SAFETY WARNINGS

Read all labels on the standards and note any warnings on the labels. Wear appropriate personal protection equipment (e.g., gloves, eye shields, etc.) when handling the standards. If necessary, consult the Material Safety Data Sheets (MSDS) for additional safety information on the chemicals in the standards.

3.0 GENERAL

All monitoring instruments must be calibrated before they are used to measure environmental samples. For instrument probes that rely on the temperature sensor (pH, dissolved oxygen, specific conductance, and oxidation/reduction potential [ORP]), each temperature sensor needs to be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST). Before any instrument is calibrated or used to perform environmental measurements, the instrument must stabilize (warm-up) according to manufacturer's instructions and must have no air bubbles lodged between the probe and probe guard.

Most projects will require at least two standards to bracket the expected measurement range. This means that one standard is less than the expected value and one is higher. When an environmental sample measurement falls outside the calibration range, the instrument must be recalibrated to bracket the new range before continuing measurements. Otherwise, the measurements that are outside the calibration range will need to be qualified.

The manufacturer's instruction manual (including the instrument specifications) must accompany the instrument into the field.

4.0 FREQUENCY OF CALIBRATION

At a minimum, the instrument is calibrated prior to use on the day the measurements are to be performed. A post calibration check at the end of the day is performed to determine if the instrument drifted out of calibration. Some projects may require more frequent calibration checks throughout the day in addition to the check at the end of the day. For these checks, the instrument can be recalibrated during the day if the instrument drifted out of calibration and only the data measured prior to the check would need to be qualified. The calibration/post calibration data information should be recorded in the field notebook and/or on an equipment calibration form.

Instruments (e.g., sonde) that monitor continuously over a period of time are calibrated before deployment. When these instruments are recovered, the calibration is checked to determine if any of them drifted out of calibration.

Some instruments lose their calibration criteria when they are turned off. Those instruments can either be left on all day (battery dependent) or calibrated at each sampling location. If they are calibrated at each sampling location, a post calibration check is not needed.

Ideally, the temperature of the standards should be close to the temperature of the ambient water that is being measured.

5.0 CALIBRATION PROCEDURES

Prior to calibration, all instrument probes and cable connections must be cleaned and the battery checked according to the manufacturer's instructions. Failure to perform these steps (proper maintenance) can lead to erratic measurements.

If a multi-probe instrument is to be used, program the instrument to display the parameters to be measured (e.g., temperature, pH, percent dissolved oxygen, mg/L dissolved oxygen, specific conductance, and ORP).

The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor (see manufacturer's instructions for the volume to be used). Check the expiration date of the standards. Do not use expired standards. All standards are stored according to manufacturer instructions.

5.1 TEMPERATURE

Most instrument manuals state there is no calibration of the temperature sensor, but the temperature sensor must be checked to determine its accuracy. This accuracy check is performed at least once per year and the accuracy check dat/ information is kept with the instrument. If the accuracy check date/information is not included with the instrument or the last check was over a year, the temperature sensor accuracy needs to be checked at the beginning of the sampling event. If the instrument contains multiple temperature sensors, each sensor must be checked. This procedure is not normally performed in the field. If the instrument is obtained from a rental company, the rental company should have performed the calibration check and should include with the instrument documentation that it was performed.

Verification Procedure

1. Fill a container with water and adjust the water temperature to below the water body's temperature to be measured. Use ice or warm water to adjust the temperature.

2. Place a thermometer that is traceable to the National Institute of Standards and Technology (NIST) and the instrument's temperature sensor into the water. Wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (e.g., ±O.2°C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

4. Adjust the water temperature to a temperature higher than the water body to be measured.

5. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (e.g., ± 0.20 C). If the measurements do not agree, the instrument may not be working properly and the manufacturer needs to be consulted.

5.2 pH (electro metric)

The pH of a sample is determined electrometrically using a glass electrode. Choose the appropriate buffered standards that will bracket the expected values at the sampling locations. If the water body's pH is unknown, then three standards are needed for the calibration: one c1ose to seven, one at least two pH units below seven, and the other at least two pH units above seven. Instruments that will not accept three standards will need to be re-calibrated if the water sample's pH is outside the initial calibration range described by the two standards.

Calibration Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

3. Remove probe from its storage container, rinse with deionized water, and remove excess water.

4. Select measurement mode. Immerse probe into the initial standard (e.g., pH 7).

5. Wait until the readings stabilize. If the reading does not change within 30 seconds, select calibration mode and then select "pH". Enter the buffered standard value into instrument.

6. Remove probe from the initial standard, rinse with deionized water, and remove excess water.

7. Immerse probe into the second standard (e.g., pH 4). Repeat step 5.

8. Remove probe from the second standard, rinse with deionized water, and remove excess water. If instrument only accepts two standards, the calibration is complete. Go to step 'II. Otherwise continue.

9. Immerse probe in third buffered standard (e.g., pH 10) and repeat step 5.

10. Remove probe from the third standard, rinse with deionized water, and remove excess water.

11. Select measurement mode, if not already selected. To ensure that the initial calibration standard (e.g., pH 7) has not changed, immerse the probe into the initial standard. Wait for the readings to stabilize. The reading should read the initial standard value within the manufacturer's specifications. If not, re-calibrate the instrument. If re-calibration does not help, the calibration range may be too great. Reduce calibration range by using standards that are closer together.

12. The calibration is complete. Rinse the probe with deionized water and store the probe according to manufacturer's instructions.

13. Record the calibration information in the field notebook and/or on an equipment calibration form.

5.3 DISSOLVED OXYGEN

Dissolved oxygen (DO) content in water is measured using a membrane electrode. To insure proper operation, the DO probe's membrane and electrolyte should be replaced prior to calibration for the sampling event. The new membrane may need to be conditioned before it is used; consult manufacturer's manual on how the conditioning is to be performed. Failure to perform this step may lead to erratic measurements. Before performing the calibration/measurements, inspect the membrane for air bubbles and nicks.

Note: some manufacturers require an altitude correction instead of a barometric correction. In that case, enter the altitude correction according to the manufacturer's directions in Step 5 and then proceed to Step 6.

Note: some instruments have a built-in barometer. Follow the manufacturer's instructions for entering the barometric value in step 5.

Calibration Procedure

1. Gently dry the temperature sensor and remove any water droplets from the DO probe's sensor membrane according to manufacturer's instructions. Note that the evaporation of moisture on the temperature sensor or DO probe may influence the readings during calibration.

2. Create a 100 percent water-saturated air environment by placing a wet sponge or a wet paper towel on the bottom of the DO calibration container. Place the DO probe into the calibration container. The probe is loosely fitted into the calibration container to prevent the escape of moisture evaporating from the sponge or paper towel while maintaining ambient pressure (see manufacturer's instructions). Note that the probe and the temperature sensor must not come in contact with these wet items.

3. Allow the confined air to become saturated with water vapor (saturation occurs in approximately 10 to 15 minutes). During this time, turn on the instrument to allow the DO probe to warm-up. Select the measurement mode. Check the temperature readings. Readings must stabilize before continuing to the next step.

4. Select calibration mode; then select "DO %".

5. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument. This measurement must be determined from an on-site barometer. Do not use barometric pressure obtained from the local weather services unless the pressure is corrected for the elevation of the sampling location. [Note: inches of mercury times 25.4 mm/inch equals mm of mercury or consult Oxygen Solubility at Indicated Pressure chart attached to the SOP for conversion at selected pressures].

6. The instrument should indicate that the calibration is in progress. After calibration, the instrument should display percent saturated DO.

7. Select measurement mode and set the display to read DO mg/L and temperature. Compare the DO mg/L reading to the Oxygen Solubility at Indicated Pressure chart attached to the SOP. The numbers should agree. If they do not agree within the accuracy of the instrument (usually ± 0.2 mg/L), repeat calibration. If this does not work, change the membrane and electrolyte solution.

8. Remove the probe from the container and place it into a 0.0 mglL DO solution (see footnote). Check temperature readings. They must stabilize before continuing.

9. Wait until the "mg/L DO" readings have stabilized. The instrument should read less than 0.5 mg/L (assuming an accuracy of ± 0.2 mg/L). If the instrument reads above 0.5 mg/L or reads negative, it will be necessary to clean the probe, and change the membrane and electrolyte solution. If this does not work, try a new 0.0 mg/L DO solution. If these changes do not work, contact the manufacturer. Note: some projects and instruments may have different accuracy requirements. The 0.5 mg/L value may need to be adjusted based on the accuracy requirements of the project or instrument.

10. After the calibration has been completed, rinse the probe with tap or deionized water and store the probe according to manufacturer's instructions. It is important that all of the 0.0 mg/L DO solution be rinsed off the probe so as not to effect the measurement of environmental samples.

11. Record calibration information in the field notebook and/or on an equipment calibration form.

Note: You can either purchase the 0.0 mg/L DO solution from a vendor or prepare the solution yourself. To prepare a 0.0 mg/L DO solution, follow the procedure stated in Standard Methods (Method 4500-0 G). The method basically states to add excess sodium sulfite (until no more dissolves) and a trace amount of cobalt chloride (read warning on the label before use) to water.

This solution is prepared prior to the sampling event. Note: this solution can be made without cobalt chloride, but the probe will take longer to respond to the low DO concentration.

5.4 SPECIFIC CONDUCTANCE

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C.

Most instruments are calibrated against a single standard which is near the specific conductance of the environmental samples. The standard can be either below or above the specific conductance of the environmental samples. A second standard is used to check the linearity of the instrument in the range of measurements. When performing specific conductance measurement on groundwater or surface water and the measurement is outside the initial calibration range defined by the two standards, the instrument will need to be re-calibrated using the appropriate standards.

Specific Conductance Calibration Procedure

1. Allow the calibration standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the standards so each standard will cover the probe and temperature sensor. Remove probe from its storage container, rinse the probe with deionized water or a small amount of the standard (discard the rinsate), and place the probe into the standard.

3. Select measurement mode. Wait until the probe temperature stabilizes.

4. Select calibration mode, then specific conductance. Enter the specific conductance standard. Value. Make sure the units on the standard are the same as the units used by the instrument. If the units are different, convert the units on the standard to the units used by the instrument.

5. Select measurement mode. The reading should remain within the manufacturer's specifications. If it does not, re-calibrate. If readings continue to change after re-calibration, consult the manufacturer's instruction manual or replace the calibration solution.

6. Remove probe from the standard, rinse the probe with deionized water or a small amount of the second standard (discard the rinsate), and place the probe into the second standard. The second standard will serve to verify the linearity of the instrument. Read the specific conductance value from the instrument and compare the value to the specific conductance on the standard. The two values should agree within the specifications of the instrument. If they do not agree, re-calibrate. If readings do not compare, then the second standard may be outside the linear range of the instrument. Use a standard that is closer to the first standard and repeat the verification. If values still do not compare, try cleaning the probe or consult the manufacturer.

7. After the calibration has been completed, rinse the probe with deionized water and store the probe according to manufacturer's instructions.

8. Record the calibration information in the field notebook and/or on an equipment calibration form.

Note: for projects where specific conductance is not a critical measurement it may be possible to calibrate with one standard in the range of the expected measurement.

5.5 OXIDATIONIREDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent.

Calibration or Verification Procedure

1. Allow the calibration standard (a Zobell solution: read the warning on the label before use) to equilibrate to ambient temperature.

2. Remove the probe from its storage container and place it into the standard.

3. Select measurement mode.

4. Wait for the probe temperature to stabilize, and then read the temperature.

5. If the instrument is to be calibrated, do Steps 6 and 7. If the instrument calibration is to be verified, then go to Step 8.

6. Look up the millivolt (mv) value at this temperature from the millivolt versus temperature correction table usually found on the standard bottle or on the standard instruction sheet. You may need to interpolate millivolt value between temperatures. Select "calibration mode", then "ORP". Enter the temperature-corrected ORP value into the instrument.

7. Select measurement mode. The readings should remain unchanged within manufacturer's specifications. If they change, re-calibrate. If readings continue to change after re-calibration, try a new Zobell solution or consult the manufacturer. Go to Step 9.

8. If the instrument instruction manual states that the instrument is factory calibrated, then verify the factory calibration against the Zobell solution. If they do not agree within the specifications of the instrument, try a new Zobell solution. If it does not agree, the instrument will need to be re-calibrated by the manufacturer.

9. After the calibration has been completed, rinse the probe with deionized water and store the probe according to manufacturer's instructions.

10. Record the calibration information in the field notebook and/or an equipment calibration form.

5.6 TURBIDITY

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidity meter is a nephelometer with a visible light source for illuminating the sample and one or more photo-electric detectors placed ninety degrees to the path of the light source. Note: the below calibration procedure is for a turbidimeter which the sample is placed into a cuvette.

Some instruments will only accept one standard. For those instruments, the second, third, etc., standards will serve as check points.

Calibration Procedures

1. Allow the calibration standards to equilibrate at the ambient temperature. The use of commercially available polymer primary standards (AMCO-AEPA-l) is preferred; however, the standards can be prepared using Formazin (read the warning on the label before use) according to the EPA analytical Method 180.1. Other standards may be used if they can be shown that they are equivalent to the previously mentioned standards.

2. If the standard cuvette is not sealed, rinse a cuvette with deionized water. Shake the cuvette to remove as much water as possible. Do not wipe dry the inside of the cuvette because lint from the wipe may remain in the cuvette. Add the standard to the cuvette.

3. Before performing the calibration procedure, make sure the cuvettes are not scratched and the outside surfaces are dry and free from fingerprints and dust. If the cuvette is scratched or dirty, discard or clean the cuvette respectively. Note: some manufacturers require the cuvette to be orientated in the instrument in a particular direction for accurate reading.

4. Select a low value standard such as a zero or 0.02 NTU and calibrate according to manufacturer's instructions. Note: a zero standard (approximately 0 NTU) can be prepared by passing distilled water through a 0.45 micron pore size membrane filter.

5. Select a high standard and calibrate according to manufacturer's instructions or verify the calibration if instrument will not accept a second standard. In verifying, the instrument should read the standard value to within the specifications of the instrument. If the instrument has range of scales, check each range that will be used during the sampling event with a standard that falls within that range.

6. Record the calibration information in the field notebook and/or on an equipment calibration form.

6.0 POST CALIBRATION CHECK

After the initial calibration is performed, the instrument's calibration may drift during the measurement period. As a result, you need to detennine the amount of drift that occurred after collecting the measurements. This is performed by placing the instrument in measurement mode (not calibration mode) and placing the probe in one or more of the standards used during the initial calibration; for turbidity place the standard in a cuvette and then into the turbidimeter. Wait for the instrument to stabilize and record the measurement in the field notebook and/or on a

field water quality form. Compare the measurement value to the initial calibration value. This difference in value is then compared to the drift criteria or post calibration criteria described in the quality assurance project plan or the sampling and analysis plan for the project. If the check value is outside the criteria, then the measurement data will need to be qualified.

For the dissolved oxygen calibration check, follow the calibration instructions steps one through three while the instrument is in measurement mode. Record dissolved oxygen value (mg/L), temperature, and barometric pressure. Compare the measurement value to the Oxygen Solubility at Indicated Pressure chart attached to this SOP. The value should be within the criteria specified for the project. If measurement value drifted outside the criteria, the data will need to be qualified.

If the quality assurance project plan or the sampling and analysis plan do not list the drift criteria or the post-calibration criteria, use the criteria below.

Measurement	**Post Calibration Criteria**
Dissolved Oxygen	± 0.5 mg/L of sat. value* < 0.5 mg/L for the 0 mg/L solution, but not a negative value
Specific Conductance	±5% of standard or ± 10 uS/cm (whichever is greater)
pH	± 0.3 pH unit with pH 7 buffer*
Turbidity	± 5% of standard
ORP	± 10 mv*

Note: * Table 8.1, USEPA Region 1 *YSI6-Series Sondes and Data Logger SOP,* January 30, 2007, revision 9.

7.0 DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration records must be documented in the project's field notebook or on an equipment calibration form. At a minimum, include the instrument manufacturer, model number, instrument identification number (when more than one instrument of the same model is used), the standards used to calibrate the instruments (including source), the calibration date, the instrument readings, the post calibration check, and the name of the person(s) who performed the calibration.

8.0 REFERENCES

Standard Methods for the Examination of Water and Wastewater, 20th edition, 1998.

Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, Revised March 1983.

Turbidity - Methods for the Determination of Inorganic Substances in Environmental Samples, EP A/600/R-93/l00, August 1993.

U.S. EPA Region 1 Quality Assurance Unit, Standard Operating Procedure Calibration of Field Instruments, January 19, 2010, Revision Number 2.

U.S. EPA Region 1 YSI 6-Series Sondes and Data Logger SOP, January 30, 2007, Revision 9.

USGS Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting, Techniques and Methods 1-D3.

Oxygen Solubility at Indicated Pressure

	Pressure (Hg)							
Temp.	760	755	750	745	740	735	730	mm
°C	29.92	29.72	29.53	29.33	29.13	28.94	28.74	in
0	14.57	14.47	14.38	14.28	14.18	14.09	13.99	mg/L
1	14.17	14.08	13.98	13.89	13.79	13.70	13.61	mg/L
2	13.79	13.70	13.61	13.52	13.42	13.33	13.24	mg/L
3	13.43	13.34	13.25	13.16	13.07	12.98	12.90	mg/L
4	13.08	12.99	12.91	12.82	12.73	12.65	12.56	mg/L
5	12.74	12.66	12.57	12.49	12.40	12.32	12.23	mg/L
6	12.42	12.34	12.26	12.17	12.09	12.01	11.93	mg/L
7	12.11	12.03	11.95	11.87	11.79	11.71	11.63	mg/L
8	11.81	11.73	11.65	11.57	11.50	11.42	11.34	mg/L
9	11.53	11.45	11.38	11.30	11.22	11.15	11.07	mg/L
10	11.28	11.19	11.11	11.04	10.96	10.89	10.81	mg/L
11	10.99	10.92	10.84	10.77	10.70	10.62	10.55	mg/L
12	10.74	10.67	10.60	10.53	10.45	10.38	10.31	mg/L
13	10.50	10.43	10.36	10.29	10.22	10.15	10.08	mg/L
14	10.27	10.20	10.13	10.06	10.00	9.93	9.86	mg/L
15	10.05	9.98	9.92	9.85	9.78	9.71	9.65	mg/L
16	9.83	9.76	9.70	9.63	9.57	9.50	9.43	mg/L
17	9.63	9.57	9.50	9.44	9.37	9.31	9.24	mg/L
18	9.43	9.37	9.30	9.24	9.18	9.11	9.05	mg/L
19	9.24	9.18	9.12	9.05	8.99	8.93	8.87	mg/L
20	9.06	9.00	8.94	8.88	8.82	8.75	8.69	mg/L
21	8.88	8.82	8.76	8.70	8.64	8.58	8.52	mg/L
22	8.71	8.65	8.59	8.53	8.47	8.42	8.36	mg/L
23	8.55	8.49	8.43	8.38	8.32	8.26	8.20	mg/L
24	8.39	8.33	8.28	8.22	8.16	8.11	8.05	mg/L
25	8.24	8.18	8.13	8.07	8.02	7.96	7.90	mg/L
26	8.09	8.03	7.98	7.92	7.87	7.81	7.76	mg/L
27	7.95	7.90	7.84	7.79	7.73	7.68	7.62	mg/L
28	7.81	7.76	7.70	7.65	7.60	7.54	7.49	mg/L
29	7.68	7.63	7.57	7.52	7.47	7.42	7.36	mg/L
30	7.55	7.50	7.45	7.39	7.34	7.29	7.24	mg/L
31	7.42	7.37	7.32	7.27	7.22	7.16	7.11	mg/L
32	7.30	7.25	7.20	7.15	7.10	7.05	7.00	mg/L
33	7.08	7.13	7.08	7.03	6.98	6.93	6.88	mg/L
34	7.07	7.02	6.97	6.92	6.87	6.82	6.78	mg/L
35	6.95	6.90	6.85	6.80	6.76	6.71	6.66	mg/L
36	6.84	6.79	6.76	6.70	6.65	6.60	6.55	mg/L
37	6.73	6.68	6.64	6.59	6.54	6.49	6.45	mg/L
38	6.63	6.58	6.54	6.49	6.44	6.40	6.35	mg/L
39	6.52	6.47	6.43	6.38	6.35	6.29	6.24	mg/L
40	6.42	6.37	6.33	6.28	6.24	6.19	6.15	mg/L
41	6.32	6.27	6.23	6.18	6.14	6.09	6.05	mg/L
42	6.22	6.18	6.13	6.09	6.04	6.00	5.95	mg/L
43	6.13	6.09	6.04	6.00	5.95	5.91	5.87	mg/L
44	6.03	5.99	5.94	5.90	5.86	5.81	5.77	mg/L
45	5.94	5.90	5.85	5.81	5.77	5.72	5.68	mg/L

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

Oxygen Solubility at Indicated Pressure (continued)

	Pressure (Hg)								
Temp.	725	720	715	710	705	700	695	690	mm
°C	28.54	28.35	28.15	27.95	27.76	27.6	27.36	27.17	in
0	13.89	13.8	13.7	13.61	13.51	13.4	13.32	13.22	mg/L
1	13.51	13.42	13.33	13.23	13.14	13	12.95	12.86	mg/L
2	13.15	13.06	12.07	12.88	12.79	12.7	12.6	12.51	mg/L
3	12.81	12.72	12.63	12.54	12.45	12.4	12.27	12.18	mg/L
4	12.47	12.39	12.3	12.21	12.13	12	11.95	11.87	mg/L
5	12.15	12.06	11.98	11.89	11.81	11.7	11.64	11.56	mg/L
6	11.84	11.73	11.68	11.6	11.51	11.4	11.35	11.27	mg/L
7	11.55	11.47	11.39	11.31	11.22	11.1	11.06	10.98	mg/L
8	11.26	11.18	11.1	11.02	10.95	10.9	10.79	10.71	mg/L
9	10.99	10.92	10.84	10.76	10.69	10.6	10.53	10.46	mg/L
10	10.74	10.66	10.59	10.51	10.44	10.4	10.29	10.21	mg/L
11	10.48	10.4	10.33	10.28	10.18	10.1	10.04	9.96	mg/L
12	10.24	10.17	10.1	10.02	9.95	9.88	9.81	9.46	mg/L
13	10.01	9.94	9.87	9.8	9.73	9.66	9.59	9.52	mg/L
14	9.79	9.72	9.65	9.68	9.51	9.45	9.38	9.31	mg/L
15	9.58	9.51	9.44	9.58	9.31	9.24	9.18	9.11	mg/L
16	9.37	9.3	9.24	9.17	9.11	9.04	8.97	8.91	mg/L
17	9.18	9.11	9.05	8.98	8.92	8.85	8.79	8.73	mg/L
18	8.99	8.92	8.86	8.8	8.73	8.67	8.61	8.54	mg/L
19	8.81	8.74	8.68	8.62	8.56	8.49	8.43	8.37	mg/L
20	8.63	8.57	8.51	8.45	8.39	8.33	8.27	8.21	mg/L
21	8.46	8.4	8.34	8.28	8.22	8.16	8.1	8.04	mg/L
22	8.3	8.24	8.18	8.12	8.06	8	7.95	7.89	mg/L
23	8.15	8.09	8.03	7.97	7.91	7.86	7.8	7.74	mg/L
24	7.99	7.94	7.88	7.82	7.76	7.71	7.65	7.59	mg/L
25	7.85	7.79	7.74	7.68	7.6	7.57	7.51	7.46	mg/L
26	7.7	7.65	7.59	7.54	7.48	7.43	7.37	7.32	mg/L
27	7.57	7.52	7.46	7.41	7.35	7.3	7.25	7.19	mg/L
28	7.44	7.38	7.33	7.28	7.22	7.17	7.12	7.06	mg/L
29	7.31	7.26	7.21	7.15	7.1	7.05	7	6.94	mg/L
30	7.19	7.14	7.08	7.03	6.98	6.93	6.88	6.82	mg/L
31	7.06	7.01	6.96	6.91	6.86	6.81	6.76	6.7	mg/L
32	6.95	6.9	6.85	6.8	6.7	6.7	6.64	6.59	mg/L
33	6.83	6.78	6.73	6.68	6.83	6.58	6.53	6.48	mg/L
34	6.73	6.68	6.63	6.58	6.53	6.48	6.43	6.38	mg/L
35	6.61	6.56	6.51	6.47	6.42	6.37	6.36	6.27	mg/L
36	6.51	6.46	6.41	6.36	6.31	6.27	6.22	6.17	mg/L
37	6.4	6.35	6.31	6.26	6.21	6.16	6.12	6.07	mg/L
38	6.3	6.26	6.21	6.16	6.12	6.07	6.02	5.98	mg/L
39	6.26	6.15	6.11	6.06	6.01	5.97	5.92	5.87	mg/L
40	6.1	6.06	6.01	5.96	5.92	5.86	5.83	5.78	mg/L
41	6	5.96	5.91	5.87	5.82	5.78	5.73	5.69	mg/L
42	5.91	5.86	5.82	5.77	5.73	5.69	5.64	5.6	mg/L
43	5.82	5.78	5.73	5.69	5.65	5.6	5.56	5.51	mg/L
44	5.72	5.68	5.64	5.59	5.55	5.51	5.46	5.42	mg/L
45	5.64	5.59	5.55	5.51	5.47	5.42	5.38	5.34	mg/L

Source: Draft EPA Handbook of Methods for Acid Deposition Studies, Field Operations for Surface Water Chemistry, EPA/600/4-89/020, August 1989.

APPENDIX C

Site Health & Safety Plan

FORM HSP-3

1.0 GENERAL INFORMATION

Site/Location: Former Wabash Alloys Facility, 9100 South Fifth Avenue, Oak Creek, WI

Project #: 117-2201472

Plan Prepared by: Mike Noel Date: April 15, 2021

Hazard Assessment Prepared by: * Mike Noel Date: April 15, 2021

* I certify that I have assessed the type, risk level and severity of hazards for this project and have selected appropriate personal protective equipment for site personnel.

Plan Updated by: Mike Noel Date: April 15, 2021

Reviewed by: John Gibbons

Date: April 15, 2021

Activity(s):

1) Hydrovac excavation to clear area of interest of utilities before installing borings/monitoring wells in area of multiple utilities.

2) Installation and sampling of soil borings to a depth of 25 ft bgs.

3) Installation, development, and sampling of monitoring wells and sumps.

4) Sampling groundwater at wells that contain no DNAPL tar

5) Measuring tar thickness in wells and using bailer to remove and drum tar

6) Internal inspection of 78-inch storm sewer and utility trench plug installation via grouting from inside 78-inch storm sewer (this work will be performed by a Tetra Tech subcontractor (TBD) under their confined space entry health and safety plan. Tetra Tech personnel will not enter the confined space.

7) In-situ stabilization using a mechanical mixer to blend in potential binding agents

Dates of work: TBD. Dates of activities will be coordinated after WDNR approval and will be based off sub-contractor availability and weather.

FORM HSP-3

Tetra Tech, Inc. personnel:	Signature
Mike Noel (PM)	
Mark Manthey* **	
Todd Thomson**	
Connor Lauzon**	
Jason Drews**	

* Safety coordinator/emergency coordinator

** Designated First-Aid provider

Contractor Personnel:

1. Sub-contractor for installation and sampling of Geoprobe direct-push soil borings and installation of monitoring well to be determined. Personnel to be determined.
2. Sub-contractor for hydro-excavation to clear area of interest of potential utilities to be determined. Personnel to be determined.
3. Sub-contractor for ISS. Personnel to be determined.

Description of Site: (include map if possible)

Closed former Wabash Alloys secondary aluminum smelting facility. The site occupies approximately 21 acres of land. Approximately 12 acres of the west side of the property had been developed in the past (included the former smelting facility structures, parking lot, and paved driveways). The remaining eastern portion of the property contained no structures except for remaining segments of railroad spurs. All building structures (including pits) and railroad spurs were removed from the site in 2013. The paved driveway and building foundation (above grade but have shallowly sloped grading around the foundation on all but the southern side) are all that remain on site. The property contained a coal tar distillation facility from 1917 through 1968. The structures related to the coal tar distillation plant were removed prior to the construction of the aluminum smelting facility on the property in 1968.

Access and security:

The Former Wabash Alloys facility can be accessed from South Fifth Avenue, through a locked gate. The facility is enclosed with fencing around majority of the property, except for the grassy/wetland area to the east. To access the wells located to the south on the City of Oak

Creek property contact the water treatment facility at: (414)768-7060 and one of their staff members will unlock to gate.

Types of hazardous material:

Coal tar and soil and groundwater potentially impacted with coal tar constituents consisting of petroleum volatile organic compounds (PVOCs) and polynuclear aromatic hydrocarbons (PAHs).

Major safety/health hazards/risks: (contamination, equipment, fire etc.)

Direct contact with free coal tar or soil and groundwater impacted with coal tar constituents (PVOCs and PAHs) when collecting soil samples, when developing and sampling monitor wells and when bailing tar from wells. Inhalation of coal tar vapors and dermal contact. Hazards associated with working around a drill rig. Potential biological hazards (insects, coyotes) when doing work in the undeveloped area on the east side of the property. Trip and fall hazards when doing work in the location of the previously existing building.

The maximum detected COC concentrations in groundwater from the most recent round of groundwater sampling (January 2020) are shown in the table below:

VOC	Concentration (ug/L)	Location
Benzene	3,200	MW-117
Ethylbenzene	430	P-110
Xylenes	1,800	MW-117
Toluene	2,800	MW-117
1,2,4-trimethylbenzene	440	MW-117
1,3,5-trimethylbenzene	180	MW-117

SVOC	Concentration (ug/L)	Location
Anthracene	12	MW-107
Benzo[a]pyrene	4.1	P-110
Benzo[b]fluoranthene	3.8	P-110
Chrysene	4.4	P-110
Fluoranthene	33	P-110
Fluorene	190	P-110
Naphthalene	12,000	MW-117
Pyrene	23	P-110

A Tetra Tech Certified Industrial Hygienist performed predictive modeling to evaluate the worst-case airborne vapor concentrations using the March 2014 groundwater sampling data. The model shows that the predominant airborne vapors would be benzene (31%), toluene (27%), xylenes (22%), and naphthalene (9%) and that is it possible that the OSHA Permissible Exposure Limit (PEL) for benzene could be exceeded if there is an open and direct pathway from the groundwater to the ambient air. Level D PPE will be the initial level of worker protection supplemented by monitoring with a PID at least once per hour to verify total VOC concentrations do not exceed the prescribed safe range for use of Level D PPE.

Confined space entry by Tetra Tech personnel is not anticipated and is expressly prohibited as part of this scope of work. The 78-inch diameter storm sewer in the utility corridor is a confined space at this Site. Tetra Tech's subcontractor (to be determined) will perform an internal sewer inspection as part of the work and will provide a health and safety plan as part of that work for Tetra Tech review.

A confined space is defined as a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, storage bins, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

2.0 SAFETY PLAN

Employee Training and Medical Surveillance:

This section specifies health and safety training requirements for Tetra Tech and subcontractor personnel working under the direction of Tetra Tech. Tetra Tech and identified personnel must complete 40 hours of introductory hazardous waste (HAZWOPER) operations site training prior to performing work onsite. Tetra Tech and subcontractor personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training and refresher training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Hazard communication/globally harmonized system (29 CFR 1910.1200) will also be required for site personnel handling any hazardous chemicals.

Additionally, at least two field persons will be current with basic first aid and CPR training to be capable of providing aid to an injured co-worker or subcontractor employee in the event of an injury or illness.

Documentation of Tetra Tech and subcontractor personnel introductory, supervisory, and refresher HAZWOPER training as well as site-specific training will be maintained at the site.

The Tetra Tech FOL/ PHSO will provide site-specific training (HASP review) to Tetra Tech and subcontractor employees who will perform work on this project. The Tetra Tech FOL/SSO will also conduct a daily tailgate safety meeting prior to initiating site work. This will consist of a brief meeting at the beginning of each day to discuss operations planned for that day,

Tetra Tech and subcontractor personnel participating in project field activities will have had a physical examination meeting the requirements of paragraph (f) 29 CFR 1910.120 medical surveillance program requirements. Documentation for medical clearances will be maintained on the project site and be made available upon request.

FORM HSP-3

Protective Equipment/Instruments (specify type, as necessary)

Hard hat:	X	when working around drill rig
Boots:	X	steel toed
Glasses (type):	X	Safety
Coveralls (type):	X	Tyvek when bailing DNAPL
Booties (type):	X	Tyvek when bailing DNAPL
First aid kit:	X	in vehicle
Gloves:	X	Disposable Nitrile
PID:	X	
Hearing Protection:	X	when working around drill rig or hydrovac

Safety Equipment Levels/Upgrades: Modified Level D. Hard hat, hearing protection, safety glasses, disposal nitrile gloves, and steel-toed boots when working around the drill rig, hydro-excavator and excavating equipment. Safety glasses and disposable nitrile gloves when collecting soil samples and developing and sampling monitor wells. Tyvek suit when bailing tar

Monitoring Requirements: The work area breathing space should be monitored with a photoionization detector (PID) during the drilling of the soil borings and monitor wells at least once per hour. The PID measurements of the work area breathing space should be recorded on Tetra Tech field PID data sheets. If a work area breathing zone PID reading is sustained at or above 5 ppm above background PID readings for more than 10 minutes, work will be stopped until PID readings decrease to below 5 ppm. If PID readings remain above 5 ppm, stop work evacuate the area, and contact the PM and Project H&S Manager for guidance.

Decontamination/Work Zone Requirements: Work zones are at the soil borings and monitor wells being sampled and the area surrounding the test pit and stockpiled soil. If possible, potential trip and fall hazards should be removed from the work zones. Diggers Hotline should be contacted at least four business days prior to the start of soil boring and monitor well drilling activities to clear the work area of potential buried utilities. A level area close to the work zone should be selected for the cleaning of the drill rods during the drilling of the monitor wells. Decontamination of the

other drilling and sampling equipment should be done at the soil borings and monitor wells. All waste products generated during the site investigation activities should be

contained. Soil cuttings and groundwater will be contained on-site pending determination of appropriate disposal options for the media. The vessels containing the soil and groundwater should be appropriately labeled with the well/borehole identification, date(s), and type of media (soil or groundwater) contained in the vessel. Other waste (disposable gloves, used soil core liners, used canning jars, foil, etc.) generated during the site investigation should be placed in garbage bags and taken off-site for proper disposal.

3.0 EMERGENCY PLANNING

Emergency Phone Numbers

Hospital: St. Luke's South Shore Hospital 5900 S. Lake Drive, Cudahy, WI 53110 Tel: 414-489-9000 (approx. 4 miles from site)

Fire Department and EMS: 911; Non-Emergency: 414-570-5630

Police: 911; Non-Emergency: 414-762-8200

CORE Incident Intervention (24/7)[1]

Occupational Health Clinic: Lakeshore Medical Clinic, 3611 S. Chicago Avenue, South Milwaukee, WI 53172 Tel:414-762-7270 (1.36 miles from site)

Tetra Tech: Jamie Dickson 262-792-1282

Contractors: To Be Determined

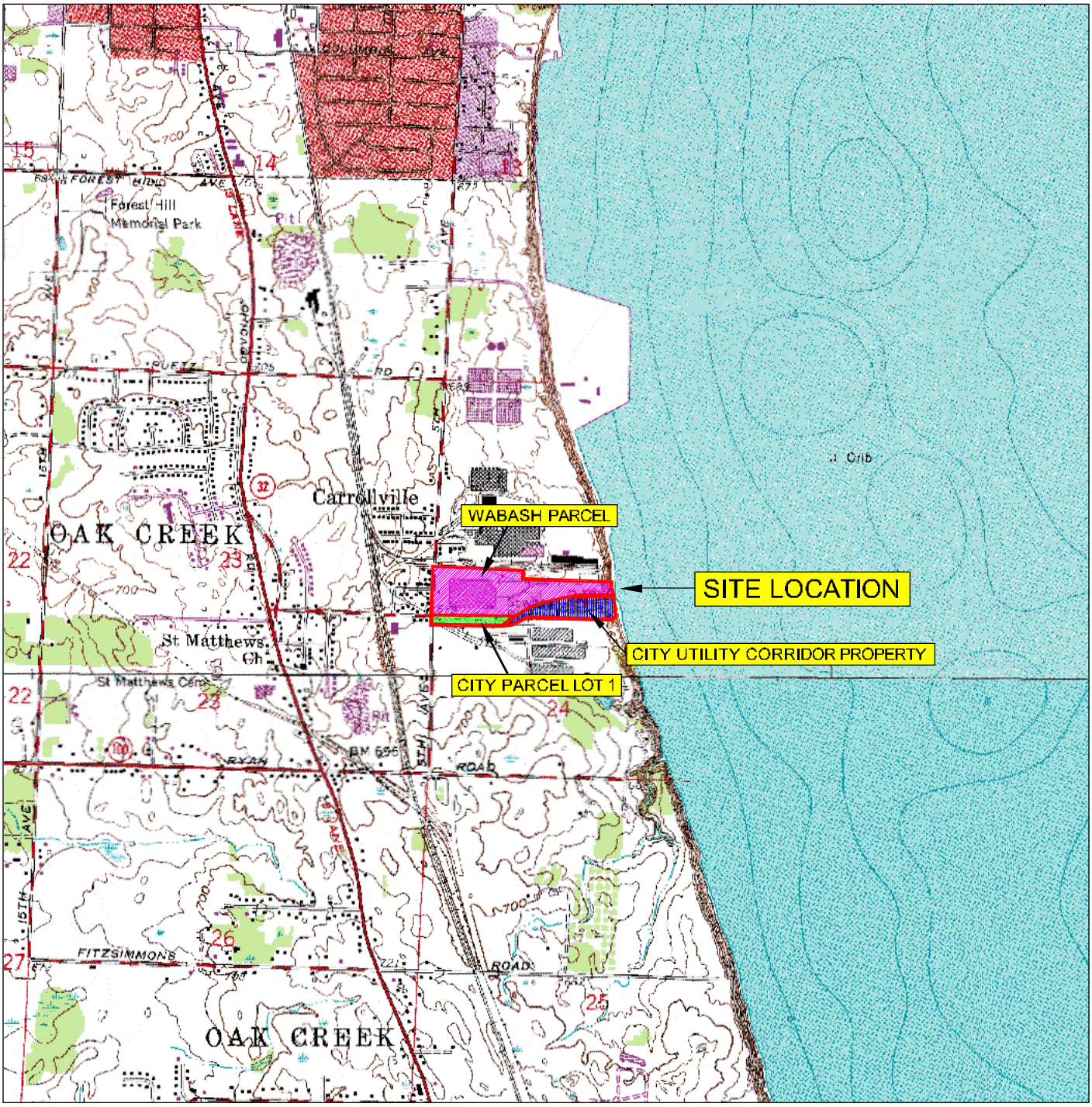
Note: Maps of route to hospital and workers comp clinic must be attached.

[1] For all non-emergency injuries/illnesses CORE should be contacted prior to going to a clinic.

FORM HSP-3

4.0 ATTACHMENTS

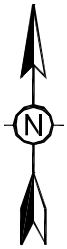
- X Site Maps
- X Route to Hospital
- X Site Safety Plan Acknowledgment Form
- X SDS
- X Data Tables
- X General Safe Work Practices for Fieldworkers
- X General Safe Work Practices HAZWOPER
- X Safe Drilling Practices
- X Safe Direct Push Boring Practices
- X Heat Illness Prevention and Monitoring
- X Cold Stress Prevention
- X Biohazards
- X Overhead Utilities Permit
- X Underground Utilities
- X Permit Required Confined Space Entry
- X Heavy Equipment
- X Ground Disturbance Permit
- X Vacuum Trucks
- X Trenching and Excavation Practices
- X Haulage and Earthmoving



National Geodetic Vertical Datum of 1929
Contour Interval 10 Feet

SCALE
0 5000
FEET

QUADRANGLE LOCATION



FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE OAK CREEK, WISCONSIN	DATE: 10/6/14
	DESIGNED: HJW
SITE LOCATION and LOCAL TOPOGRAPHY	CHECKED: DLM
	APPROVED: DLM
	DRAWN: HJW
	PROJ.: 117-2201323
TETRA TECH	Figure 1

Base map from U.S.G.S. 7.5' SOUTH MILWAUKEE, WISCONSIN and RACINE NORTH, WISCONSIN topographic quadrangle map.

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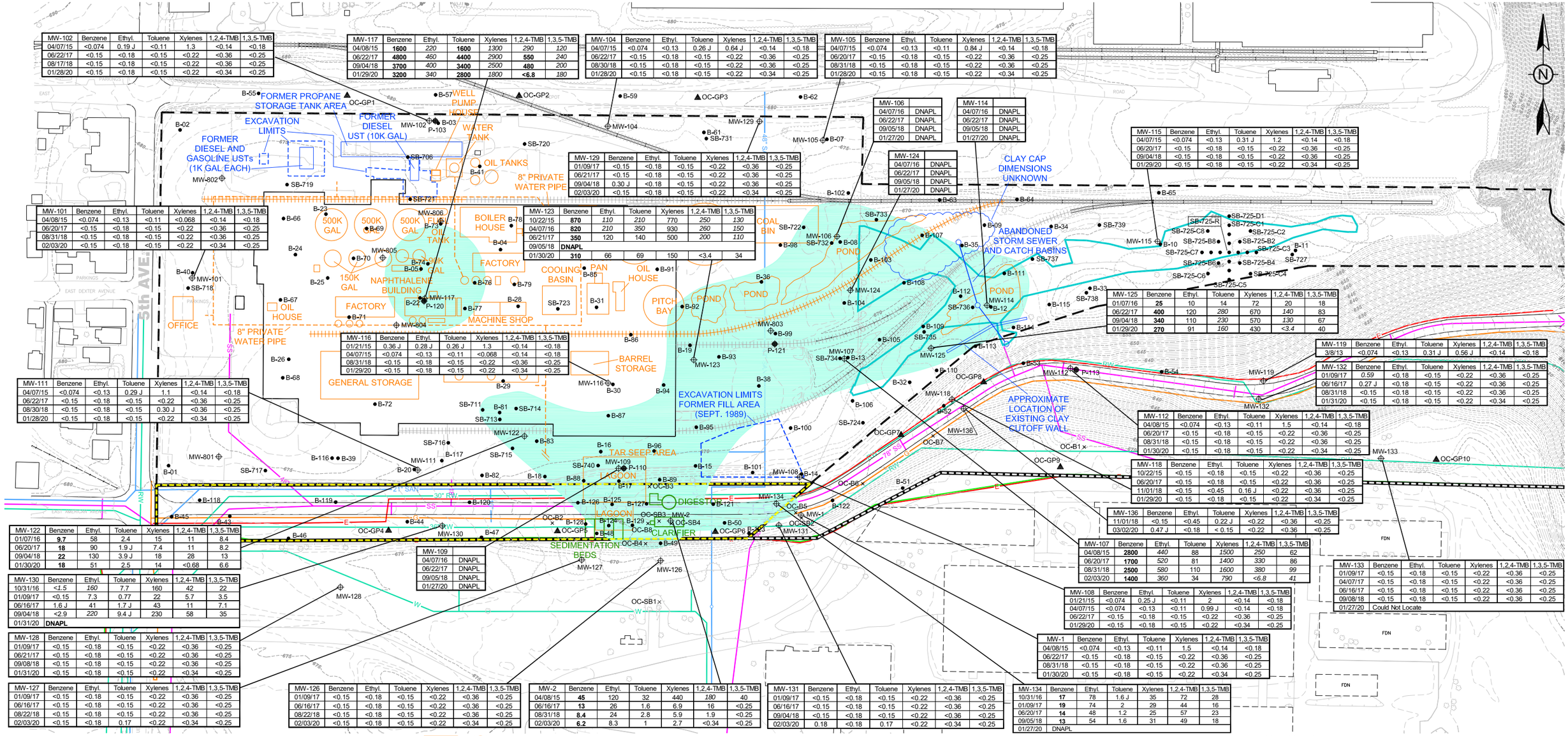


MW-102	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	0.19 J	<0.11	1.3	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/17/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-117	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	**1600**	*220*	**1600**	*1300*	*290*	*120*
06/22/17	**4800**	*460*	**4400**	*2900*	**550**	*240*
09/04/18	**3700**	*400*	**3400**	*2500*	**480**	*200*
01/29/20	**3200**	*340*	**2800**	*1800*	**<6.8**	*180*

MW-104	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	0.26 J	0.64 J	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/30/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-105	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	<0.11	0.84 J	<0.14	<0.18
06/20/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-106	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-114	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-124	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-115	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	0.31 J	1.2	<0.14	<0.18
06/20/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/04/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/29/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-129	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/21/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/04/18	0.30 J	<0.18	<0.15	<0.22	<0.36	<0.25
02/03/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-101	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	<0.074	<0.13	<0.11	<0.068	<0.14	<0.18
06/20/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
02/03/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-123	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/22/15	**870**	*110*	*210*	*770*	*250*	*130*
04/07/16	**820**	*210*	*350*	*930*	*260*	*150*
06/21/17	**350**	120	140	500	*200*	*110*
09/05/18	**DNAPL**					
01/30/20	**310**	66	69	150	<3.4	34

MW-125	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/07/16	**25**	10	14	72	20	18
06/22/17	**400**	120	*280*	670	*140*	83
09/04/18	**340**	110	*230*	570	*130*	67
01/29/20	**270**	91	*160*	430	*<3.4*	40

MW-116	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/21/15	0.36 J	0.28 J	0.26 J	1.3	<0.14	<0.18
04/07/15	<0.074	<0.13	<0.11	<0.068	<0.14	<0.18
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/29/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-119	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
3/8/13	<0.074	<0.13	0.31 J	0.56 J	<0.14	<0.18

MW-132	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	*0.59*	<0.18	<0.15	<0.22	<0.36	<0.25
06/16/17	0.27 J	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/31/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-111	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	0.29 J	1.1	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/30/18	<0.15	<0.18	<0.15	0.30 J	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-112	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	<0.074	<0.13	<0.11	1.5	<0.14	<0.18
06/20/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/30/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-118	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/22/15	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/20/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
11/01/18	<0.15	<0.45	0.16 J	<0.22	<0.36	<0.25
01/29/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-136	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
11/01/18	<0.15	<0.45	0.22 J	<0.22	<0.36	<0.25
03/02/20	0.47 J	<0.18	< 0.15	<0.22	<0.36	<0.25

MW-107	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	**2800**	*440*	88	*1500*	*250*	62
06/20/17	**1700**	*520*	81	*1400*	*330*	86
08/31/18	**2500**	*580*	110	*1600*	*380*	*99*
02/03/20	**1400**	*360*	34	*790*	*<6.8*	*41*

MW-133	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
04/07/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/16/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/08/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/27/20	Could Not Locate					

MW-108	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/21/15	<0.074	0.25 J	<0.11	2	<0.14	<0.18
04/07/15	<0.074	<0.13	<0.11	0.99 J	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/29/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-122	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/07/16	**9.7**	58	2.4	15	11	8.4
06/20/17	**18**	90	1.9 J	7.4	11	8.2
09/04/18	**22**	130	3.9 J	18	28	13
01/30/20	**18**	51	2.5	14	<0.68	6.6

MW-109	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-130	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/31/16	*<1.5*	*160*	7.7	160	42	22
01/09/17	<0.15	7.3	0.77	22	5.7	3.5
06/16/17	1.6 J	41	1.7 J	43	11	7.1
09/04/18	*<2.9*	*220*	9.4 J	230	58	35
01/31/20	**DNAPL**					

MW-128	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/21/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/08/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/31/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-127	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/16/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/22/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
02/03/20	<0.15	<0.18	0.17	<0.22	<0.34	<0.25

MW-126	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/16/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/22/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
02/03/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-2	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	**45**	120	32	440	*180*	40
06/16/17	**13**	26	1.6	6.9	16	<0.25
08/31/18	**8.4**	24	2.8	5.9	1.9	<0.25
02/03/20	**6.2**	8.3	1	2.7	<0.34	<0.25

MW-131	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
01/09/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/16/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/04/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
02/03/20	0.18	<0.18	0.17	<0.22	<0.34	<0.25

MW-1	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	<0.074	<0.13	<0.11	1.5	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/30/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

MW-134	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/31/16	**17**	78	1.6 J	35	72	28
01/09/17	**19**	74	2	29	44	16
06/20/17	**14**	48	1.2	25	57	23
09/05/18	**13**	54	1.6	31	49	18
01/27/20	DNAPL					

EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- × OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- ▲OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD

	VOC	Benz.	Toluene	Ethyl.	Xylene	1,2,4-TMB	1,3,5-TMB
WDNR	PAL	*0.5*	*200*	*140*	*1000*	*96*	*96*
NR140	ES	**5**	**1000**	**700**	**10000**	**480**	**480**

ALL VALUES IN ug/L (ppb)
ITALIC VALUES EXCEED NR 140 PAL
BOLD VALUES EXCEED NR 140 ES

0 160 320
SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
SHALLOW GROUNDWATER BTEXTM CONCENTRATIONS

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201417
DATE	3/6/20

FIGURE: 10

S:\CAD\BEAZER\WABASH\MARCH 2020\FIGURE 10_SHALLOW GW BTEXTM CONC_2-28-20.DWG

P-103	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	<0.11	<0.068	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/17/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

P-120	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/22/15	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
09/04/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/29/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

P-110	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/07/15	<0.074	<0.13	<0.11	<0.068	<0.14	<0.18
06/22/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	**940**	*430*	*750*	990	<6.8	*120*

P-113	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
04/08/15	<0.074	<0.13	<0.11	<0.068	<0.14	<0.18
06/21/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/30/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

P-121	Benzene	Ethyl.	Toluene	Xylenes	1,2,4-TMB	1,3,5-TMB
10/22/15	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
06/21/17	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
08/31/18	<0.15	<0.18	<0.15	<0.22	<0.36	<0.25
01/28/20	<0.15	<0.18	<0.15	<0.22	<0.34	<0.25

0 160 320

SCALE IN FEET

EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- × OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- ▲ OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD

	VOC	Benz.	Toluene	Ethyl.	Xylene	1,2,4-TMB	1,3,5-TMB
WDNR	PAL	*0.5*	*200*	*140*	*1000*	*96*	*96*
NR140	ES	**5**	**1000**	**700**	**10000**	**480**	**480**

ALL VALUES IN ug/L (ppb)
ITALIC VALUES EXCEED NR 140 PAL
BOLD VALUES EXCEED NR 140 ES

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
DEEP GROUNDWATER BTEXTM CONCENTRATIONS

LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201417
DATE	3/6/20

FIGURE: 11

S:\CAD\BEAZER\WABASH\MARCH 2020\FIGURE 11 DEEP GW BTEXTM CONC 2-28-20.DWG

MW-102	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.25	<0.074	**0.92**	**0.68**	0.86	<0.18	0.6 J	0.71 J
06/22/17	<0.26	**1.8**	**2.3**	**1.9**	1.8	<0.19	0.50 J	1.7
08/17/18	<0.25	**1.7**	**2.2**	**1.7**	2.3 J	0.64	<0.23	1.7
01/28/20	<0.28	*0.16*	*0.17*	*0.12*	<0.38	<0.20	<0.26	<0.35

MW-117	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
06/22/17	<130	<38	<31	<26	<170	*130 J*	**15000**	<160
08/21/18	<25	<7.4	<6.0	<5.1	<34	*120*	**17000**	<32
08/21/18	<25	<7.3	<6.0	<5.0	<34	*110*	**15000**	<32
01/29/20	<27	<8.1	<6.6	<5.6	<37	*140*	**12000**	<35

MW-104	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	0.7 J	<0.32
06/22/17	<0.26	<0.077	*0.11 J*	<0.053	<0.35	<0.19	1.3	<0.33
08/21/18	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	<0.23	<0.32
01/28/20	<0.28	<0.084	<0.068	<0.058	<0.38	<0.21	<0.26	<0.36

MW-105	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.26	<0.077	<0.063	<0.053	<0.35	<0.19	2.9	<0.33
06/20/17	<0.25	<0.075	<0.061	<0.052	<0.35	<0.19	0.27	<0.32
08/22/18	<0.25	<0.073	<0.060	<0.051	<0.34	<0.18	1.5	<0.32
01/28/20	<0.28	<0.084	<0.069	<0.058	<0.39	<0.21	0.82	<0.36

MW-106	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-114	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-115	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	4.7	<0.33
06/20/17	<0.25	*0.11 J*	*0.14 J*	**0.21**	<0.34	<0.18	2.6	<0.32
08/22/18	<0.25	<0.073	0.091 J	*0.095 J*	<0.34	<0.18	3.7	<0.32
01/29/20	<0.30	<0.088	<0.071	<0.060	<0.40	<0.22	5	<0.38

MW-129	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.075	<0.061	<0.052	<0.35	<0.19	<0.24	<0.32
06/21/17	<0.25	<0.075	<0.061	<0.052	<0.34	<0.18	4.6	<0.32
08/27/18	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	8.3 B	<0.32
02/03/20	<0.29	<0.086	<0.070	<0.059	<0.40	<0.21	<0.27	<0.37

MW-124	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

MW-101	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
06/20/17	<0.26	*0.17*	**0.37**	**0.29**	0.49 J	<0.19	0.54 J	0.36 J
06/20/17	<0.25	*0.13 J*	**0.26**	**0.21**	0.35 J	<0.18	<0.23	<0.32
08/27/18	<0.25	<0.074	<0.060	<0.051	<0.34	<0.18	4.7 B	<0.32
02/03/20	<0.31	**0.36**	**0.66**	**0.48**	0.86	<0.22	6.6	0.72

MW-123	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/22/15	27	**8.1**	**8.4**	**8.9**	38	*140*	**6300**	44
04/07/16	23	**11**	**14**	**11**	48	*110*	**8600**	36
06/21/17	30	**13**	**15**	**16**	58	*140*	**5200**	*52*
09/05/18	**DNAPL**							
01/30/20	7.5	**0.75**	**0.81**	**0.73**	9.2	*85*	**3200**	4.2

MW-125	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/07/16	13	**3.1**	**3.9**	**4.5**	27	79	**250**	17
06/22/17	22 J	**5.4 J**	**6.6 J**	**7.9**	35 J	*130*	**3400**	30 J
08/22/18	15	**3.2**	**4.2**	**3.6**	30	*140*	**6000**	18
01/29/20	4.5	**0.93**	**0.67**	**0.88**	7.6	32	**2500**	6.2

MW-119	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
03/08/13	0.38	**0.52**	**0.71**	**0.62 ***	1.7 *	<0.12	<0.12 *	1.2 *

MW-132	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	0.39 J	**0.99**	**1.4**	**1.0**	2.2	0.62 J	0.68 J	1.7
06/16/17	<0.25	**0.23**	*0.19*	*0.15*	0.34J	0.43J	<0.23	<0.32
08/21/18	<0.24	<0.072	<0.059	<0.050	<0.33	<0.18	0.29 J	<0.31
01/31/20	<0.29	**0.27**	**0.39**	**0.28**	0.56	<0.21	0.46	0.45

MW-111	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
06/22/17	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	0.24 J	<0.33
06/22/17	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	0.30 J	<0.33
08/21/18	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	1.3	<0.32
01/28/20	<0.30	<0.089	<0.073	<0.061	<0.41	<0.22	8	<0.38

MW-116	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/21/15	0.34 J	<0.073	*0.072 J*	*0.13 J*	*0.83*	*0.88*	*14*	0.5 J
04/07/15	<0.25	<0.073	<0.060	<0.051	<0.34	0.52 J	9.1	<0.32
08/22/18	<0.25	<0.073	<0.059	*0.068 J*	<0.33	<0.18	5.6	<0.31
01/29/20	0.92	<0.083	<0.068	<0.057	<0.38	0.34	0.73	<0.36

MW-112	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/08/15	<0.25	<0.073	<0.059	<0.050	<0.33	<0.18	0.77	<0.31
06/20/17	<0.25	<0.074	<0.061	<0.051	<0.34	0.24 J	0.79	<0.32
08/21/18	<0.25	<0.073	<0.060	<0.051	<0.34	<0.18	0.30 J	<0.32
01/30/20	0.96	**0.22**	*0.15*	*0.13*	0.52	<0.22	0.79	0.77

MW-118	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/22/15	<0.25	<0.075	<0.061	<0.051	<0.34	<0.18	1.3	<0.32
06/20/17	<0.25	**0.23**	**0.32**	**0.22**	<0.35	<0.19	0.33	<0.32
10/19/18	<0.25 *	<0.073 *	<0.060	<0.050 *	<0.33 *	<0.18	<0.23	<0.31 *
01/29/20	0.95	**0.34**	**0.31**	**0.24**	0.86	<0.20	<0.26	0.89

MW-133	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.075	<0.061	<0.052	<0.34	<0.18	<0.23	<0.32
04/07/17	<0.25	<0.075	<0.061	<0.051	<0.34	<0.18	<0.23	<0.32
06/16/17	<0.25	<0.075	<0.061	<0.052	<0.34	<0.19	<0.23	<0.32
08/28/18	<0.25	<0.073	<0.059	<0.050	<0.33	<0.18	<0.23	<0.31
01/27/20	Could Not Locate							

MW-136	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/19/18	<0.26 *	**0.36 ***	**0.48**	**0.39 ***	0.71 J *	<0.19	<0.24	0.79 *
03/02/20	<0.25	<0.076	<0.062	<0.052	<0.35	<0.19	<0.24	<0.33

MW-107	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
06/20/17	11	<0.37	<0.30	**0.34 J**	10	*97*	**12000 D**	6.1
08/27/18	13	<0.74	<0.60	<0.51	12	*130*	**10000 B**	8.3
08/27/18	13	<0.73	<0.60	**0.59 J**	11	*120*	**9000 B**	8
02/03/20	12	**0.78**	**0.81**	**0.91**	11	*150*	**11000**	6.8

MW-108	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/21/15	<0.25	**0.29**	**0.42**	**0.36 J**	0.55 J	<0.18	2.4	0.53 J
04/07/15	<0.25	<0.074	<0.061	<0.051	<0.34	<0.18	1	<0.32
06/22/17	<0.26	<0.078	<0.064	<0.054	<0.36	<0.19	<0.24	<0.34
01/29/20	<0.27	<0.080	<0.066	<0.055	<0.37	<0.20	0.97	<0.35

MW-1	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/08/15	<0.25	<0.073	<0.060	<0.050	<0.33	<0.18	0.74	<0.31
06/22/17	<0.26	<0.076	<0.062	<0.053	<0.35	<0.19	1.8	<0.33
08/21/18	<0.25	<0.073	<0.059	<0.050	<0.33	<0.18	0.30 J	<0.31
01/30/20	0.85	**0.23**	**0.2**	*0.15*	0.47	<0.19	<0.24	0.66

MW-134	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/31/16	47	**27**	**37**	**30**	*220*	*340*	**720**	*160*
01/09/17	*1500*	**1300**	**1900**	**1300**	**9400**	**4500**	**3200**	**6500**
06/20/17	300	**230**	**310**	**240**	**1500**	**850**	**620**	**1100**
08/28/18	**21000**	**14000**	**17000**	**14000**	**89000**	**45000**	**35000**	**74000**
01/27/20	DNAPL							

MW-122	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
06/20/17	4.2	*0.18*	*0.18*	*0.18*	2.1	33	**1300**	1
08/22/18	5.6	*0.18*	**0.24**	**0.22**	3.6	46	**2800**	1.5
08/22/18	6	**0.24**	**0.31**	**0.24**	4.2	50	**3000**	1.8
01/30/20	3	<0.088	<0.071	*0.14*	2.6	29	**660**	1.2

MW-130	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	2.5	<0.075	<0.061	*0.089 J*	4.4	30	**830**	2.3
06/16/17	4.5	*0.16*	*0.11 J*	**0.33**	12	59	4.1	7.8
08/27/18	**2200**	**580**	**1100**	**1700**	**17000**	**12000**	**41000 B**	**12000**
02/03/20	**DNAPL**							

MW-109	
04/07/16	DNAPL
06/22/17	DNAPL
09/05/18	DNAPL
01/27/20	DNAPL

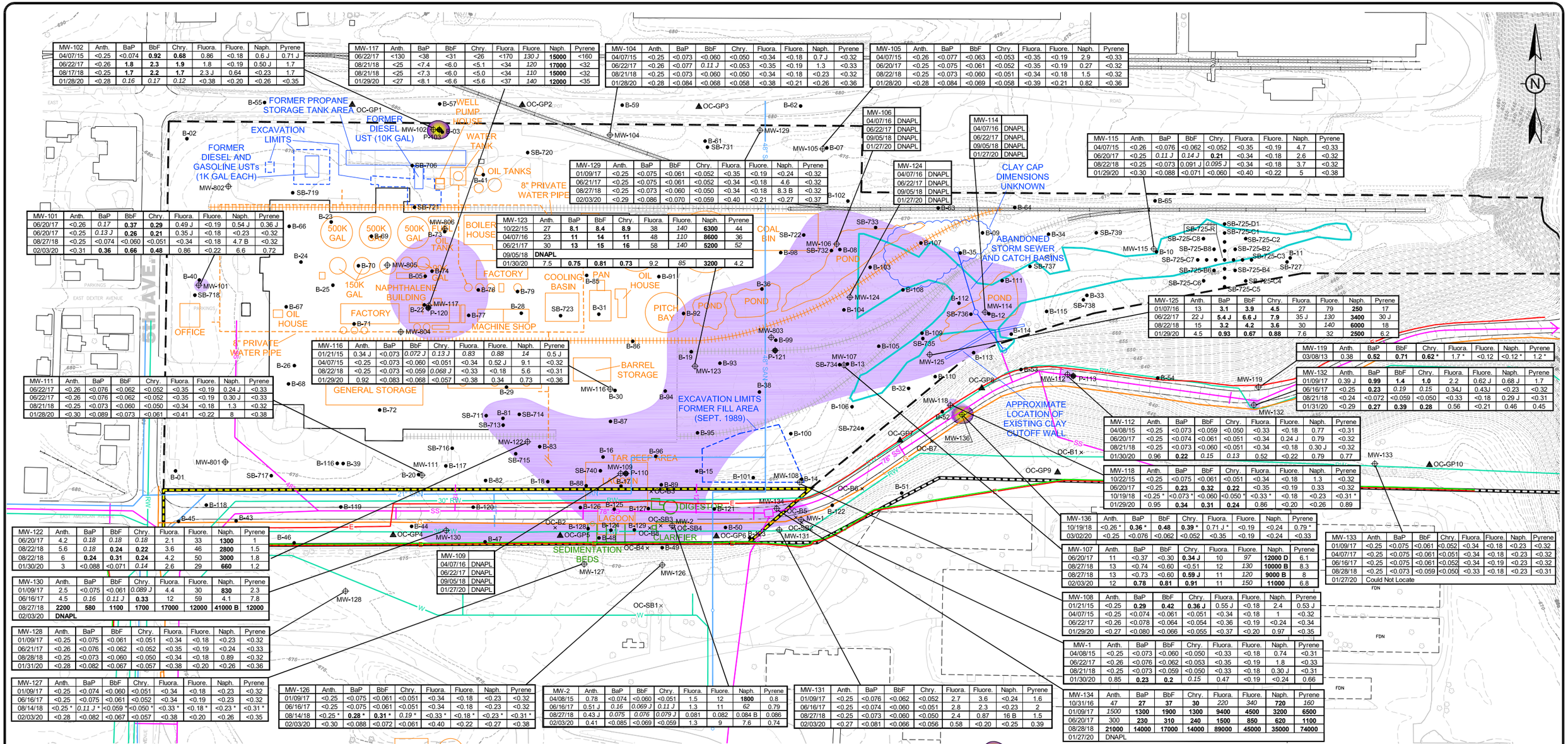
MW-128	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.075	<0.061	<0.051	<0.34	<0.18	<0.23	<0.32
06/21/17	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	<0.24	<0.33
08/28/18	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	0.89	<0.32
01/31/20	<0.28	<0.082	<0.067	<0.057	<0.38	<0.20	<0.26	<0.36

MW-127	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.074	<0.060	<0.051	<0.34	<0.18	<0.23	<0.32
06/16/17	<0.25	<0.075	<0.061	<0.052	<0.34	<0.19	<0.23	<0.32
08/14/18	<0.25 *	*0.11 J* *	<0.059 *	<0.050 *	<0.33 *	<0.18 *	<0.23 *	<0.31 *
02/03/20	<0.28	<0.082	<0.067	<0.057	<0.38	<0.20	<0.26	<0.35

MW-126	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.075	<0.061	<0.051	<0.34	<0.18	<0.23	<0.32
06/16/17	<0.25	<0.075	<0.061	<0.051	<0.34	<0.18	<0.23	<0.32
08/14/18	<0.25 *	**0.28 ***	**0.31 ***	*0.19 **	<0.33 *	<0.18 *	<0.23 *	<0.31 *
02/03/20	<0.30	<0.088	<0.072	<0.061	<0.40	<0.22	<0.27	<0.38

MW-2	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/08/15	0.78	<0.074	<0.060	<0.051	1.5	12	**1800**	0.8
06/16/17	0.51 J	*0.16*	*0.069 J*	*0.11 J*	1.3	11	*62*	0.79
08/27/18	0.43 J	*0.075*	*0.076*	*0.079 J*	0.081	0.082	0.084 B	0.086
02/03/20	0.41	<0.085	<0.069	<0.059	1.3	9	7.6	0.74

MW-131	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
01/09/17	<0.25	<0.076	<0.062	<0.052	2.7	3.6	<0.24	1.6
06/16/17	<0.25	<0.074	<0.060	<0.051	2.8	2.3	<0.23	2
08/27/18	<0.25	<0.073	<0.060	<0.050	2.4	0.87	16 B	1.5
02/03/20	<0.27	<0.081	<0.066	<0.056	0.58	<0.20	<0.25	0.39



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- × OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- ▲ OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD
- INTERMITTENT DETECTIONS ABOVE AND BELOW STANDARDS

	PAH	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
WDNR	PAL	*600*	*0.02*	*0.02*	*0.02*	*80*	*80*	*10*	*50*
NR140	ES	**3000**	**0.2**	**0.2**	**0.2**	**400**	**400**	**100**	**250**

ALL VALUES IN ug/L (ppb)
ITALIC VALUES EXCEED NR 140 PAL
BOLD VALUES EXCEED NR 140 ES

0 160 320
SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
SHALLOW GROUNDWATER PAH CONCENTRATIONS

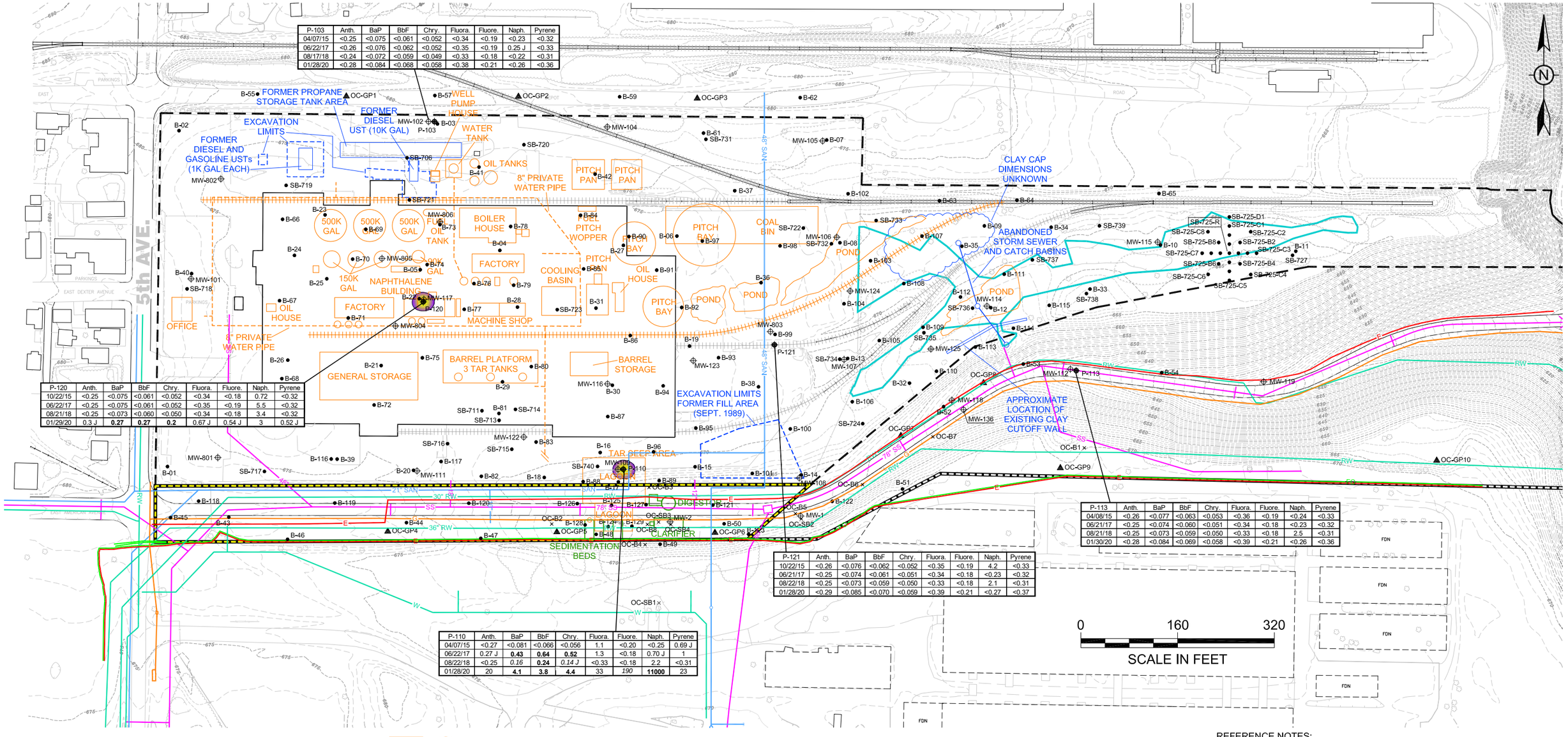
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201417
DATE	3/6/20

FIGURE: 12

S:\CAD\BEAZER\WABASH\MARCH 2020\FIGURE 12_SHALLOW GW PAH CONC_2-28-20.DWG



P-103	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.25	<0.075	<0.061	<0.052	<0.34	<0.19	<0.23	<0.32
06/22/17	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	0.25 J	<0.33
08/17/18	<0.24	<0.072	<0.059	<0.049	<0.33	<0.18	<0.22	<0.31
01/28/20	<0.28	<0.084	<0.068	<0.058	<0.38	<0.21	<0.26	<0.36

P-120	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/22/15	<0.25	<0.075	<0.061	<0.052	<0.34	<0.18	0.72	<0.32
06/22/17	<0.25	<0.075	<0.061	<0.052	<0.35	<0.19	5.5	<0.32
08/21/18	<0.25	<0.073	<0.060	<0.050	<0.34	<0.18	3.4	<0.32
01/29/20	0.3 J	**0.27**	**0.27**	**0.2**	0.67 J	0.54 J	3	0.52 J

P-110	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/07/15	<0.27	<0.081	<0.066	<0.056	1.1	<0.20	<0.25	0.69 J
06/22/17	0.27 J	**0.43**	**0.64**	**0.52**	1.3	<0.18	0.70 J	1
08/22/18	<0.25	*0.16*	**0.24**	*0.14 J*	<0.33	<0.18	2.2	<0.31
01/28/20	20	**4.1**	**3.8**	**4.4**	33	*190*	**11000**	23

P-121	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
10/22/15	<0.26	<0.076	<0.062	<0.052	<0.35	<0.19	4.2	<0.33
06/21/17	<0.25	<0.074	<0.061	<0.051	<0.34	<0.18	<0.23	<0.32
08/22/18	<0.25	<0.073	<0.059	<0.050	<0.33	<0.18	2.1	<0.31
01/28/20	<0.29	<0.085	<0.070	<0.059	<0.39	<0.21	<0.27	<0.37

P-113	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
04/08/15	<0.26	<0.077	<0.063	<0.053	<0.36	<0.19	<0.24	<0.33
06/21/17	<0.25	<0.074	<0.060	<0.051	<0.34	<0.18	<0.23	<0.32
08/21/18	<0.25	<0.073	<0.059	<0.050	<0.33	<0.18	2.5	<0.31
01/30/20	<0.28	<0.084	<0.069	<0.058	<0.39	<0.21	<0.26	<0.36

EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- APPROXIMATE AREA OF GROUNDWATER THAT EXCEEDS ENFORCEMENT STANDARD
- INTERMITTENT DETECTIONS ABOVE AND BELOW STANDARDS

	PAH	Anth.	BaP	BbF	Chry.	Fluora.	Fluore.	Naph.	Pyrene
WDNR	PAL	*600*	*0.02*	*0.02*	*0.02*	*80*	*80*	*10*	*50*
NR140	ES	**3000**	**0.2**	**0.2**	**0.2**	**400**	**400**	**100**	**250**

ALL VALUES IN ug/L (ppb)
ITALIC VALUES EXCEED NR 140 PAL
BOLD VALUES EXCEED NR 140 ES

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
DEEP GROUNDWATER PAH CONCENTRATIONS

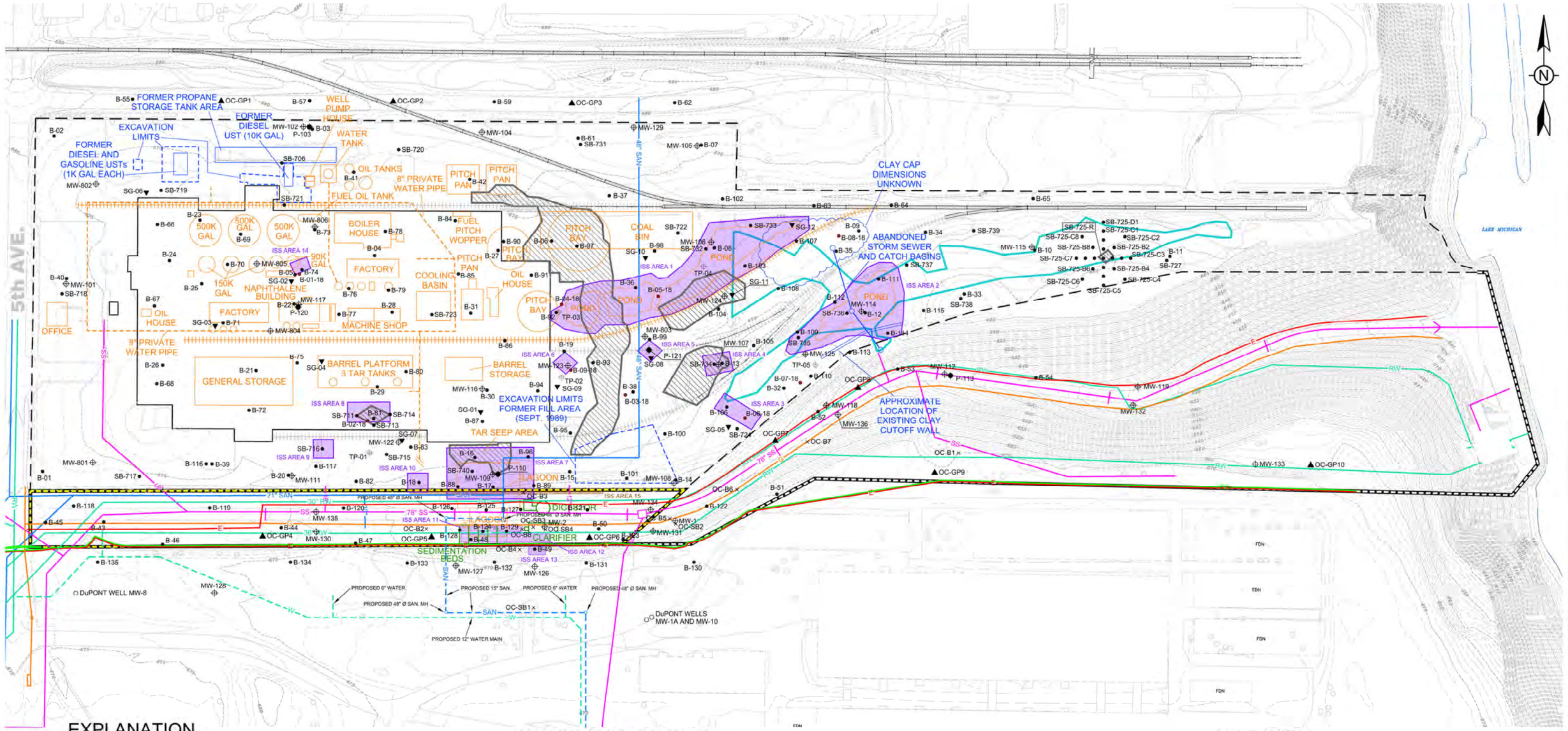
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201417
DATE	3/6/20

FIGURE: 13

S:\CAD\BEAZER\WABASH\MARCH 2020\FIGURE 13_DEEP GW PAH CONC_2-28-20.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- TP-01 — TEST PIT
- SG-07 — SOIL GAS PROBE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED 0-15' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- F — FIBER OPTIC

0 160 320

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
SITE LAYOUT

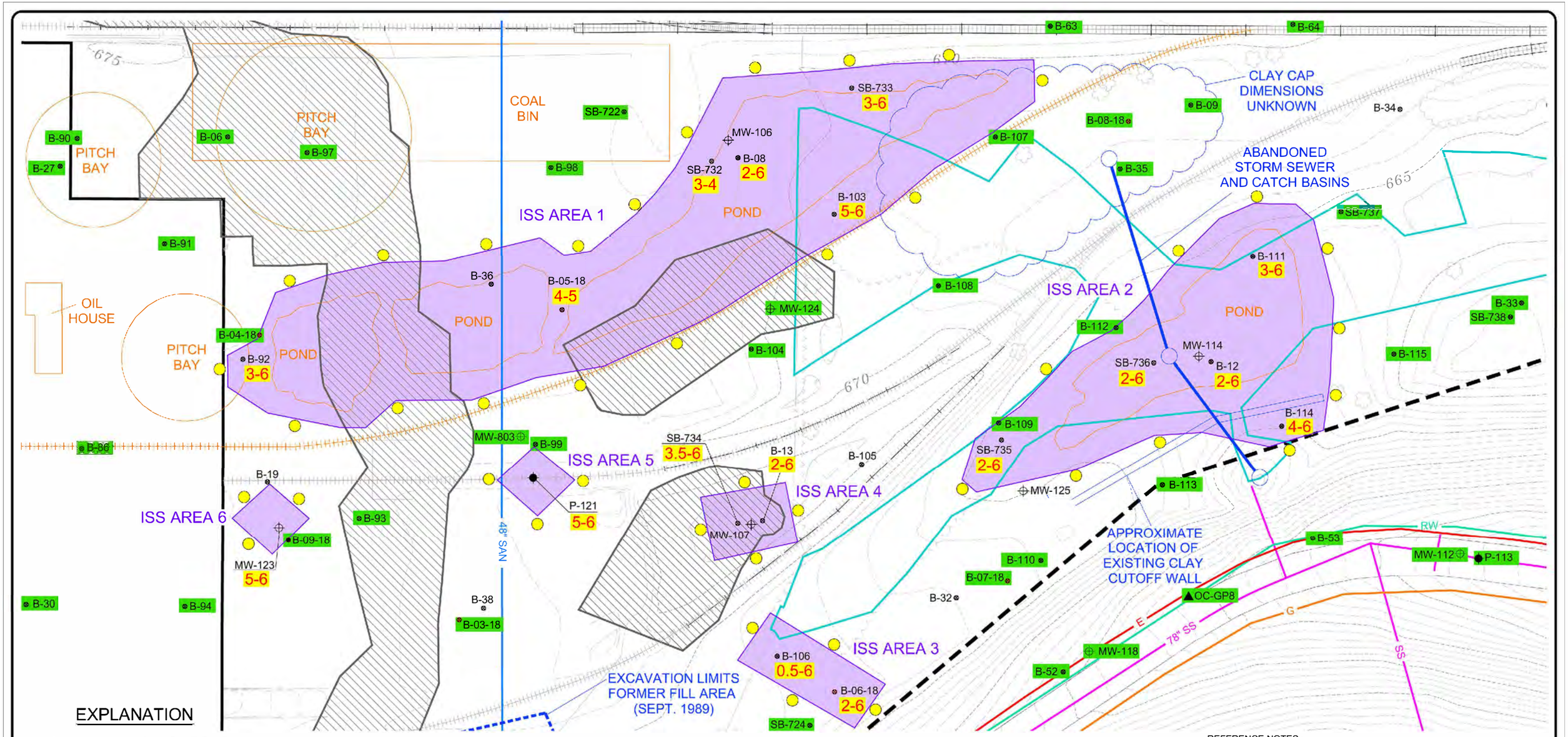
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	04/14/21

FIGURE: 2

S:\CAD\BEAZER\WABASH\APRIL 2021\FIGURE 2_SITE LAYOUT_04-14-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE
- N
- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC
- 0-6 — OBSERVED TAR (0-6' BGS)
- B-52 — NO OBSERVED TAR

0 50 100
SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

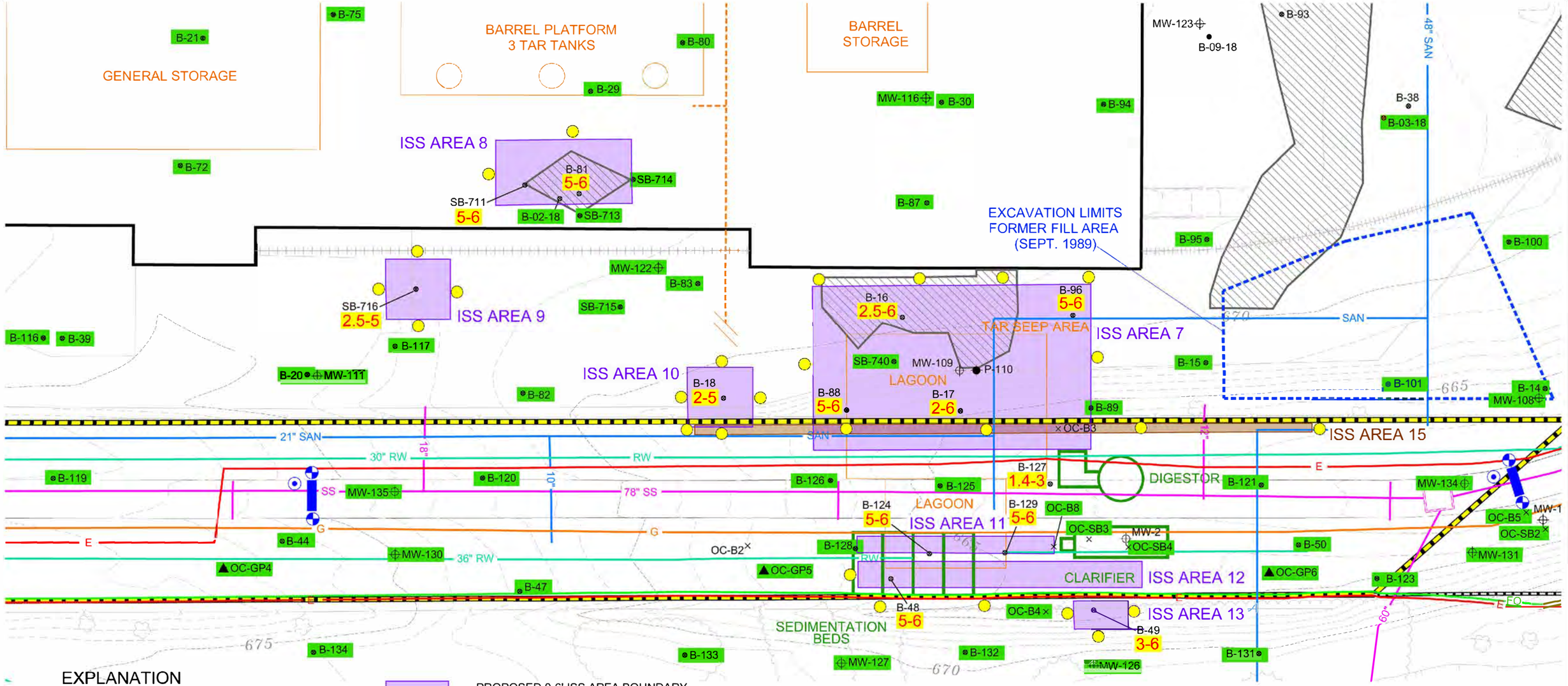
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	04/05/21

FIGURE: 3

S:\CAD\BEAZER\WABASH\APRIL 2021\ISS BLOWUP1 DELINEATION 04-02-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED MONITORING WELL ADJACENT TO TRENCH PLUG
- PROPOSED NESTED PRODUCT RECOVERY / MONITORING WELL
- PROPOSED TRENCH PLUG LOCATION
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- PROPOSED 0-15' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE

- E — ELECTRICAL
- G — NATURAL GAS
- RW — RAW WATER
- SAN — SANITARY
- SS — STORM SEWER
- FO — FIBER OPTIC

0-6 OBSERVED TAR (0-6' BGS)

B-14 NO OBSERVED TAR

0 50 100

SCALE IN FEET

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

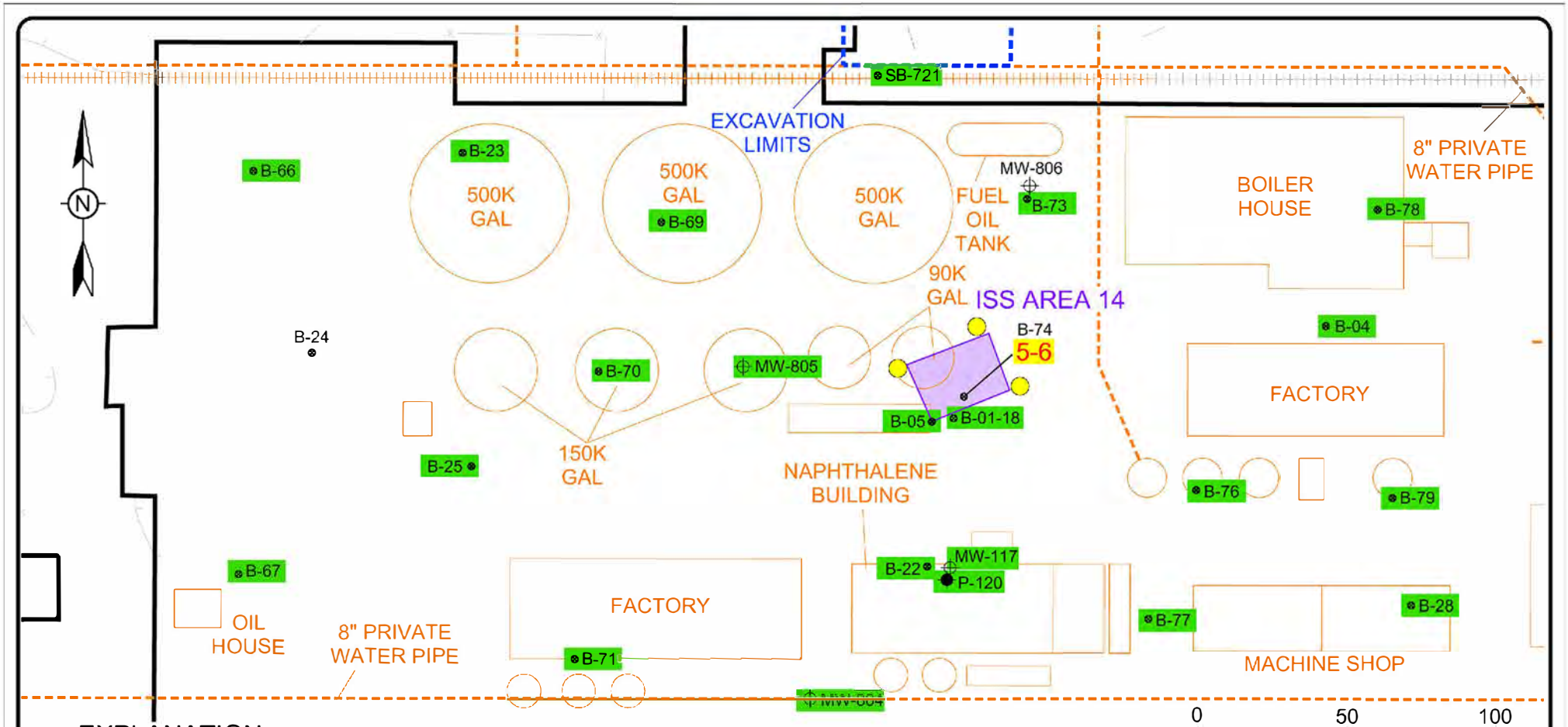
LOCATION: OAK CREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	04/05/21

FIGURE: 4

S:\CAD\BEAZER\WABASH\APRIL 2021\ISS BLOWUP2 DELINEATION_04-02-21.DWG



EXPLANATION

- MW-101 — WATER TABLE WELL
- P-103 — NESTED PIEZOMETER
- B-01 — SOIL BORING
- OC-SB1 — SOIL BORING (CITY OF OAK CREEK)
- OC-GP1 — GEOPROBE (CITY OF OAK CREEK)
- APPROXIMATE WABASH PARCEL BOUNDARY (VPLE 06-41-560068)
- APPROXIMATE CITY PARCEL BOUNDARY (VPLE # TBD)
- PROPOSED ISS AREA BOUNDARY DELINEATION BOREHOLE
- PROPOSED 0-6' ISS AREA BOUNDARY FOR TAR, APPROXIMATE
- FORMER TAR PLANT STRUCTURES
- PAST REMEDIAL ACTIVITIES
- FORMER WASTEWATER TREATMENT PLANT STRUCTURES
- APPROXIMATE WETLAND BOUNDARY
- APPROXIMATE CITY UTILITY CORRIDOR PROPERTY BOUNDARY
- PROPOSED EXCAVATION AREAS BOUNDARY FOR PCBs, APPROXIMATE
- 0-6 — OBSERVED TAR (0-6' BGS)
- B-77 — NO OBSERVED TAR

REFERENCE NOTES:

1. EXISTING TOPOGRAPHY AND SITE FEATURES FROM LAND INFORMATION SERVICES, INC. - ENVIRONMENTAL SURVEY, 12/21/2001.
2. FORMER TAR PLANT STRUCTURES FROM THE SANBORN LIBRARY - EDR INQUIRY 2284158.1s, ©1950.
3. FORMER POND AND LAGOON LOCATIONS FROM 1937-1968 AERIAL PHOTOGRAPHY - COMPILED BY AERO-DATA CORPORATION, APRIL 2013.
4. FORMER WASTEWATER TREATMENT PLANT STRUCTURES FROM HARTMAN-STRASS, INC. - FILE NO. 72051-C-303, 12/1/1971.

TITLE: FORMER KOPPERS TAR PLANT AND WABASH ALLOYS SITE
OBSERVED TAR (0-6') AND PROPOSED ISS AREAS

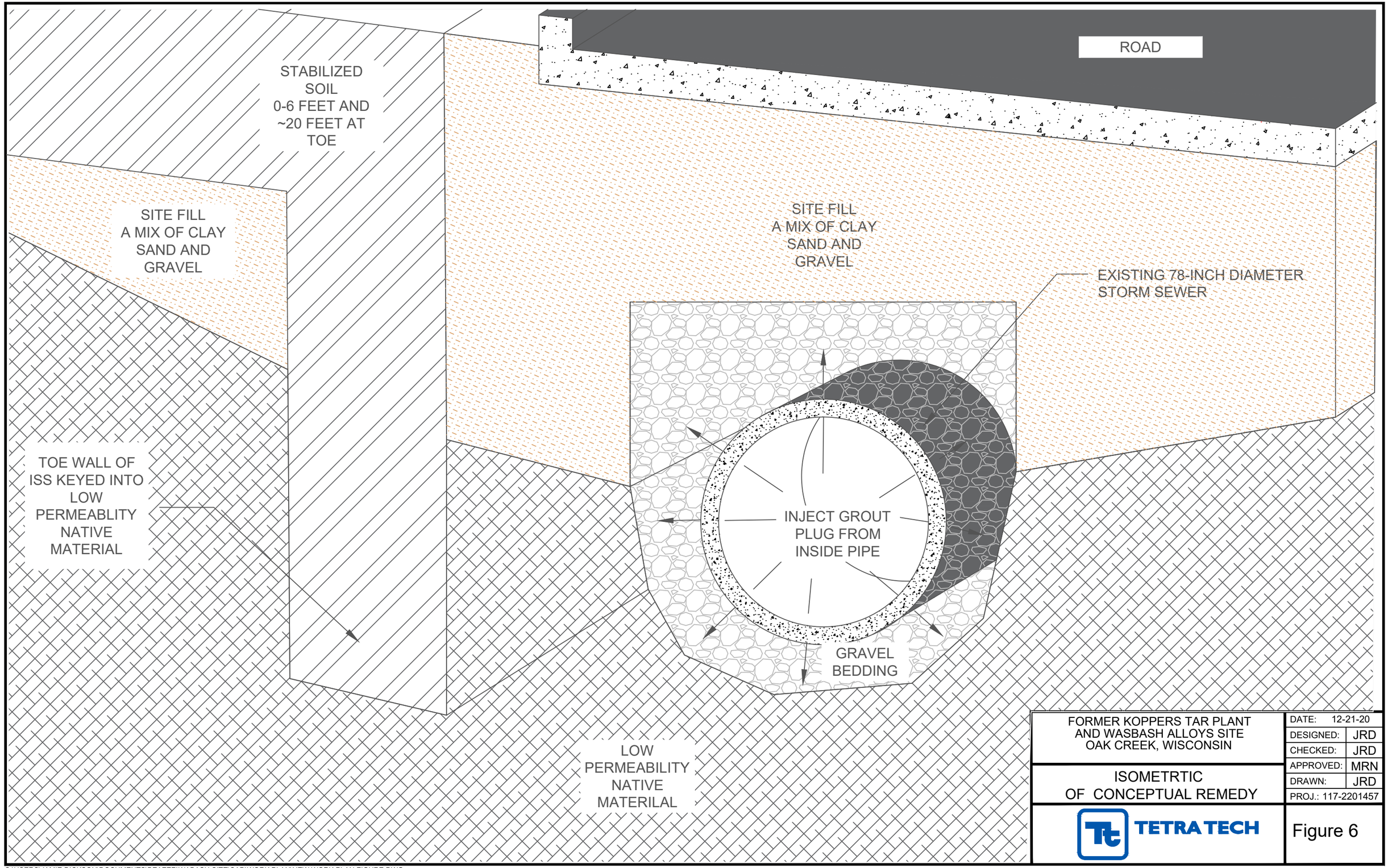
LOCATION: OAKCREEK, WISCONSIN

TETRA TECH

CHECKED	MRN
DRAFTED	CMP
PROJECT	117-2201452
DATE	04/05/21

FIGURE: 5

S:\CAD\BEAZER\WABASH\APRIL 2021\ISS BLOWUP3 DELINEATION_04-02-21.DWG



FORMER KOPPERS TAR PLANT
AND WASBASH ALLOYS SITE
OAK CREEK, WISCONSIN

ISOMETRTIC
OF CONCEPTUAL REMEDY

TETRA TECH

DATE:	12-21-20
DESIGNED:	JRD
CHECKED:	JRD
APPROVED:	MRN
DRAWN:	JRD
PROJ.:	117-2201457

Figure 6

C:\USERS\JAMIE.DICKSON\DOCUMENTS\BEAZER\WABASH SITE\CAD\WORK PLAN\NEW WORK PLAN FIGURE.DWG

bing maps

A 9100 S 5th Ave, Oak Creek, WI 53154

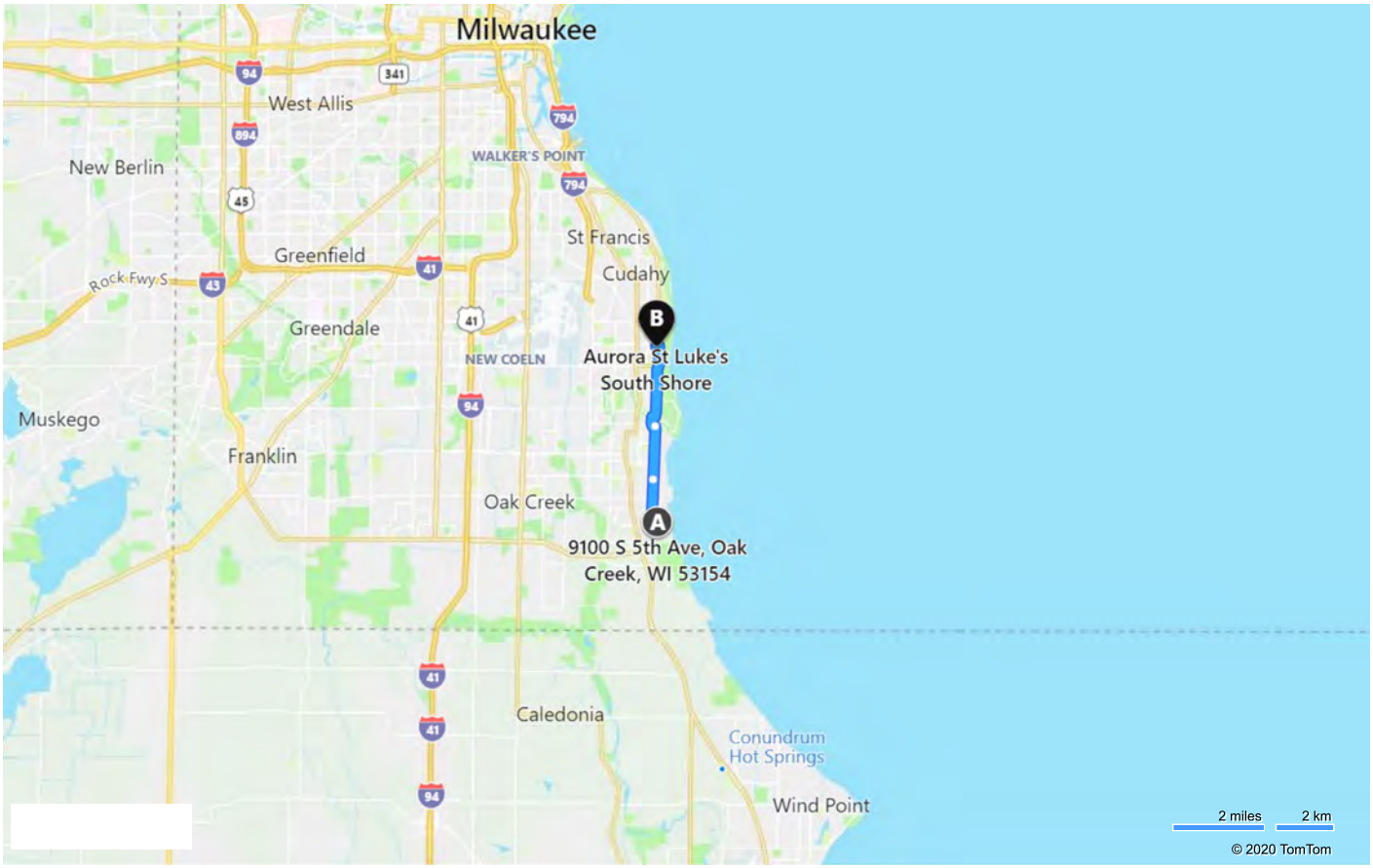
B Aurora St Luke's South Shore, 5900 S Lake Dr, Cudahy, WI 53110

11 min , **4.4 miles**
Light traffic
Via 5th Ave, Lake Dr
· Local roads

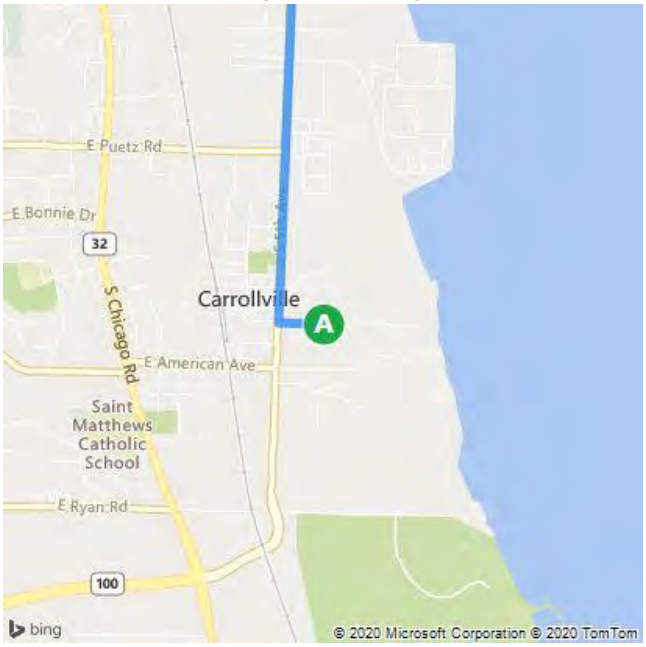
A 9100 S 5th Ave, Oak Creek, WI 53154

↑	1.	Head **west** on **E Depot Rd** toward S 5th Ave	0.1 mi
↱	2.	Turn **right** onto **S 5th Ave**	1.0 mi
↑	3.	Road name changes to **5th Ave**	1.2 mi
↑	4.	Road name changes to **Milwaukee Ave**	325 ft
↱	5.	Turn **right** onto **Mill Rd**	0.3 mi
↱	6.	Turn **right** onto **Hawthorne Ave**, and then immediately turn **left** onto **Lake Dr**	1.2 mi
↰	7.	Bear **left** onto **WI-32 / S Lake Dr**	0.5 mi
↰	8.	Turn **left** onto **E Ramsey Ave**	348 ft
↰	9.	Turn **left**	220 ft
	10.	Arrive at your destination on the left The last intersection is S Trinthammer Ave	

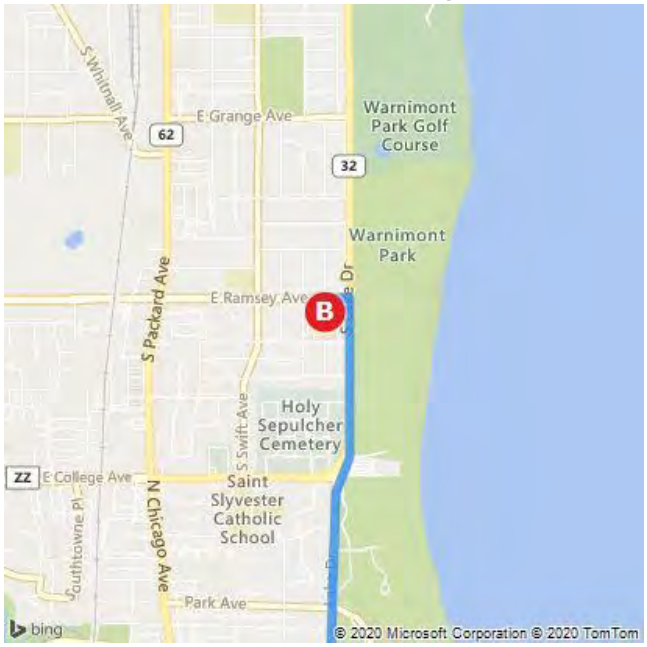
B Aurora St Luke's South Shore



A 9100 S 5th Ave, Oak Creek, WI 53154



B Aurora St Luke's South Shore, 5900 S Lake...



To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards. These SWPs establish a pattern of general precautions and measures for reducing risks associated with field operations not conducted on hazardous waste sites. This list is not inclusive and may be amended as necessary.

- Be familiar with and knowledgeable of and adhere to all instructions in the construction health and safety plan (C-HASP), job safety analysis, job hazard analysis, work permit or other health and safety documentation.
- At a minimum, a safety meeting will be held at the start of each project to discuss the hazards of the site and site work. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.
- Use the “buddy system” whenever respiratory protection, fall protection, or other protective equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- In order to assist each other in the event of an emergency, buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity.
- Do not bring nonessential vehicles and equipment onto the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).
- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech personnel, subcontractor personnel, and project site visitors; and other information related to safety matters.

- A portable eyewash station should be located in the support zone if corrosive materials are used or stored on the site.
- Smoking is not allowed on Tetra Tech projects sites, except in designated smoking areas.
- Do not bring matches and lighters in the exclusion zone or contamination reduction zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.
- Anyone known to be under the influence of drugs or intoxicating substances that impair the employee's ability to safely perform assigned duties shall not be allowed on the job while in that condition.
- Horseplay, scuffling, and other acts that tend to have an adverse influence on the safety or well-being of the employees is prohibited.
- Work shall be well planned to prevent injuries in the handling of materials and when working with equipment.
- No one shall knowingly be permitted or required to work while the employee's ability or alertness is so impaired by fatigue, illness, or other causes that might unnecessarily expose the employee or others to injury.
- Use proper lifting techniques. Heavy objects will be lifted using the large muscles of the leg instead of the smaller muscles of the back.
- Wear appropriate footwear and all other protective equipment required for work.
- Cleanse thoroughly after handling hazardous substances.
- Maintain all tools and equipment in good condition.
- First aid kits shall be located in a prominent location and stocked with basic first aid supplies.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	NEW

	TETRA TECH, INC. GENERAL SAFE WORK PRACTICES for HAZARDOUS WASTE SITE ACTIVITIES	Revision Date: 10/1/2008 Document Control Number: SWP 5-2 Page 1 of 3

To prevent injuries and adverse health effects, the following general safe work practices (SWP) are to be followed when conducting work involving known and unknown site hazards on hazardous waste sites. These SWPs establish a pattern of general precautions and measures for reducing risks associated with hazardous site operations. This list is not inclusive and may be amended as necessary.

- Do not eat, drink, chew gum or tobacco, take medication, or smoke in contaminated or potentially contaminated areas or where the possibility for contact with site contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. If a source of potable water is not available at the work site that can be used for hands-washing, the use of waterless hand cleaning products will be used, followed by actual hand-washing as soon as practicable upon exiting the site. A thorough shower and wash must be conducted as soon as possible if excessive skin contamination occurs.
- Avoid contact with potentially contaminated substances. Do not walk through puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on drums, equipment, or the ground. Do not place monitoring equipment on potentially contaminated surfaces.
- Remove beards or facial hair that interferes with a satisfactory qualitative respirator fit test or routine pre-entry positive and negative pressure checks.
- Be familiar with and knowledgeable of and adhere to all instructions in the site-specific health and safety plan (HASP). At a minimum, a safety meeting will be held at the start of each project to discuss the HASP. Additional meetings will be held, as necessary, to address new or continuing safety and health concerns.
- Be aware of the location of the nearest telephone and all emergency telephone numbers.
- Attend a briefing on the anticipated hazards, equipment requirements, SWPs, emergency procedures, and communication methods before going on site.
- Plan and delineate entrance, exit, and emergency escape routes.
- Rehearse unfamiliar operations prior to implementation.

- Use the "buddy system" whenever respiratory protection equipment is in use. Buddies should establish hand signals or other means of emergency communication in case radios break down or are unavailable.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity in order to assist each other in case of emergency.
- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Nonessential vehicles and equipment should remain within the support zone.
- Establish appropriate support, contamination reduction, and exclusion zones.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the site safety coordinator (SSC).
- Maintain a portion of the site field logbook as a project safety log. The project safety log will be used to record the names, entry and exit dates, and times on site of all Tetra Tech personnel, subcontractor personnel, and project site visitors; air quality and personal exposure monitoring data; and other information related to safety matters. Form SSC-1, Daily Site Log, may be used to record names of on-site personnel.
- A portable eyewash station should be located in the support zone if chemical splashes to eyes are possible.
- Do not bring matches and lighters in the exclusion zone or contamination reduction zone. Flames and open fires are not permitted on site.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform coworkers of nonvisual effects of illness if you experience them, such as headaches, dizziness, nausea, or blurred vision.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
10/1/2008	Chris McClain		Update from 1998 format
	Rick Lemmon		

This document establishes safe work practices (SWP) to follow during drilling operations. These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Before beginning any drill operation, each employee must conform to the following requirements:

- Wear a hard hat, safety glasses or goggles, steel-toed work boots, a shirt and full-length pants when working with or near the drill rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the drill rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that drill masts or other projecting devices will be farther than 25 feet in any direction from overhead power lines.
- Ensure that the drill rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Drill rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the drill rig is operating, employees must:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving drill rig parts.

- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the drill rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.
- Only qualified and licensed personnel should operate drill rigs.
- Workers should not assume that the drill rig operator is keeping track of the rig's exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.
- Workers should maintain visual contact with drill rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.
- Auger sections and other equipment are extremely heavy. All lifting precautions should be taken before moving heavy equipment. Appropriate equipment, such as chains, hoists, straps, and other equipment, should be used to safely transport heavy equipment too heavy to safely lift.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.
- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded to prevent the buildup of static electricity.
- Keep drill rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.
- Store tools in clean, secure areas to prevent damage, loss, or theft.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

This document establishes safe work practices (SWP) to follow during operating involving boring using direct push technology (DPT). These SWPs are based on suggested safety procedures provided in the National Drilling Association's "Drilling Safety Guide." Procedures to follow before, during, and after drilling are listed below.

Conventional and sonic drilling rigs can penetrate virtually any material to great depth, but they are expensive and cumbersome to operate in environmental investigations. Contaminated material brought to the surface requires special handling and can be a safety concern for workers. An alternative, the direct-push cone penetrometer, was developed in the 1930s in The Netherlands. This device uses up to 40,000 pounds of hydraulic force to push a steel instrumented cone or a sampling device into the ground. No material comes to the surface unless soil or groundwater samples are being collected. Direct-push technology eliminates the need for disposal of cuttings and solidification of drilling fluid. Therefore, DPT is frequently used for environmental investigation applications as an alternative to conventional drilling.

Before beginning any DPT operation, employees must understand and comply with the following requirements:

- Safety glasses or goggles, steel-toed work boots, hard hat, a shirt and full-length pants must be worn when working with or near the direct push rig. Shirts must be tucked in at the belt.
- Do not wear loose or frayed clothing, loose long hair, or loose jewelry while working with rotating equipment.
- Do not eat, drink, or smoke near the direct push rig.
- Identify all underground utility and buried structure locations before drilling.
- Ensure that the direct push rig and any other machinery used is inspected daily by competent, qualified individuals. The site safety coordinator (SSC) will ensure compliance with this precaution.
- Direct push rig operators will be instructed to report any abnormalities, such as equipment failure, oozing liquids, and unusual odors, to their supervisors or the SSC.
- Establish hand-signal communications for use when verbal communication is difficult. One person per work team will be designated to give hand signals to equipment operators.

While the direct push rig is operating, employees should be aware of the following:

- Wear appropriate respiratory and personal protective equipment (PPE) when conditions warrant their use.
- Avoid direct contact with known or suspected contaminated surfaces.
- Move tools, materials, cords, hoses, and debris to prevent tripping hazards and contact with moving direct push rig parts.
- Adequately secure tools, materials, and equipment subject to displacement or falling.
- Store flammable materials away from ignition sources and in approved containers.
- Maintain adequate clearance of the direct push rig and mast from overhead transmission lines. The minimum clearance is 25 feet unless special permission is granted by the utility company. Call the local utility company for proper clearance.
- Only qualified and licensed personnel should operate direct push rigs.
- Workers should not assume that the direct push rig operator is keeping track of their exact location. Workers should never walk directly behind or beside heavy equipment without the operator's knowledge.
- Workers should maintain visual contact with direct push rig operators at all times.
- When an operator must maneuver equipment in tight quarters, the presence of a second person is required to ensure adequate clearance. If much backing is required, two ground guides will be used: one in the direction the equipment is moving, and the other in the operator's normal field of vision to relay signals.
- Proper personal lifting techniques will be used. Workers should lift using their legs, not their backs.
- Workers will not use equipment they are not familiar with. This precaution applies to heavy as well as light equipment.
- All personnel not essential to work activities will be kept out of the work area.
- Workers will be aware of their footing at all times.

- Workers will remain alert at all times.

After drilling operations are completed, employees should do the following:

- Shut down machinery before repairing or lubricating parts (except parts that must be in motion for lubrication).
- Shut down mechanical equipment prior to and during fueling operations. When refueling or transferring fuel, containers and equipment must be bonded and grounded to prevent the buildup of static electricity.
- Keep direct push rigs in the exclusion zone until work has been completed. Such equipment should then be decontaminated within the designated decontamination area.
- Engage parking brakes when equipment is not in use.
- Implement an ongoing maintenance program for all tools and equipment. All tools and moving equipment should be inspected regularly to ensure that parts are secured, are intact, and have no cracks or areas of weakness. The equipment must turn smoothly without wobbling and must operate in accordance with manufacturer specifications. Defective items should be promptly repaired or replaced. Maintenance and repair logs will be kept.
- Store tools in clean, secure areas to prevent damage, loss, or theft.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	NEW

1.0 PURPOSE

The purpose of this procedure is to identify minimum requirements, and to provide guidance to Tetra Tech Inc. (Tetra Tech) project personnel concerning the management of construction tools and equipment on construction projects.

2.0 SCOPE

This procedure applies to all Tetra Tech projects that include a construction, O&M, and/or UXO component, including remediation construction.

3.0 MINIMUM REQUIREMENTS

3.1 Definitions

3.1.1 Construction Equipment

For the purposes of this procedure, construction equipment shall mean heavy equipment, such as excavators, scrapers, off-road trucks, dozers, road graders, compactors, dredges, and cranes; light equipment, such as skid-steers, forklifts, generators, and light plants; and operating systems such as screens, crushers, conveyors, pugmills, mobile treatment plants, and pumps. Any discussion of construction equipment shall be understood not to include cars, pickup trucks, flatbed trucks, etc. registered for use on public roadways, which shall be called vehicles hereinafter. Also for the purposes of this procedure, construction equipment shall be synonymous with Contractor's Equipment, a term also commonly used in the construction industry to designate the types of equipment described above.

3.1.2 Terms

The terms "should, may, and might" as used in statements in this procedure are intended to denote a discretionary consideration; the terms "shall & must" are intended to impose a mandatory requirement. The terms "is, are, & will" as used in statements in this procedure are intended to denote discretionary or mandatory requirements that are addressed in other department/disciplines' procedures. However, nothing contained herein should be interpreted as to prohibit development and approval of project-specific procedures or plans that take exception to mandatory direction presented in this procedure provided that the appropriate level of approval, (Executive Vice President of Construction, Business Line Executive Vice President, or the Vice President ESQ Services as appropriate) is obtained for deviations from such requirements.

3.1.3 Tools of the Trade

Specific hand tools and or equipment (e.g., manlifts, trucks, trenchers, and pumps) normally provided by or to workers for the performance of their particular work activity.

3.2 Roles & Responsibilities

3.2.1 Equipment Supervisor

Depending on the project's equipment needs, an individual may be designated as the Equipment Supervisor. Responsibilities of the Equipment Supervisor include:

- Determination of the equipment needs for the project;
- Providing input to the Work Plan concerning equipment;
- Identification of Contract and legal/regulatory requirements for mobilization of equipment on client facilities;
- Submit required certifications, inspection reports, and test reports for equipment;
- Arranging for the mobilization/demobilization of equipment in support of the project's schedule, providing required notices, such as mobilization details and dates, and obtaining Contractual or legally required approvals for mobilization;
- Receipt inspection of equipment arriving at the site, including coordination of any client or third party inspection;
- Coordination with equipment yard personnel or vendors regarding equipment maintenance;
- Ensuring implementation of safe work practices for equipment utilization; and
- Assuring that the return of demobilized equipment is performed in accordance with the terms of the rental/lease/PO agreement and documented correctly, or, for Tetra Tech owned equipment, that the equipment transfer form is completed and coordinated with the Equipment Manager; and
- All other responsibilities as assigned by the Project Manager or Site Supervisor

3.3 Safe Operation Requirements for Tools

3.3.1 Manual T-Post Drivers

There shall be no use of manual fence post drivers, such as those typically used to drive T-posts, without prior approval from the Site Safety Coordinator or the Vice President of Construction. Any approval of the use of such a tool shall require the implementation of an Activity Hazard Analysis (AHA) to identify and control the hazards presented by the tool. The AHA shall address appropriate PPE and position for the task in order to avoid injury to the worker.

3.3.2 Tools

The Site Supervisor shall determine the nature and quantity of tools required for the construction effort and shall ensure that adequate tools are provided in support of the schedule.

Tools may be assigned to workers or crews for the duration of their activities and shall be stored in gang boxes or other secured storage areas when not in use.

The Site Supervisor may designate certain tools to be issued from a tool control area on a daily basis. These tools should be signed out at the beginning of the work, returned to the tool control area at the end of the work, and signed back in.

3.3.3 Worker Provided Personal Tools

Workers may be required to provide personal tools of the trade for their particular work. Master mechanics, for example, may be required to provide tools required for repairs and maintenance of construction equipment and vehicles. Requirements for workers to provide their own tools shall be established based on the project requirements and shall be discussed at the Pre-Job Conference to be held in accordance with the requirements of the Labor Relations Guidelines LR-8, Pre-Job Conferences.

Any worker required or offering to provide personal tools shall be required to present a list of personal tools being provided upon reporting to the project site. The Site Supervisor shall inventory the tools against this list for verification that all listed tools have been provided. The list shall then be maintained for use in performing an inventory of the tools when the worker is to leave the site at the end of the worker's assignment and shall be the basis for any claims for loss or damage.

The Site Supervisor shall ensure that any personal tools brought onto the project site receive a safety inspection. The safety inspection shall include as a minimum, the items addressed in Section 3.3.4 of this procedure.

The Site Supervisor should ensure that secure, lockable facilities are provided for the storage of worker provided personal tools.

The worker shall be responsible for notification of lost or damaged tools immediately on discovery of the loss. The limits of the project's liability (if any) for loss or damage to personal tools provided by the workers should be established at the Pre-Job Conference.

Use of personal tools, other than addressed above, either by manual or by Tetra Tech nonmanual personnel, should not be allowed except as specifically authorized by the Project Manager or Site Supervisor. Project personnel should be notified that Tetra Tech will not be liable for any theft, loss, or damage of unauthorized personal tools on the project site.

3.3.4 Tool Safety Inspection

OSHA 29 CFR Part 1926 Subpart I Tools – Hand and Power provides guidance for tool safety. All tools shall be inspected for the following minimum features by the person using the tool prior to starting the work:

- Proper general condition of tools, electrical cords, and air hoses;
- Presence and serviceability of guards and safety devices;
- Proper electrical grounding or double insulation protection;
- Power tools properly equipped with constant pressure switches;
- Tool retainers installed on pneumatic tools;
- Proper adjustment of the tool; and
- Confirming that the load rating of the tool is sufficient for the work to be performed.

Unsafe tools shall be removed from service and the Site Supervisor advised of the condition for corrective action. An Out of Service tag should be placed on all unsafe or defective tools to prevent their inadvertent use by others. These tools should be physically segregated from the acceptable tools.

3.3.5 Environmental Safety and Quality Policy Implementation

Proper selection of construction equipment can impact employee health, consideration should be given to ergonomic design when selecting construction equipment.

Selection of construction equipment and vehicles may have significant impacts on the environment, either adverse or beneficial. Proper selection of the size and type of equipment and vehicles can reduce the adverse impacts from their operation.

Project procurement practices for construction equipment, parts, supplies, lubricants, and fuel shall be consistent with the principles of pollution prevention. For example, consideration should be given to such factors as rent versus buy options, disposable versus reusable filters, recycled versus virgin oils/fluids, recycling versus disposal of spent fluids and used parts, and fuel efficiency and economy of operation.

Spent fluids, filters, and used parts shall be recycled to the extent practical, or otherwise disposed of in accordance with the environmental compliance elements of the Work Plan or EHS plan.

Proper utilization of construction equipment and vehicles can also reduce adverse impacts on the environment. (For example, it is Tetra Tech's policy to not allow unattended equipment and vehicles to be left with motors running. This is not only a safety consideration; it reduces adverse environmental impacts and is generally cost effective due to reduced fuel consumption.)

3.3.6 Insurance

The Project Manager shall ensure that all construction equipment, including Tetra Tech-owned or rental/lease equipment, is covered by appropriate insurance policies for the intended use of the equipment. Property insurance on construction equipment is normally arranged by Tetra Tech if Tetra Tech bears the risk of loss or if Tetra Tech is required to arrange such insurance. However, all rented/leased construction equipment valued in excess of $100,000, and all cranes regardless of their value shall be reported to the Administration and Compliance Department via the 'Insurance Request for Leased Equipment' (Attachement 5, and available in Tetra Links and from procurement) for specific inclusion under the Tetra Tech property insurance policy. The procurement representative should be contacted to ensure that this

occurs in each case. Notification is not required for equipment valued under $100,000 except when the construction equipment provider requests a certificate of insurance be provided, or the equipment is a crane.

The Project Manager, usually through the designated procurement representative, should ensure that duplicate insurance coverage is not provided through the equipment provider since this will increase the rental rates. In those cases where the provider requires insurance certificates to verify coverage by Tetra Tech, the procurement representative should be contacted to obtain the appropriate documentation.

A Vehicle Insurance Form (available from the Vehicle Insurance Coordinator, Tetra Links or procurement) shall be processed and sent to the Vehicle Insurance Coordinator for all vehicles (leased, rented, or owned) which are registered and operated off jobsites on public highways.

3.3.7 Receipt and Inspection

All construction equipment shall be subject to a receipt inspection by a competent person and any Contract or otherwise required additional person(s) prior to acceptance at the project site. The inspections and tests shall be in accordance with the manufacturer's recommendations. Most vendors provide a form for notation of any existing damage to the equipment to be filled out on receipt. The equipment should be inspected carefully to determine its condition, including any damage, missing or non-functional equipment. The agreement should be used as a basis to determine that everything required (e.g., the equipment, its condition, manuals, spares, documentation of inspections, and certifications) has been provided. All discrepancies should be noted on the form. A pre-inspection of the equipment prior to transport to the Project site should be considered. Particular attention shall be given to the following items:

- All safety equipment and its condition;
- Operator (when provided) certification for the equipment;
- Posted operating and safety instructions;
- All pollution control devices and their condition;
- Safe entry and egress, with steps, ladders, handholds, and platforms provided as required, including safe access to perform routine checks, maintenance, and refueling operations;
- Leaking fluids, such as hydraulic oil, engine oil, transmission fluid, and coolant;

- Deteriorated or cracked hydraulic and coolant hoses which could result in leaks or spills;
- Guard belts, gears, shafts, pulleys, fly wheels and other reciprocating, rotating or moving parts shall be guarded to protect workers from becoming caught on, in or between machinery; and
- Presence of the manufacturer operation and maintenance manual.

Equipment or vehicles with deficient conditions relating to safety or protection of the environment shall not be placed into service until the deficiencies have been corrected and documented.

All construction equipment shall be subject to an operational check prior to acceptance at the project site. The operational check should verify that the equipment has the capability to function as intended or as required through the full range of its intended use.

Receipt of construction equipment shall be documented; with a copy of the receipt inspection report provided to the Equipment Supervisor and to the equipment purchase order file. Documentation should include entries for date and time of receipt, condition of equipment, mileage or engine hours at time of receipt, information on next scheduled maintenance, and a record of operating and maintenance manuals received with the equipment. Photographs or a video record of the equipment on receipt should be taken if conditions are noted that would warrant further documentation.

Construction equipment providers will often include terms and conditions on receipt documentation to be signed when construction equipment is delivered to the project site. **Project personnel requested to sign this receipt documentation shall not sign any delivery forms unless authorized to do so by Legal of the Project Manager. Further, if they are required to sign delivery forms, they shall be instructed to cross out all terms and conditions, on both the front and back of the forms, before signing.** Alternately, the person receiving the construction equipment should enter the following statement in the immediate vicinity of their signature: “In lieu of the terms and conditions set forth on this document, the Original Purchase Order (or appropriate form of agreement) terms and conditions apply to the receipt of this item(s).” These actions are necessary to avoid acceptance of additional or different terms and conditions.

Construction equipment delivered to the project site should be accompanied with operating and maintenance manuals. Cranes and lifting equipment shall include certification of satisfactory completion of annual inspection and have load charts posted in the cab. Additionally, some

construction equipment may be supplied with common replacement parts, such as filters and belts, and any specialized tools required for routine operation or maintenance. (i.e. forks, buckets, lift arms, and tool carries) These items should be carefully inventoried upon receipt, and documented on the receipt inspection report. Responsibility for protection and maintenance of the construction equipment shall be verified, and all measures necessary to protect the construction equipment from damage or loss will be instituted in accordance with the agreement, operating, and maintenance manuals or other instructions as appropriate.

Disposition requirements for construction equipment found to not be in accordance with the rental/lease/sale agreement when received shall be confirmed with the vendor immediately.

A sample Equipment/Vehicle Inspection Report is included as Attachment 1 to this procedure.

3.3.8 Protection from Environmental Extremes

Consideration shall be given to the environmental conditions to which the construction equipment will be exposed to during its time at the project site or during transportation. The manufacturer's instructions shall be reviewed and followed to ensure adequate protection from damage due to environmental conditions.

Adequate protection to the construction equipment's cooling system shall be verified by ensuring that the appropriate coolant/antifreeze mixture, as recommended by the manufacturer, has been used.

Appropriate procedures for operating or storing construction equipment, such as water treatment systems, shall be developed in accordance with the manufacturer's instructions. Measures such as draining and venting the system, providing auxiliary heat sources (e.g., heat tape), dry storage, shaft rotation, fluid levels, shall be taken to protect construction equipment subject to damage from environmental conditions.

Manufacturer's instructions concerning periodic operation of construction equipment shall be followed.

A means of ensuring that appropriate protective measures are instituted and performed as required should be implemented through the establishment of site procedures, logs, and/or checklists.

3.3.9 Equipment Inspections

All construction equipment shall be inspected daily (when in use) for safety and operability, including manufacturer's recommended daily inspections. The inspection form/checklist should note any deficiencies for correction and serve as documentation of the inspection performance. The Equipment Supervisor shall be notified of any deficiency immediately. A Daily Equipment Inspection form, a sample of which is included as Attachment 2 to this procedure, should be filled out at the start of the shift and provided to the Equipment Supervisor. Other supplemental forms which may be used in conjunction with Attachment 2 are the equipment specific "Pre-operation Inspection" and/or "Function Tests" forms, which are normally supplied by the equipment manufacturer. This information is usually found in the equipment's Operation Manual.

Government property control procedures usually require the implementation of a vehicle utilization log for vehicles when used on government projects; other projects should also implement a similar system for logging use of these vehicles. The log should be kept in the vehicle and an entry made for each use, including name of the driver, purpose of the trip, starting mileage, ending mileage, fuel purchased, maintenance performed, and any damage incurred. The log sheets should be transmiTetra Teched as required in the contract documents and the project's documentation plan. Copies of the log sheets will be maintained and filed as discussed in Section 3.3.12 of this procedure.

A separate Daily Equipment Inspection Report should be filled out for each shift if construction equipment is utilized on multiple shifts.

The Equipment Supervisor should use the information on Daily Equipment Inspection forms to schedule any repairs or preventive maintenance required for the equipment. Equipment with missing or defective safety features should not be put in service until repairs have been performed to bring the equipment into compliance with any applicable Tetra Tech H&S Program and/or regulatory requirements.

Implementation of the daily equipment inspections should be the subject of periodic verification inspections performed by the Project Manager, Site Supervisor, and/or the Site Safety Coordinator (SSC). These periodic inspections should include verification that the required maintenance is being performed in a timely manner to ensure that unsafe conditions or impacts to the environment (e.g., spills, releases, and discharges) are not created by delays in correcting deficiencies noted on the Daily Equipment Inspection Forms.

Rigging equipment, wire rope, nylon or KEVLAR slings and chokers shall be inspected by a competent person prior to use each shift; particular attention shall be paid to the rigging condition and presence of load/certification tags.

Cranes (weight handling equipment) shall be subjected to annual and certification inspections per OSHA guidelines. Mobile and crawler cranes shall be inspected on a monthly basis; a sample checklist form is included as Attachment 3 to this procedure.

Construction equipment to be demobilized shall be given a final inspection, similar to the receipt inspection, to identify and document, by means of written description and pictures, the condition of the equipment as it leaves the project site. Where possible, a concurrent inspection by the vendor is preferred. Additionally, some projects, particularly USACE projects, require a certificate of decontamination prior to the equipment leaving the site.

3.3.10 Operator Qualifications

Tetra Tech employees operating vehicles or construction equipment on public rights of way shall be required to have in their possession a valid driver's license appropriate to the location where the item is being operated and containing the appropriate endorsement for the type of vehicle or construction equipment being operated. A Commercial Driver's License (CDL) may be required for operation of some construction equipment on public rights of way, or as a specific requirement of a client's safety program. In addition, individual states may require specific licenses or certifications for operators of certain equipment, such as forklifts, and hoisting equipment. Additionally, the client's safety program may include license or certification requirements for personnel operating equipment on their property. The contract documents should be reviewed carefully to ensure that any such requirements are incorporated into the project's Work Plan or HASP. The Site Supervisor shall verify that the operator possesses the required license(s). Copies of licenses should be maintained in the on-site project employee file.

Any agreements for the rental or lease of vehicles or equipment should be reviewed for any provider's requirements for licensing or certification of operators to ensure that any such requirements are incorporated into the project's Work Plan or HASP.

Operators shall be required to demonstrate their proficiency in operating the construction equipment to be assigned to them prior to being allowed to work. Crane operators shall have qualifications for the type of crane to be operated.

Operator proficiency may be demonstrated through a performance test such as those

developed by the International Union of Operating Engineers, or by equipment manufacturers such as Caterpillar. These performance tests include exercises developed to demonstrate operator proficiency in various aspects of equipment operation, including daily operator inspections, ability to follow directions, ability to understand equipment limitations and operating guidelines, safety, and productivity. Also included are checklists that assist an observer in evaluating all of the various aspects of equipment operation. Attachment 4 is an example of Operator/Driver Observation Checklist.

Where it is not possible or practical to demonstrate operator proficiency through a performance test as described above, there should be a period of observation of the operator during the initial period of performance, whether the operator is a new employee or a current employee who is being assigned to a different type of equipment than previously operated on the project site. This observation may be performed by a knowledgeable member of the management team or a designated craft employee such as a foreman or steward. The above referenced checklists could be used for this observation in lieu of the performance test.

Operators shall be physically fit to perform their duties and may be required to participate in the Tetra Tech Medical Surveillance program.

3.3.11 Refresher Training and Evaluation

Refresher training in relevant topics shall be provided to Crane (as defined by OSHA 1910.180(a) operators, and Powered Industrial Truck (PIT) as defined by OSHA 1910.178(a)(1) operators prior to be allowed to continue operating when:

- The operator has been observed to operate the PIT/Crane in an unsafe manner.
- The operator has been involved in an accident or near-miss incident.
- The operator has received an evaluation that reveals that the operator is not operating the PIT/Crane safely.
- The operator is assigned to operate a different type of PIT/Crane; or
- A condition in the workplace changes in a manner that could affect safe operation of the PIT/Crane.

An evaluation of each PIT/Crane operator's performance shall be conducted at least once every three years.

Refresher training in relevant topics shall be provided to all other construction equipment operators when:

- The operator has been observed to operate the equipment in an unsafe manner.
- The operator has been involved in an accident or near-miss incident.
- The operator has received an evaluation that reveals that the operator is not operating the equipment safely.
- The operator is assigned to drive a different type of equipment; or
- A condition in the workplace changes in a manner that could affect safe operation of the equipment.

The employer shall certify that each operator has been trained and evaluated. The certification shall include the name of the operator, the type of equipment, the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation.

3.3.12 Repairs

All construction equipment shall be repaired as necessary and maintained in good working order. Repairs to rented/leased construction equipment shall be in accordance with the terms of the rental/lease agreement. Repairs to rented/leased and Tetra Tech's construction equipment shall be documented and a record of the repairs maintained in the project files. Copies of the repair records are to be forwarded to the equipment yard for Tetra Tech-owned equipment.

Construction equipment with deficiencies noted on the Daily Inspection Report should be repaired promptly. The Equipment Supervisor, with input from the Environmental and Safety Supervisor as appropriate, should evaluate if a piece of equipment or a vehicle should be removed from service until the deficiency is corrected.

Construction equipment that develops a fluid leak such as engine oil, hydraulic oil, transmission fluid, or coolant shall be removed from service until the deficient condition has been corrected.

Construction equipment with missing or inoperable exhaust systems, including spark or flame arrestors, mufflers, and catalytic converters, shall be removed from service until the deficient

condition has been corrected.

Tampering with, removal, modification, or otherwise rendering inoperable any pollution control device on construction equipment shall not be allowed except as specifically authorized by the equipment manufacturer or appropriate authority and the Project Manager or Supervisor's concurrence

Only trained, qualified personnel shall be allowed to repair equipment. The project's Work Plan should address repairs to equipment by designating required actions in the event of an equipment failure.

An Authorization for Capital Expenditure or Lease (AFCEL) is to be completed for all major repair work (i.e., $1500.00 and over) performed on Tetra Tech-owned construction equipment in accordance with Accounting/Finance Procedure AF-8, Fixed Assets. (Note that on some construction equipment, the cost of a specific item, a replacement tire for example, may require the processing of an AFCEL due to the item cost.)

Costs for major repairs, as well as repairs for deficiencies, to Tetra Tech-owned construction equipment shall be charged back to the project releasing the equipment if the need for repairs is identified within 30 days of the equipment's release and removal from a project and there are indications that the repairs are needed as the result of lack of maintenance or failure of the releasing project to otherwise keep the equipment in good working order.

No repair shall be undertaken for damage covered by an insurance claim until the damage is reported to the Administration and Compliance Department and the insurer approves the repairs.

3.3.13 Documentation and Record Keeping

A file shall be established and maintained for each operator which contains documentation that the operator has the proper qualifications, licenses/certificates, and training to perform his/her job function. Records may include training identified in the HASP (e.g., OSHA, DOT, Waste Management training), vehicle operator licenses, results of site-administered proficiency testing, and any other special licenses/certificates required by state/local law or the client.

A file shall be established and maintained for each piece of construction equipment, and all records relating to that equipment shall be placed in the file, including the Receipt Inspection Report, annual inspections (for cranes), record of the date the equipment was first placed in

service, Daily Equipment Inspection records, maintenance records, repair records, record of the last date that the equipment was in service, demobilization inspection report, and the decontamination certificate, if applicable. For ease of retrieval, all records pertaining to pieces of equipment should be maintained in separate folders for each piece of equipment.

Additional copies of inspection reports and records may be required to be maintained in other project files, such as the procurement files and/or the Environmental Health and Safety files, based on the project's Documentation Plan.

The Equipment Supervisor should ensure that complete and accurate record of equipment utilization, including a list of idle equipment, is provided to the Quality Control Site Manager on a daily basis..

It may be useful to maintain equipment utilization information on a spreadsheet depending on the size of the project. Information such as equipment mobilization date, date of first use, utilization of equipment by rental period (for example, if rental rate is based on hourly usage and is billed on a monthly cycle, there should be an entry for the number of hours the equipment was used in each billing period), scheduled equipment release date, actual release date, and demobilization date. This information may be useful in verification of vendor invoices, in review of production rates, for preparation of requests for change orders or equitable adjustment, or for backup for use in support of (or defense against) claims.

Copies of all maintenance and repair records for Tetra Tech-owned construction equipment shall be forwarded to the Tetra Tech Equipment Manager at the regional equipment yard on a periodic basis. This period should be monthly, and in no circumstances should it exceed quarterly. An Equipment Service Form is available from the Equipment Manager. This form shall be used to report unscheduled and preventative maintenance on Tetra Tech-owned construction equipment.

The Equipment Manager produces a spreadsheet for Tetra Tech-owned construction equipment that is distributed to the projects on a monthly basis. The Equipment Supervisor shall ensure that reports of mileage or meter readings and routine maintenance for all Tetra Tech-owned construction equipment and vehicles assigned to the project are provided to the Equipment Manager for inclusion on the spreadsheet on a monthly basis. A Meter/Mileage Reading Update Form, available from the Equipment Manager, shall be used to report the required information.

The Equipment Supervisor should review the availability date included on the spreadsheet for Tetra Tech-owned equipment and vehicles assigned to the project and inform the Equipment

Manager of any required revisions to these dates.

The Equipment Supervisor shall complete an Equipment Transfer Report, available from the Equipment Manager, for all Tetra Tech-owned construction equipment and vehicles to be mobilized to, and demobilized from the project. Copies of the Equipment Transfer Reports shall be provided to the Equipment Manager at the regional equipment yard.

There shall be no equipment disposal action (junk or sale) for Tetra Tech-owned construction equipment or vehicles without prior notification and approval from the Tetra Tech President.

4.0 GUIDANCE

4.1 Additional Considerations

4.1.1 Control of Government Property

Activities involving the use of Government property are to be controlled by specific procedures negotiated with the Client in accordance with the contract's terms and conditions; such procedures shall be consulted where appropriate. Such activities may involve the handling or installation of Government property, whether furnished by the Government to Tetra Tech or acquired by Tetra Tech for use in the performance of work and for which the Government has retained title.

Government property may include construction tools and equipment purchased as a project cost, as well as permanent materials or equipment purchased for incorporation into the work. Project-specific procedures for control of Government property are to address issues relevant to the use, storage, inventory control, maintenance, and/or final disposition of the Government property.

4.1.2 Spill Control and Emergency Response Dedicated Tools and Equipment

The project's Emergency Response Plan, or Emergency Action Plan is to identify dedicated personal protective equipment and emergency response tools and equipment to be available for an emergency response to a spill or discharge of hazardous material.

Dedicated emergency response tools and equipment are to be segregated and identified for use in emergency response situations. The use of dedicated emergency response tools or equipment for any other activity is not to be permitted.

4.1.3 Inventory Control

An individual should be designated as the Material Control Supervisor and should be responsible for inventory control of all tools issued from the tool control area. A log should be maintained for all tools issued and should record, as a minimum, the identification by name and employee number of the individual signing out the tool, the date and time the tool was signed out, the intended use of the tool (by area or system), an indication of when the tool is to be returned, and the time and date when the tool is returned.
Inventory control of tools assigned to individuals or crews should be performed on a daily basis as the tools are returned to the gang box or storage area. The crew foreman should be responsible for inventory control of tools assigned to the foreman's crew.

The Site Supervisor should immediately be made aware of any missing tools and should take the appropriate action to investigate and/or replace the missing tools.

4.1.4 Disposition of Tools at Project Completion

The Project Manager should make a determination of the disposition of tools remaining at the end of the project. The project may not be reimbursed by the client for the purchase of tools on certain cost reimbursable and lump sum projects. On other projects, a dollar value for individual tools may establish whether or not the client provides any reimbursement. The terms and conditions of the contract should provide direction as to the required disposition of the tools. Tools for which the project has been reimbursed by the client are to be dispositioned in accordance with the client's preferences and the contract terms and conditions.

Tools purchased for the project as a project cost, and which are not to be turned over to the client, should be dispositioned by the Project Manager. Means of disposition may include, but not be limited to, declaring the tools surplus, sale of the tools, or providing the tools to another project. The Project Manager should consult with the appropriate Business Line Executive Vice Presidents, concerning disposition of project tools.

Tetra Tech owned tools (i.e., not purchased as a project cost) should be dispositioned by the Project Manager based on consultation with the appropriate Business Line Executive Vice Presidents. Means of disposition of Tetra Tech-owned tools may include, but not be limited to, declaring the tools surplus, sale of the tools, return of the tools to an equipment yard, or providing the tools to another project.

4.1.5 Company-Owned Equipment

Tetra Tech utilizes regional equipment yard(s) for the temporary storage and maintenance of Tetra Tech-owned construction equipment and vehicles when not currently assigned to a project. Available Tetra Tech-owned equipment should be considered for support of a project's construction effort based on an analysis of the benefits to the project and/or Tetra Tech. When evaluating Tetra Tech owned equipment the requirements discussed in 4.1.6 below should be considered when making the equipment selection.

4.1.6 Rental/Lease Equipment

Agreements for rental/lease of construction equipment should be coordinated through an authorized procurement representative to ensure that appropriate terms and conditions are included in the agreement. The Scope of Work for the agreement should be developed and reviewed carefully, including review by the Site Supervisor or Equipment Supervisor for inclusion of sufficient detail in order to clearly define the scope of work.

The Equipment Supervisor, or requisitioner if there is no designated Equipment Supervisor, should review the terms and conditions of all rental/lease agreements to determine that the following topics are adequately addressed:

- Receipt and return of the rental or leased equipment and any required accessories;
- Inspection and documentation of receipt and release;
- Provision of documentation required to be submitted, such as Occupational Safety and Health Administration (OSHA) accredited inspection reports, NDE reports, test reports (i.e. load test for cranes), typically annual inspections, and wire rope certification.
- Provision of all safety equipment and accessories, as required, such as fire extinguishers, seat belts, Roll Over Protection Structures (ROPS), Falling Object Protection Structures (FOPS), access steps, handholds, platforms, and anti two-block devices and load moment indicator (cranes);
- Provision of documentation demonstrating operator certification;
- Provision of Certificate of Compliance when required, for instance by NAVFAC P-307 Management of Weight Handling Equipment, Appendix P - Contractor Crane Requirements.

- Provision and requirements of routine and non-routine maintenance and repairs, including payment for labor, parts, filters, lubricants, and fluids;
- Documentation requirements for the above maintenance and repairs;
- Disposal/recycling requirements for used parts, filters, lubricants, and fluids;
- Items such as point of delivery, costs of delivery and return, rental charges during idle time, notification requirements for demobilization, and point of return;
- Appropriate rental rate provisions for straight time and overtime;
- Responsibility for damage to equipment;
- Insurance;
- Indemnification (if included);
- Payment for replacement of parts subject to normal wear and tear, such as tires, tracks, cuTetra Teching edges, and teeth; and
- Documentation requirements required in support of invoices for basic rental rates and overtime rates, as well as labor, parts, filters, lubricants, and fluids.

Rental agreements should be structured to include normal wear and tear on the equipment in the basic rental rate. In all cases, there should be mutual agreement with the equipment vendor as to the condition of the equipment as it is delivered. This should include items such as the life expectancy of the parts subject to wear and tear, their condition on receipt (i.e., percentage of usable life remaining), and the expected condition on return of the equipment. There should be agreement on minor versus major repairs and on what constitutes normal wear and tear. Mutual agreement is essential to mitigate potential claims from vendors for excessive wear and tear.

4.1.7 Mobilization of Equipment

Mobilization of construction equipment may be a long lead time item and may require client or third party involvement or approvals to gain site access, depending on the required equipment. The Site Supervisor or Equipment Supervisor should determine the lead time required, including Contract submitted and advance notice/approval requirements, and plan for the mobilization of equipment to support the project's schedule.

- Planning for mobilization of equipment should include a thorough review of Contract requirements for utilization of each equipment and site access requirements.
- Documentation of certification, and OSHA compliant annual inspection, load testing, safety devices (e.g., anti two-block) installed, wire rope certification, and operator's certification for cranes (weight handling equipment) should be reviewed prior to initiating mobilization of cranes.

4.1.8 Equipment Maintenance

The Equipment Supervisor should be responsible for administration of a construction equipment maintenance program for the project. A spreadsheet of all Tetra Tech-owned equipment, titled the Status of All Project Equipment, is maintained by the Construction Department providing notification of the scheduled maintenance requirements for each piece of equipment. Either this spreadsheet, or a project specific spreadsheet, should be maintained and statused on a periodic basis. Specific maintenance requirements may also be contained in specific contract negotiated property procedures or in other Tetra Tech corporate procedures.

As construction equipment is received on site, it should be added to the spreadsheet for tracking of the required maintenance.

A review of the scheduled maintenance should be performed for all construction equipment to be used in the Exclusion Zone to determine the desirability of performing any upcoming scheduled maintenance prior to placing the equipment in service. It may be difficult and expensive to perform the maintenance under the conditions required in the Exclusion Zone, or to decontaminate the construction equipment in order to perform the maintenance under clean conditions. When the maintenance of equipment in the Exclusion Zone is anticipated, the Site Supervisor should ensure that qualified personnel are available with the appropriate medical clearances and certifications to work in the Exclusion Zone.

4.1.9 Construction Equipment Safe Operation Requirements

Standards for safe operation of equipment are contained in the documents identified herein, inclusive and in particular of the requirements for safe operation of lifting and rigging equipment and weight handling equipment. The Contract typically will specify certain documents/codes to be followed for the project.

- The United States Army Corps of Engineers (USACE) Safety and Health Requirements Manual, EM 385-1-1, Chapters 16, 17, and 18, provide guidance concerning the safe operation of construction equipment.
- Safe operation of earth drilling equipment is addressed in SWP 5-36 Drill Rigs.
- Safe operation of hand and power tools is addressed in OSHA standard 29CFR Part 1926 Subpart I.
- Safe operation of cranes, derricks, hoists, elevators and conveyors is addressed in OSHA standard 29CFR Part 1926 Subpart N.
- Safe operation of motor vehicles, mechanized equipment and marine operations is addressed in 29CFR Part 1926 Subpart O.
- Rollover protective structures and overhead protection is addressed in 29CFR Part 1926 Subpart W.
- The American Society of Mechanical Engineers (ASME) provides guidance in the B30 commiTetra Techee volumes – Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.
- The United States Department of Energy (DOE) provides guidance for safe lifting operations in Technical Standard DOE-STD-1090 – Hoisting and Rigging.
- The United States Navy publication NAVFAC P-307 – Management of Weight Handling Equipment includes requirements for Contractor Cranes (see appendix P). Navy facilities issue Instructions specific to particular facilities such as 'NAVSHIPYDPUGET INSTRUCTION 11262.4A' which provides requirements for weight handling equipment at all Navy facilities within the Puget Sound.

Construction Equipment safety requirements shall be met before any task can be safely and properly performed, including

- Equipment will be used only in the manner in which it was designed.

- Vehicles and equipment shall be kept in the appropriate gear or drive range when in motion, specifically when ascending or descending a grade. Freewheeling or coasting is prohibited.
- Steps, handrails and grab irons shall be used and equipment shall be faced when mounting or dismounting equipment. When climbing onto or from equipment a 3-point contact shall be maintained. Steps, handrails and grab rails shall be kept maintained, clean and free from slip, trip and fall hazards. Allow extra time in winter or rainy conditions to clean ice, snow and mud from equipment.
- Operators shall wear seat belts before starting and while in operation if the equipment is supplied with seat belts.
- Eye protection is mandatory if the equipment does not have an enclosed cab.
- Passengers shall not ride on equipment unless the equipment is designed to accommodate passengers.
- Before dismounting, the operator shall secure the equipment from movement by lowering all ground-engaging attachments, if so equipped (i.e., setting the parking brake, placing the transmission in park, disabling the hydraulics and activating any other elements of the equipment per the operator's manual).
- Wheeled equipment, without ground-engaging attachments, shall be chocked immediately following dismount with chock blocks that are adequate for the wheel size and equipment weight.
- Blades, buckets and other materials shall be in contact with the ground before the operator dismounts the equipment.
- Equipment should not be left unattended while the engine is running. If conditions exist that make it necessary for equipment to be left running in an unattended state (i.e., cold weather and certain start-ups), do not allow the general public entrance to the area unless the area can be clearly delineated. If the area cannot be clearly delineated to preclude casual entrance by the general public, unattended equipment shall not be left running.

- The work site around equipment shall be clear prior to moving equipment. The operator shall be attentive to people and any vehicles that may have entered the area during the walk-around inspection.
- All operations shall be in accordance with manufacturers Standard Operating Procedures (SOPs).
- All ground disturbance operations shall comply with the DCN 4-5 Trenching and Excavation Practices.
- Proper working distances shall be maintained when operating equipment that is near electrical lines, as defined in DCN 5-9 Safe Electrical Work Practices.
- Employees shall not get on or off a vehicle or piece of equipment while it is moving.

4.1.10. General Traffic Requirements

The traffic rules in this section shall be followed, at a minimum, when heavy equipment and haul trucks are operated on project sites. The PM or SSC shall implement new traffic rules as conditions or project changes dictate.

- All applicable local governing authority driving rules shall be followed when driving heavy equipment and haul trucks on public or project sites.
- Operators shall understand and adhere to the site traffic right-of-way rules and work zone configurations.
- Speed limits, dependent on the risk associated with the site, shall be posted for the location and shall always be observed. Violation of speed limits shall result in disciplinary actions, which shall be posted and discussed with the workforce. Appropriate signage shall adequately communicate haul roads and traffic hazards.
- Vehicles and equipment shall follow at a safe distance as determined by road conditions, the specific vehicle and loading. The site shall define a minimum following distance.

- Passing shall be limited to areas of adequate clearance, visibility and where marked accordingly. Passing may be prohibited completely on some sites or areas.

- Lights should be used to direct equipment at night; work zone lighting shall be sufficient for the work being performed.

- Adequate equipment spotters and ground employees should be deployed in conjunction with the job zone and traffic control plan. Spotters shall be not in the path of equipment travel while equipment is backing into a dump or loading area. Spotters shall wear bright, reflective clothing and be competent in directing and signaling equipment. Spotters and operators shall have a clear understanding of signal protocol for the site. When applicable, equipment will be equipped with a working signal alarm while backing up.

- A communications plan shall be developed by the site to allow the workforce to have communications with operators and spotters. A direct communication technique such as radio communication is preferred. If noise may impede operators to hear radios, then visual alerts (e.g., warning lights) inside the cab that are visible to the operator shall be considered.

4.1.11 Road Construction and Maintenance

For the safest and most efficient worksite, these construction and maintenance rules shall be followed when applicable:

- Elevated haul roads and roads, where risk is high from activities such as building dikes, shall have side berms or barriers that are axle height or greater to accommodate for the largest type of equipment that normally occupies the road. Drainage shall be allowed.

- All curves shall have open sight lines and have as large a radius as practical.

- Haul road/traffic changes shall be communicated to all affected personnel.

- Roadways shall be constructed with a slight crown to facilitate drainage.

- All roadways, including haul roads, shall be routinely maintained in a safe condition, including the elimination or control of dust, ice or similar hazards. Adequate dust control equipment shall be provided on the job site and shall be utilized to control the hazards.

4.1.12 Demobilization of Equipment

Construction equipment should be demobilized when no longer required for the work. The Executive Vice President of Construction should be provided with a status of Tetra Tech-owned construction equipment and scheduled release dates in order to coordinate availability of equipment with other projects.

The Project Manager or designee should request demobilization instructions from the Executive Vice President of Construction or designee to determine the location to receive Tetra Tech-owned equipment.

Construction equipment leaving the Exclusion Zone of a remediation construction project will be decontaminated in accordance with the requirements of DCN 3-9 Decontamination and the site specific HASP.

Individual state regulations may require cleaning of construction equipment leaving a site, not limited to remediation construction, in order to control the spread of microorganisms contained in the soil. Such requirements are to be identified in the project HASP plans.

Revision Date	Document Authorizer	Revision Details
2/16/2012	Chris McClain	Content & Format Revision

	TETRA TECH, INC. OVERHEAD UTILITIES	Document Control Number: FORM – Overheard Utilities Page 1 of 2

Name of Utility Company: _____Telephone Number:_____

Type of Equipment Used: _____

Description of Overhead Utilities: _____

Are Guy Wires present? If so, describe: _____

Voltage of Power Lines_____
(If not determined, maximum clearance will be used.)

Approximate Distance from Power Lines and Guy Wires: _____

Physical Hazards Present: _____
(e.g. traffic, poles)

Potential Accident Hazards: _____

Measures to Prevent Contact: _____

Indicate status of items 1-7.* Note: *Any item answered "NO," must be addressed as an attachment to this permit or a Job Hazard Assessment before work can proceed

1.	Have all relevant utility companies been contacted?	Yes	No	N/A
2.	Have the voltages been verified?	Yes	No	N/A
3.	Have telephone, cable and other overhead utilities been considered and addressed above?	Yes	No	N/A
4.	Has a pre-job safety meeting, including a task safety environmental analysis, been conducted with employees immediately prior to work around overhead utilities or guy wires?	Yes	No	N/A
5.	Has everyone involved in the work reviewed the specific emergency response procedures to be undertaken in the event of electrical contact and are these procedures available for review?	Yes	No	N/A
6.	Are visible barriers, marking or a spotter available?	Yes	No	N/A
7.	Have other work permits (Confined Space, Ground Disturbance, Hot Work, Lifting Operations, Working at Heights), as applicable, been issued?	Yes	No	N/A

I understand the nature of the work and certify that the above conditions shall be observed at all times.

Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:
Signature:	Date:

1.0 INTRODUCTION

This safe work practice (SWP) addresses situations during which heat illness is likely to occur and provides procedures for preventing and treating heat-related injuries and illnesses. This SWP is applicable to all Tetra Tech employees performing outdoor activities at both domestic and international project locations. This SWP incorporates safety regulations of the States of California and Washington to protect outdoor workers from heat-related illness. An "outdoor place" is an open area such as an agricultural field, forest, park, equipment and storage yard, outdoor utility installation, tarmac, and road. An outdoor workplace also can include a construction site at which no building shell has been completed, and areas of a construction site outside of any building shells that may be present.

Many factors contribute to heat illness and UV exposure, including personal protective equipment (PPE), ambient temperature and humidity, workload, sun exposure, and the physical condition of the employee, as well as predisposing medical conditions. However, the primary factors of heat illness are elevated ambient temperatures in combination with fluid loss. Because heat illness is one of the more common health concerns during field activities, employees must be familiar with the signs, symptoms, and various treatment methods of each form of heat illness. Health effects from heat illness may range from transient heat fatigue or rashes to serious illness or death. Tracking the weather is imperative during outdoor field projects because heat-related illness and fatalities occur primarily during heat waves.

2.0 Definitions

The following are typical terms and definitions associated with heat illness prevention and monitoring activities:

Acclimatization – Gradual adaptation of the body to work under temperature conditions to which it is exposed. Acclimatization peaks in most people within 4 to 14 days of regular work taking up at least 2 hours per day in the heat.

Ambient Temperature – Temperature of the surroundings.

Electrolytic Sports Drink – A beverage containing sodium and potassium salts that replenish the body's water and electrolyte levels after dehydration caused by physical activity.

Environmental Risk Factors for Heat Illness – Working conditions under which heat illness could occur. Environmental risk factors include air temperature, relative humidity, radiant heat from the sun and other sources, conductive heat sources such as the ground, air movement (or lack of), workload severity and duration, and protective clothing and PPE worn by employees.

Heat Illness – A serious medical condition resulting from the body's inability to cope with a particular heat load. Symptoms include heat cramps, heat exhaustion, and heat stroke (see Table 1).

Heat Index – An index that combines air temperature and relative humidity to indicate the human-perceived equivalent temperature (i.e., how hot it feels outdoors).

Heavy Work – Digging/hand-auguring, heavy lifting, cutting trees, using heavy hand tools, and similar tasks.

Light Work – Walking, writing notes, handling samples, and similar tasks.

Medium Work – Bailing wells, moving light equipment, driving nails, and similar tasks.

Personal Risk Factors for Heat Illness – Factors such as an individual's age, degree of acclimatization, health, water consumption, alcohol consumption, caffeine consumption, and use of prescription medications that affect the body's water retention or other physiological responses to heat.

Preventive Cool Down and Recovery Period – Period of time needed to recover from the heat in order to prevent heat illness.

Relative Humidity – The amount of water vapor that exists in a gaseous mixture of air and water vapor.

Shade – Blockage of direct sunlight. Canopies, umbrellas, and other temporary structures or devices may be used to provide shade. One indicator that blockage is sufficient is absence of a shadow of an object within the area of blocked sunlight. Shade is not adequate when heat in the area of shade defeats the purpose of shade, which is to allow the body to cool. For example, a car sitting in the sun does not provide acceptable shade to a person inside it unless the car is running with air conditioning.

Wet Bulb Globe Temperature (WBGT) - a measurement used to indicate heat stress. WBGT takes into account the effects of humidity

3.0 Employee Duties and Responsibilities

Written procedures help Project Managers (PM), Site Safety Coordinators (SSC), and field team members reduce the risk of heat-related illnesses, and ensure that emergency assistance is provided without delay to all Tetra Tech employees. The following are the duties and responsibilities of the Project Team for implementing and managing the Heat Illness Prevention and Monitoring SWP.

3.1 Project Management

The PM must understand and agree to the responsibility for implementing this SWP for worker safety. The PM will assure that all employees at the work site comply with this SWP.

- The PM must designate an appropriate field team member to serve as the SSC who will implement this SWP and who will perform and document necessary monitoring requirements for worker safety.
- The PM will ensure necessary resources required to implement this SWP and necessary monitoring resources for worker safety are acquired and present at the work site prior to initiation of project activities in hot environments.
- The PM will work with the Director of Health and Safety and identify at risk employees.
- The PM will ensure all field team members are trained in heat illness management and emergency response procedures prior to working outdoors.
- The PM and SSC will modify working hours to schedule work during the cooler hours of the day, when possible. When a modified or shorter work-shift is not possible, more water and rest breaks shall be provided.
- The PM and SSC will verify that the elements of this SWP are documented in the Health and Safety Plan, as necessary.

3.2 Site Safety Coordinator

- The SSC must understand and agree to the responsibility for implementing this SWP in the field and implement the necessary monitoring requirements for worker safety during outdoor activities.
- The SSC must have appropriate Occupational Safety and Health Administration (OSHA)-related training and experience to understand and implement this SWP, and to ensure required monitoring for worker safety during outdoor activities.
- The SSC must ensure that resources needed to implement this SWP and required monitoring for worker safety are acquired and present at the work site prior to initiation of project activities in hot environments.
- The SSC must maintain all necessary resources required under the SWP during project activities in hot environments.
- The SSC must ensure implementation and appropriate documentation of required monitoring for worker safety during site activities.
- The SSC must be familiar with and continuously monitor all employees and must remain alert for onset of heat-related symptoms.
- The SSC and co-workers are encouraged never to discount any signs or symptoms of heat-related illness shown by one or more project team members, and to immediately report these signs or symptoms.
- The SSC will carry a cell phone or other means of communication to ensure that emergency services can be contacted and will verify that these resources are functional at the worksite prior to each shift.

3.3 Field Team

- The field team will be able to recognize the hazards of working in warm environments.

- Co-workers will use a "buddy system" to monitor each other closely for discomfort or symptoms of heat illness.

- Every morning, workers must attend a daily tailgate safety meeting to be reminded of site-specific emergency procedures.

- A copy of site specific heat illness procedures shall be available for employee review.

4.0 Description and Requirements

4.1 Effects of Hot Weather

As the environment heats up, the body tends to warm up as well. The body's internal thermostat maintains a constant temperature by pumping more blood to the skin, which is cooled by evaporation from increasing perspiration production. In this way, the body increases the rate of heat loss to balance the heat burden created by a hot environment. Such situations generally do not cause harm, as long as the body is allowed to adjust to cope with the increasing heat.

In a very hot environment, however, the rate of heat gain exceeds the rate of heat loss. In this situation, the body's coping mechanisms can be overwhelmed, resulting in heat illness and leading to a range of serious and possibly fatal conditions.

4.2 Preparation for Hot Weather Work

The following list describes the process for preparing to work in hot weather conditions:

- Identify work that can pose a risk of heat stress and Ultraviolet (UV) exposure.
- Identify at-risk employees.
- Identify possible controls:
  - Establish controls for hot weather situations
  - Determine mandatory work and rest regimens based on current conditions, workload, clothing requirements, temperature and humidity for Threshold Limit Value (TLV).
  - Identify required fluid and food replacement schedules.

- Provide a location to cool down during breaks.
- Establish requirements to address UV exposure.
- Monitor workers in extreme heat conditions.

• Establish emergency response procedures to be followed for heat-related emergency situations.

• Provide for first aid and establish the requirement that first aid be administered immediately to employees displaying symptoms of heat-related illness.

• Provide training to employees and verify training records about site legal and regulatory requirements and about the characteristics and effects of heat stress and the recognition and prevention of heat-related injuries (See Table 1).

5.0 Employee Training

Training is an important component of heat illness prevention. Employees are instructed to recognize and treat heat-related illnesses during 8-hour health and safety refresher and first aid training courses. The conditions, symptoms, and treatment for heat-related illnesses are listed below in Table 1.

TABLE 1
HEAT ILLNESS CONDITIONS

Condition	Causes	Signs and Symptoms	Treatment
Heat cramps	Fluid loss and electrolyte imbalance from dehydration	• Painful muscle cramps, especially in legs and abdomen • Faintness • Profuse perspiration	• Move affected worker to cool location • Provide sips of liquid such as Gatorade® • Stretch cramped muscles • Transport affected worker to hospital if condition worsens
Heat Exhaustion	Blood transport to skin to dissipate excessive body heat, resulting in blood pooling in the skin with inadequate return to the heart	• Weak pulse • Rapid and shallow breathing • General weakness • Pale, clammy skin • Profuse perspiration • Dizziness • Unconsciousness	• Move affected worker to cool area • Remove as much clothing as possible • Provide sips of cool liquid or Gatorade® (only if conscious) • Fan the person but do not overcool or chill • Treat for shock • Transport to hospital if condition worsens
Heat Stroke**	Life threatening condition from profound disturbance of body's heat-regulating mechanism	• Dry, hot, and flushed skin • Constricted pupils • Early loss of consciousness • Rapid pulse • Deep breathing at first, and then shallow breathing • Muscle twitching leading to convulsions • Body temperature reaching 105 or 106 degrees Fahrenheit (°F) or higher	• Immediately transport victim to medical facility • Move victim to cool area • Remove as much clothing as possible • Reduce body heat promptly by dousing with water or wrapping in wet cloth • Place ice packs under arms, around neck, at ankles, and wherever blood vessels are close to skin surface • Protect patient during convulsions
**** Any of these symptoms require immediate attention. If heat stroke is suspected, emergency medical personnel should be immediately contacted and on-site first aid provided.**			

Employee training procedures include, but are not limited to, the following:

- All employees (including and especially newly hired employees) will receive heat illness prevention training prior to working outdoors. This training will review the signs and symptoms of heat illness, detail the concept and importance of acclimatization and Tetra Tech's responsility to provide water, shade, cool-down rests and access to first aid. Training will also communicate the employees' right to exercise their rights without retaliation.

- SSCs will hold short tailgate meetings daily to review important heat illness and prevention information with all field team members. Information communicated in tailgate meetings will include a reminder of the importance of frequent consumption of small quantities of water, up to 4 cups per hour when the work environement is hot and employees are likely to be sweating more than usual.

- The expectation to immediately report any symptoms or signs of heat illness in themselves or in co-workers.

- All workers will be assigned a "buddy" or experienced coworker to ensure that they understood the training and follow the company procedures.

- Training will include a review of how emergency services will be provided if necessary, procedures for contacting emergency medical services and if necessary transporting employees to a point where they can be reached by emergency medical services.

- PMs and SSCs will be trained before assignment to supervise outdoor workers.

6.0 Heat Illness Prevention and Monitoring Requirements

6.1 Identification of Work Conditions

Hot weather is a condition that will be encountered during Tetra Tech operations. When work takes place outdoors during warm weather, working conditions shall be identified for both heat stress conditions and UV exposure.

6.2 Heat Index

The Heat Index (HI) can be used as a first indicator of thermal comfort. The HI can be obtained by directly measuring the dry bulb temperature and relative humidity. The dry bulb temperature and relative humidity forecast can be obtained by checking the local weather station information or measured by using a wet bulb thermometer. A direct reading of HI can be obtained by placing a heat stress monitor in full shade at the workplace.

The HI does not take into account acclimation, clothing or nature of work; therefore, if the HI is at 80°F (26.7°C) or above, further evaluation is required to adjust workload and clothing.

6.3 Heat Exposure Limits and Measurement

The TLV is a means of providing heat exposure limits and gauging potential heat impacts. To determine the TLV, the Wet Bulb Globe Temperature (WBGT) index is measured. The WBGT is calculated using a formula that takes into account air temperature, speed of air movement, radiant heat from hot objects, sunshine and body cooling due to sweat evaporation. WBGT direct reading meters, often called 'heat stress analyzers,' are also available. These meters give direct WBGT readings; no calculations are necessary.

A trained person shall take WBGT measurements. If a WBGT direct reading meter is not available, two different methods are used to calculate WBGT in the workplace: one for workplaces with direct sunlight, and the other for workplaces without direct sunlight. In addition, when conditions of the workplace fluctuate widely, time-weighted WBGT is often used. The WBGT calculation is used in determining heat stress exposure guidelines and heat stress and clothing guidelines. Table 2 presents approximate WBGT values.

APPROXIMATE WBGT VALUE (°F) TABLE

Dry Bulb Temperature		Relative Humidity																			
°C	°F	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
18.33	65	59	59	60	61	62	62	63	64	64	65	66	67	67	68	69	70	70	71	72	73
18.89	66	59	60	61	61	62	63	64	65	65	66	67	68	68	69	70	71	71	72	73	74
19.44	67	60	61	61	62	63	64	65	65	66	67	68	69	69	70	71	72	72	73	74	75
20.00	68	60	61	62	63	64	64	65	66	67	68	69	69	70	71	72	73	74	74	75	76
20.56	69	61	62	63	63	64	65	66	67	68	69	69	70	71	72	73	74	75	75	76	77
21.11	70	62	62	63	64	65	66	67	68	69	69	70	71	72	73	74	75	76	77	77	78
21.67	71	62	63	64	65	66	67	68	69	69	70	71	72	73	74	75	76	77	78	79	79
22.22	72	63	64	65	66	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81
22.78	73	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82
23.33	74	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
23.89	75	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
24.44	76	65	66	67	68	69	71	72	73	74	75	76	77	78	79	80	81	82	83	85	86
25.00	77	66	67	68	69	70	71	72	74	75	76	77	78	79	80	81	82	84	85	86	87
25.56	78	66	67	69	70	71	72	73	74	76	77	78	79	80	81	82	84	85	86	87	88
26.11	79	67	68	69	71	72	73	74	75	76	78	79	80	81	82	84	85	86	87	88	90
26.67	80	68	69	70	71	72	74	75	76	77	79	80	81	82	84	85	86	87	88	90	91
27.22	81	68	69	71	72	73	75	76	77	78	80	81	82	83	85	86	87	89	90	91	92
27.78	82	69	70	71	73	74	75	77	78	79	81	82	83	85	86	87	88	90	91	92	94
28.33	83	69	71	72	73	75	76	78	79	80	82	83	84	86	87	88	90	91	92	94	95
28.89	84	70	71	73	74	76	77	78	80	81	83	84	85	87	88	90	91	92	94	95	97
29.44	85	71	72	73	75	76	78	79	81	82	84	85	87	88	89	91	92	94	95	97	98
30.00	86	71	73	74	76	77	79	80	82	83	85	86	88	89	91	92	94	95	97	98	100
30.56	87	72	73	75	76	78	80	81	83	84	86	87	89	90	92	93	95	97	98	100	101
31.11	88	72	74	76	77	79	80	82	84	85	87	88	90	92	93	95	96	98	100	101	103
31.67	89	73	75	76	78	80	81	83	85	86	88	90	91	93	94	96	98	99	101	103	104
32.22	90	74	75	77	79	80	82	84	86	87	89	91	92	94	96	97	99	101	103	104	106
32.78	91	74	76	78	80	81	83	85	87	88	90	92	94	95	97	99	101	102	104	106	108
33.33	92	75	77	79	80	82	84	86	88	89	91	93	95	97	98	100	102	104	106	107	109
33.89	93	76	77	79	81	83	85	87	89	90	92	94	96	98	100	102	103	105	107	109	111
34.44	94	76	78	80	82	84	86	88	90	92	93	95	97	99	101	103	105	107	109	111	113
35.00	95	77	79	81	83	85	87	89	91	93	95	97	99	101	103	105	107	108	110	112	114
35.56	96	77	79	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116
36.11	97	78	80	82	84	86	89	91	93	95	97	99	101	103	105	108	110	112	114	116	118
36.67	98	79	81	83	85	87	90	92	94	96	98	100	103	105	107	109	111	113	116	118	120
37.22	99	79	82	84	86	88	91	93	95	97	99	102	104	106	108	111	113	115	117	120	122
37.78	100	80	82	85	87	89	91	94	96	98	101	103	105	108	110	112	115	117	119	121	124
38.33	101	81	83	85	88	90	92	95	97	100	102	104	107	109	111	114	116	119	121	123	126
38.89	102	81	84	86	89	91	93	96	98	101	103	106	108	111	113	116	118	120	123	125	128
39.44	103	82	84	87	89	92	94	97	100	102	105	107	110	112	115	117	120	122	125	127	130
40.00	104	83	85	88	90	93	96	98	101	103	106	108	111	114	116	119	121	124	127	129	132
40.56	105	83	86	89	91	94	97	99	102	105	107	110	113	115	118	121	123	126	129	131	134
41.11	106	84	87	89	92	95	98	100	103	106	109	111	114	117	120	122	125	128	131	133	136
41.67	107	84	87	90	93	96	99	101	104	107	110	113	116	119	121	124	127	130	133	136	138
42.22	108	85	88	91	94	97	100	103	106	108	111	114	117	120	123	126	129	132	135	138	141
42.78	109	86	89	92	95	98	101	104	107	110	113	116	119	122	125	128	131	134	137	140	143
43.33	110	86	90	93	96	99	102	105	108	111	114	117	120	124	127	130	133	136	139	142	145
43.89	111	87	90	93	97	100	103	106	109	113	116	119	122	125	128	132	135	138	141	144	148
44.44	112	88	91	94	98	101	104	107	111	114	117	121	124	127	130	134	137	140	143	147	150
45.00	113	88	92	95	99	102	105	109	112	115	119	122	126	129	132	136	139	142	146	149	153
45.56	114	89	93	96	99	103	106	110	113	117	120	124	127	131	134	138	141	145	148	152	155
46.11	115	90	93	97	100	104	108	111	115	118	122	125	129	133	136	140	143	147	150	154	158
46.67	116	90	94	98	101	105	109	112	116	120	123	127	131	134	138	142	146	149	153	157	160
47.22	117	91	95	99	102	106	110	114	118	121	125	129	133	136	140	144	148	152	155	159	163
47.78	118	92	96	100	103	107	111	115	119	123	127	131	134	138	142	146	150	154	158	162	166
48.33	119	92	96	100	104	108	112	116	120	124	128	132	136	140	144	148	152	156	160	164	168
48.89	120	93	97	101	105	110	114	118	122	126	130	134	138	142	147	151	155	159	163	167	171

Notes: Calculated values assume outdoor work in full sun, with a light (<5 mph) wind.
WBGT of green-shaded cells is less than dry-bulb temperature.

6.4 Heat Stress Exposure Guidelines

Heat stress exposure guidelines recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) are shown in Table 3: ACGIH Screening Criteria for Heat Stress Exposure. This table is used to determine the allocation of work in a work/rest cycle, which is dependent on the type of work and WBGT values.

Table 3: ACGIH Screening Criteria for Heat Stress Exposure

PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUE															
Clothing Type	**Summer Lightweight**			**Cotton Coveralls**			**Winter Work**			**Permeable Water Barrier (Tyvek)**			**Fully-Encapsulating Suit (Level 4)**		
Work Load	**Light**	**Moderate**	**Heavy**	**Light**	**Moderate**	**Heavy**	**Light**	**Moderate**	**Heavy**	**Light**	**Moderate**	**Heavy**	**Light**	**Moderate**	**Heavy**
Work/Rest Schedule / WBGT	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)	(°F)
Continuous Work	86	80	77	82	76	73	79	73	70	75	69	66	68	62	59
75% Work, 25% Rest / Hr	87	82	79	83	79	75	80	75	71	76	72	68	69	64	61
50% Work, 50% Rest / Hr	89	85	82	85	81	79	81	78	75	78	74	71	71	67	64
25% Work, 75% Rest / Hr	90	88	86	86	84	82	83	81	79	79	77	75	72	70	68

Notes: Temperature is approximate WBGT from accompanying tables, based on outdoor work, temperature, and relative humidity measurement during work activities. Light Work includes walking, writing notes, handling samples, and similar activities (metabolic rate up to 200 kilocalories [kcal]/hour). Medium Work includes bailing wells, moving light equipment, driving nails, and similar tasks (metabolic rate of 200-350 kcal/hour). Heavy Work is digging, heavy lifting, cutting trees, using heavy hand tools, and similar tasks (metabolic rate above 350 kcal/hour).

Table 3 is based on five-day work weeks and eight-hour work days with conventional breaks. Conventional breaks include a 15-minute break in a four-hour period and a half-hour lunch in an eight-hour period. The ACGIH exposure limits are intended to protect most workers from heat-related illnesses. The limits are higher than that if they had been developed to prevent discomfort. A safety factor should be used to protect sensitive individuals or increase comfort. Examples to clarify work load intensity:

- Rest: sitting (quietly or with moderate arm movements).
- Light work: sitting or standing to control machines, performing light hand or arm work (e.g., using a table saw), occasional walking, driving.
- Moderate work: walking about with moderate lifting and pushing or pulling, walking at a moderate pace, scrubbing in a standing position.
- Heavy work: digging, carrying, pushing/pulling heavy loads, walking at a fast pace, pick and shovel work, carpenter sawing by hand.
- Very heavy: very intense activity at a fast to maximum pace (e.g., shoveling wet sand).

For example, in order to minimize heat stress exposure, an employee who is acclimated and is performing heavy work such as shoveling dirt in a temperature of 78°F (25.6°C), would fall into a work/rest regimen of 100% work.

TLVs assume that workers who are exposed to these conditions are adequately hydrated, are not taking medication, are wearing lightweight clothing and are in generally good health.
When the WBGT is at a temperature that exceeds the TLV, 'Stop Work' should be enforced.

6.5 Heat Stress and Clothing Guidelines

The exposure limit should be adjusted for workers wearing heavy clothing. ACGIH recommendations for these conditions are listed in Table 4: Correction of TLV for Clothing.

Table 4: Correction of TLV for Clothing

Clothing Type	WBGT Correction (in °F [°C])
Work Clothes (long-sleeved shirts and pants)	0 (0)
Cloth coveralls (woven material)	+3 (0)
Spunbonded Meltdown Spunbonded polypropylene coveralls	+6 (+0.5)
Polyolefin coveralls	+8 (+1)
Double-layer woven clothing	+9 (+3)
Limited-use vapor-barrier coveralls	+18 (+11)

For example, an acclimated worker wearing double-layer woven clothing doing moderate work in 30ºC would have a corrected exposure level of 30 + 3 = 33ºC (91.4ºF). This would lower the allowable exposure to 0-25% work from 25-50% work.

For Fire Retardant Clothing (FRC), there is no WBGT correction. FRC can be obtained in various weight materials. The lightest weight FRC should be worn during work in warm environments. No second layer of clothing should be worn except for cotton undergarments.

These values are not to be used for completely encapsulating suits. The assumption is that coveralls are worn with only modest clothing underneath, not a second layer of clothing.

6.6 Identifying At-risk Employees

A screening program for identifying at risk employees shall include identification of health conditions that are aggravated by extreme environmental temperatures. How a person functions under conditions of heat stress will be unique that person and will depend on:

- Age.
- Weight.
- Metabolism.
- Alcohol or drug use.
- Pre-existing medical conditions.

- Level of physical fitness.
- Use of medications.
- Individual sensitivity to heat.
- Possibility of hypertension.

Note: Employees with any 'at-risk' conditions shall have more stringent work/rest regimens or controls

6.7 Health and Safety Controls

Controls shall be based on a risk assessment approach. Conditions and available controls will vary from site to site. Therefore, the HASP shall define and document the site-specific control plan. Controls shall be appropriate for the risks that are associated with heat hazards.

6.7.1 Acclimation

The human body can adapt to heat exposure to some extent. This physiological adaptation is called acclimation. Acclimation is a response by the body that results in increased heat tolerance.

People differ in their ability to acclimate to heat. Usually, acclimation is obtained in four to five days. However, it is lost in approximately the same amount of time. After a period of acclimation, the same activity will produce fewer cardiovascular demands. The worker will perspire more efficiently, leading to better evaporative cooling, and thus will more easily be able to maintain normal body temperatures.

All site workers who could be exposed to hot weather conditions shall be acclimated or go through an acclimation process, as necessary. Where workers are already acclimated, no acclimation process is necessary. A previously acclimated person is someone who has already been in similar working and heat conditions. Employees newly assigned to a high heat area will be closely observed by the SSC or designees for the first 14 days of the employee's assignment.

All employees shall be closely observed by a supervisor or designee during a heat wave. For acclimization purposes only, a heat wave is defined as any day in which the predicted high temperature for the day will be at least 80 degrees Fahrenheit and at least ten degrees Fahrenheit higher than the average high daily temperature in the preceding five days.

6.7.2 Fluid and Nutrient Replacement

Cool (50°-60°F [10°-15°C]) water or other cool liquid, except alcoholic beverages, should be made available to workers.

Provision of Water (Not Temperature Dependent)

Water is the principal preventive measure to minimize the risk of heat-related illnesses. Tetra Tech employees shall have access to potable drinking water (or electrolytic sports drink). Where the supply of water is not plumbed or otherwise continuously supplied, water shall be provided in sufficient quantity at the beginning of the work shift to provide **1 quart per employee per hour for drinking for the entire shift**. Frequent drinking of water shall be encouraged by the SSC. Water provision requirements include the following:

- At least 2 quarts of water per employee will be available at the start of the shift.
- The SSC will monitor water containers every 30 minutes, and employees are encouraged to report low levels or dirty water to the SSC when observed.
- The SSC will provide reminders to the field team members to drink frequently, and more water breaks will be provided as needed.
- During the daily tailgate safety meeting each morning, the SSC will remind the field team about the importance of frequent water consumption throughout the shift.
- Water containers will be placed as close to the workers as safety conditions allow.
- When drinking water levels within a container drop below 50%, the water shall be replenished immediately.
- If a common water source is used, disposable/single-use drinking cups will be provided to employees each day.
- Communication devices such as radios, cell phones, or air horns may be used to remind field team members to take water breaks.

Although some commercial replacement drinks contain salt, this is not necessary for acclimated people, because most people have enough salt in their normal diets. Commercial replacement drinks contain high amounts of sugar and may contribute to an individual's inability to cope with the warm environment. If used, commercial replacement drinks should not be used at full strength and should be diluted with water on at least a one-to-one ratio.

Energy drinks shall not be used while working in warm environments.

Poor nutrition, over eating and under eating are factors contributing to heat stress. During hot conditions, employees should eat small, regular meals.

6.7.3 Additional Control Measures

Outdoor workers are exposed to not only potential heat illness, but also UV radiation. Long-term exposure to UV radiation poses additional risks and can lead to a variety of skin disorders, including skin cancer and cataracts of the eyes.

Protection from UV exposure, sunscreen and appropriate eye protection should be considered in addition to the additional controls listed below:

Access to Shade

Access to rest and shade or other cooling measures are important preventative steps to minimize the risk of heat-related illnesses and exposure to UV radiation. Tetra Tech employees working in temperatures exceeding 80 degrees Fahrenheit for any period shall be provided access to an area with shade that is either open to the air or provided with ventilation or cooling. Such access to shade shall be permitted at all times. The amount of shade present shall be at least enough to accommodate the number of employees on recovery or rest periods, so that they can sit in a normal posture fully in the shade without having to be in physical contact with each other. When the outdoor temperature in the work area does not exceed 80 degrees Fahrenheit, shade shall be made available as addressed in this section or employees may be provided timely access to shade upon request.

Procedures for the provision of shade include the following:

- SSC will set up an adequate number of shaded areas as needed. Examples of shaded areas include vehicles with air conditioning, umbrellas, canopies, or other portable devices. Shading should be placed in close proximity to the work activity (no more than 50-100 yards away, or at the closest location safety conditions allow). Employees will be allowed and encouraged to take preventative cool down rest in the shade when they feel the need to do so to protect themselves from overheating. Employees should have access to an office, construction trailer, or other places with air conditioning.

- Any individual who takes a preventative cool down rest shall be monitored and asked if they are experiencing symptoms of heat illness.

- If an employee exhibits signs or reports symptoms of heat illness while taking a preventative cool down rest or during a preventative cool down rest period, appropriate first aid or emergency response measures must be provided.

- Any employee experiencing signs and symptoms of heat illness shall not be ordered back to work until signs and symptoms of heat illness have abated but in no event less than 5 minutes in addition to the time needed to access the shade.

- Every morning a short tailgate meeting will occur to remind workers about the importance of rest breaks and the location of shade.

- As safety conditions allow, SSCs shall provide areas for employee breaks that are:
  - Readily accessible
  - In the shade, open to air, and ventilated
  - Near sufficient supplies of drinking water, shade provided during meal periods shall be enough to accommodate the number of employees who remain outside.

7.0 Heat Illness Monitoring

A medical monitoring program shall be planned with the assistance of a medical or industrial hygiene professional. The monitoring program shall be specify the leading indicators to be used (e.g. heat rate, body temperature, blood pressure, respiration rate, and other) and frequency of measurement.

Heat illness monitoring will be conducted by the SSC or his/her designee when work conditions warrant implementation of a work/rest schedule based on temperature conditions and PPE requirements associated with project activities. Monitoring will be conducted as follows:

- Heart Rate: Count the radial (wrist) pulse during a 30-second period as early as possible in the rest period; if heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third without changing the rest period.
    - If the heart rate still exceeds 110 beats per minute at the next period, shorten the following work cycle by one-third.
- Body Temperature: If body temperature exceeds 99.6 degrees Fahrenheit (°F) (37.6 degrees Celsius [°C]), shorten the next work cycle by one-third without changing the rest period. If body temperature still exceeds 99.6 °F at the beginning of the next rest period, shorten the following work cycle by one-third. Do not permit a worker to wear impermeable PPE when his or her body temperature exceeds 100.6 °F (38.1 °C). Use any of the following thermometers:
    - Oral Thermometer – Use a clinical thermometer (3 minutes under the tongue) to measure the oral temperature at the end of the work period.
    - Tympanic (ear) Thermometer
    - Temporal (swipe) Thermometer

The SSC will document throughout the entire work shift results of heat illness monitoring for each team member participating in work activities. Any employee exhibiting signs and symptoms of heat illness shall not be left alone or sent home without being offered onsite first aid and/or being provided with necessary emergency medical services in accordance with Site HASP emergency response procedures.

8.0 HIGH HEAT PROCEDURES

Extra Measures During Heat Waves

Extreme environmental conditions during a heat wave can cause an employee's physical and mental conditions to change rapidly into a serious medical condition. Workers previously fully acclimatized are at risk for heat illness during a heat wave because during a heat wave, the body does not have enough time to adjust to a sudden, abnormally high temperature or other extreme conditions. The onset of heat illness may be confused with other problems and may not always be obvious before it becomes life-threatening. Therefore, the following extra measures may be required to prevent and/or respond to heat illness during heat waves or when temperatures exceed 95 degrees Fahrenheit. These measures will be discussed at the preshift tail gate meeting before commencement of work.

- **Communication** – Make sure voice, observation or electronic means of communication (text messaging or cell phone if service is available) is maintained so that site personnel can contact a supervisor when necessary. Designate one or more employees at the site as authorized to call for emergency services, when designated person(s) are not available any employee can call for emergency services.

- **Alertness to the Weather** – Make sure to monitor the weather and the specific locations where work activities are occurring. Continue to stay updated throughout the work shift on the changing air temperatures and other environmental factors. Use current weather information to make the appropriate adjustments in work activities throughout the workday.

- **Extra Vigilance and Observation** – Apply real-time communication methods as stated above as well as a mandatory "Buddy System" to account for the whereabouts of employees at more frequent intervals throughout the work shift and at the end of the work shift. Employee observation methods may also include, supervisor or designee direct observation if less than 20 employees are at the site.

- **Additional Water Consumption** – Remind employees throughout the work shift to drink small quantities of water more frequently and have effective replenishment measures in place for provision of extra drinking water to ensure available supplies.

- **Additional Cooling Measures** – Other alternative cooling measures may be necessary in addition to shade (e.g., allowing employees to spend time in air-conditioned places or having them spray themselves with water).

- **Additional and/or Longer Rest Breaks** – Remind employees of their right to take a more frequent and cool down rests when necessary.

- **Change of Work Scheduling and Assignments** – One or more of the following additional measures may be necessary:

  - Start the work shift earlier in the day or later in the evening.
  - Cut work shifts short or stop work altogether.
  - Bring in more personnel to accommodate longer, more frequent breaks as necessary to meet production requirements.
  - Reduce the severity of work by scheduling slower paced, less physically demanding work during the hot parts of the day, and the heaviest work activities during the cooler parts of the day (early morning or evening).

9.0 Establish Emergency Response

Specific procedures to be followed for heat related first aid and emergency response shall be established relevant to project location and task and documented in the Site-specific HASP. The HASP emergency response procedures must include clear and concise directions to the work site that can be provided to emergency responders. The HASP will also identify local emergency services and if necessary provide a means to transport employees to a place where they can be reached by emergency responders.

10.0 Variation to the Heat Illness Prevention and Monitoring Program

Before deviation from the requirements of this document, a designated manager shall authorize the variation. The exception process does not need to be followed for variations that impose more stringent requirements that those outlined in this document.

11.0 Disclaimer

This safe work practice (SWP) is the property of Tetra Tech, Inc. (Tetra Tech). Any reuse of the SWP without Tetra Tech's permission is at the sole risk of the user. The user will hold harmless Tetra Tech for any damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
12/19/2018	Chris McClain	12/21/2018	Revision to align with Cal-OSHA Heat Illness Prevention

1.0 PURPOSE

This safe work practices (SWP) describes situations where cold stress is likely to occur and discusses procedures for the prevention and treatment of cold-related injuries and illnesses. Cold conditions may present health risks to employees during field activities. Types of cold stress include: trenchfoot, frostbite, and hypothermia. When the body is unable to warm itself, serious cold-related illnesses and injuries may occur, and permanent tissue damage and death may result.

1.1 SCOPE

This policy applies to members of the Tetra Tech workforce who work for extended periods in conditions of low temperatures, especially in combination with wind or moisture.

2.0 ROLES AND RESPONSIBLITIES

Tetra Tech firmly believes protecting the health and safety of our employees is everyone's responsibility.

2.1 Project Managers

- Provide adequate resources to evalute cold stress hazards prior to work beginning.
- Provide proper personal protective equipment as necessary to the job.
- Arrange for employee training on cold stress prevention techniques.
- Assign a competent person or Site Safety Coordinator to conduct daily weather assessment and to adjust daily operations and prevention measures as necessary.

2.2 Competent Person/Site Safety Coordinator (SSC)

- Be competent to assess or measure weather conditions in cold stress environments
- Conduct regular hazard assessments of the weather to determine appropriate controls.
- Communicate proper controls and prevention strategies to Tetra Tech workers

2.3 Tetra Tech Staff

- Recognize the hazards of working in cold environments *(See Appendix B).*
- Mitigate the risk of cold stress by establishing and enforcing engineering controls, appropriate work practices, and protective clothing guidelines.
- Monitor for for signs of cold stress in co-workers and help to provide adequate warming periods.

3.0 COLD STRESS ASSESSMENT & PREVENTION

If an employee is or may be exposed to cold stress conditions; a cold stress assessment should be performed prior to starting work to determine the potential for hazardous exposure and to properly identify safety controls measures. Project Managers and Site-Safety Coordinators can complete this through conducting an Activity Hazard Analysis (AHA), outlined in the *DCN 02-21F Tetra Tech Activity Hazards Analysis.*

Activity Hazard Analysis will consider factors such as the:

- Areas and activities with an equivalent chill temperature (ECT) below 19.4°F (-7°C) *(Appendix A).*
- Fine dexterity tasks that require work with bare hands.
- Contact with metal surfaces or use of evaporative liquids (gasoline, alcohol, or cleaning liquids).
- Working on or near bodies of water.
- Areas about which employees have expressed concern.

Based on the outcomes of the AHA, the Project Manager will designate a Site Safety Coordinator (SSC) when cold stress hazards are anticipated. The SSC shall check temperature, wind speed, and the conditions of the worker, as often as needed, to determine the appropriate controls and changes to control strategies. The SSC will be responsible for

conducting daily and just in time education and communication to workers on cold stress prevention strategies.

3.1 Prevention Measures

Project Managers, in collaboration with the Site Safety Coordinator, shall adopt work schedules and work practices that help protect employees from the effects of cold stress. Guidelines include, but are not limited to, the following:

- Monitor current weather conditions (s*ee the table in Appendix A for the effects of wind speed on air temperatures).*
- Establish a work/warm-up cycle *(see Appendix C, Scheduling Work in Extreme Cold).*
- Schedule work at the warmest times.
- Move work to warmer areas.
- Plan for worker weather acclimization.
- Assign additional workers to the job to shorten its duration.
- Encourage self-pacing and extra breaks in warm dry shelters, if required.
- Establish a buddy system, emphasizing mutual observation.
- Allow for reduced efficiency and productivity when employees are wearing protective clothing.
- Urge employees to drink warm, sweet fluids (sugar water, sports-type drinks) before beginning work and during breaks. Avoid drinks with caffeine (coffee, tea, sodas, or hot chocolate).
- Ensure a thermometer and chemical hot packs are available onsite.

- Review tools and machine controls to evaluate if gloved hands can operate in cold conditions and establish appropriate safety control measures.

- Cover metal handles of tools and control bars with thermal insulating materials for temperatures below -1°C (30.2°F).

- Provide adequate warming measures when work will need to be performed with bare hands for more than 10-20 minutes when skin or body is at risk of effects of air temperature and air speed on exposed flesh (see Appendix A).

- Have a survival kit in the workers vehicle consisting of at least the following:

  o Blanket or warm heavy coat

  o Candles and lighter or matches

  o Flashlight

  o Cell phone or alternative and battery charger

  o High-energy snacks (i.e. chocolate, dried fruit).

Employees who are at risk for occupational exposure to cold stress must be familiar with the causes and symptoms of cold-related injuries *(see Appendix B).* Personnel working in cold conditions should follow recognized procedures for controlling cold stress, this includes, but not limited to:

- Eat a well-balanced diet. *Note: Energy bars and dried fruits are good sources of quick energy. Nuts, seeds, and other proteins provide longer-lasting energy. Caffeine and nicotine, which can restrict circulation or accelerate heat loss, should be avoided.*

- Stay hydrated. *Note: Working in cold, dry air can cause significant water loss through the skin and lungs. Increased fluid intake prevents dehydration, which puts the extremities at greater risk of damage due to decreased blood flow.*

- Wear appropriate protective clothing that keeps the extremities warm and dry.

  a) Dress in layers. Wear clothes that are snug but not tight. This allows insulating air between the clothes and your skin. Layers can be adjusted to changing conditions.

  b) Wear appropriate underwear that wicks moisture away from the skin.

  c) Cover as much of the head, face, and neck as possible without restricting vision.

  d) If working in rain, snow, or extreme wind, wear an outer layer of waterproof or windproof garments that allow water vapor created by perspiration to escape.

  e) Wear insulated boots and socks with insulating properties.

  f) Wear gloves when skin or body is at risk of effects of air temperature and air speed on exposed flesh (see Appendix A).

  g) Change out of wet clothing as soon as possible.

  h) Wear tinted eye protection, if needed, when working in snow- or ice-covered terrain.

  i) Lone workers should have a check in plan for periodic checks with the office or specific contact to ensure safety.

  j) When traveling, call the office when you leave and again when you reach your destination.

- Take regular breaks and move to a dry, heated area to warm up.

- Never touch cold metal objects with exposed skin and wear gloves when cold metal surfaces are within close contract range.

- At the first sign of overexposure, stop work and go indoors or to a dry, heated area to warm up. Don't push yourself to finish a task.

4.0 EMERGENCY RESPONSE

Employees will be trained to recognize the signs and symptoms of frostbite and hypothermia (see Appendix C) in themselves as well as in coworkers. Employees are required to report incidents of cold stress to the Site Safety Coordinator. If a worker exposed to cold shows signs or reports symptoms of cold stress or injury, the worker must be removed from further exposure and treated by an appropriate medical provider. Emergency response and injury case management process will be outlined in the project Health and Safety Plan (HASP) and be documented according to the *DCN 02-02 Tetra Tech Incident Reporting and Investigation Program*.

5.0 TRAINING

Training is an essential component of cold stress prevention. Employees will be taught to identify and treat cold-related injuries during various mandatory training events such as, but not limited to, annual refresher training, site-specific training, tailgate meetings, and first aid training courses.

The training and education material provided to workers who have not previously worked in a cold stress environment should include the following information:

- Recognition of the signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur
- Recognition of impending frostbite
- Proper re-warming procedures and appropriate first aid treatment
- Methods for weather acclimization in cold work environments
- Proper use of clothing
- Proper eating and drinking practices

- Safe work practices appropriate to the work that is to be performed
- The dangers associated with working around unstable snow and ice build ups as applicable.

6.0 RECORDKEEPING REQUIREMENTS

Cold Stress awareness training shall be documented and available for review to the employee, client, or regulatory authority upon request. Recordkeeping will comply with the *DCN 01-04 Tetra Tech Recordkeeping and Reporting Requirements Program.*

DEFINITIONS

If a definition is not listed in this section, please contact your supervisor. If your supervisor is unaware of what the term means, please contact your Health and Safty Representative .

Core body temperature—The temperature in the brain, the heart, and the abdominal organs. It changes very little (normal range: 97.6–98.8°F or 36.3–39.9°C) and is vital for the normal functioning of these organs.

Cold stress—The strain placed on the body when heat losses are greater than normal and compensatory thermoregulatory mechanisms are required to maintain normal body temperature. The main factors that contribute to cold stress are environmental: cold air temperatures, high-velocity air movement, dampness of the air, and contact with cold water or surfaces. Other factors include age, weight, fitness level, acclimatization to cold, fatigue, use of medications, and use of alcohol or nicotine. Cold-related injuries are either localized (frostnip, frostbite) or generalized (hypothermia).

Equivalent Chill Temperature (ECT)—The air temperature that would produce the same cooling effect on exposed flesh as a given combination of air temperature and air movement. Commonly called the wind chill index, it is a useful tool in determining the clothing requirements and potential hazards of different air temperatures and wind speeds.

Frostbite—The freezing of tissues in some part of the body as a result of exposure to extreme cold or contact with cold objects. Blood circulation may cease in the affected areas, and blood vessels can be irreparably damaged. In milder cases, the symptoms include a patchy inflammation of the skin, accompanied by slight pain. In more severe cases, there is often tissue damage without pain. Frostbitten skin is susceptible to infection and gangrene. There are three stages of frostbite:

- Frostnip—the affected body parts begin to feel cold and stiff with a prickling pain; the skin is usually white and blotchy.
- Superficial frostbite—ice crystals form in the skin cells, causing the area to feel hard and waxy. The skin looks purplish, and blisters may appear. Nerve endings, blood vessels, and muscle tissue are damaged, so the affected area becomes numb and sensations of cold and pain go away.
- Deep frostbite—tissue is frozen through to the bone, causing blood clots and gangrene. If the victim receives medical attention soon enough, the frozen limb may be saved from amputation.

Hypothermia—A decrease in the core body temperature that impairs normal metabolic, muscular, and cerebral functions. This condition occurs when the body loses heat faster than it is replaced. Symptoms begin when the core body temperature drops below 95°F (35°C); if it falls below 90°F (32.2°C), the condition is critical and eventually fatal. Hypothermia is a threat when an individual is exposed to water temperatures below 60°F (15.6°C) or air temperatures below 50°F (10°C). Symptoms include intense shivering, muscle tension, fatigue, feelings of cold or numbness, slurred speech, stumbling, lethargy, erratic behavior, or irritability.

Trench foot—An injury to nerve and muscle tissue in the feet after they have been wet and cold (but not frozen) for a prolonged period. Also known as "immersion foot."

References & Standards

OSHA, Department of Labor, Fact Sheet OSHA 98-55, "Protecting Workers in Cold Environments."
OSHA, Department of Labor, OSHA Publication 3156, "The Cold Stress Equation."
CDC, Department of Health and Human Services, "Cold Stress."
US SAR Task Force, Department of Homeland Security, "Cold Water Survival."
Infastructure Health and Safety Association; Ontario, Canada, Construction Health and Safety Manual, "Cold Stress"

Related Programs, Procedures & Forms

DCN 01-04 Recordkeeping and Reporting Requirements Program
DCN 02-02 Incident Reporting and Investigation Program
DCN 02-21 Project Safety Management Program
DCN 02-21F Activity Hazard Analysis

damages that result from unauthorized reuse of this SWP. Authorized users are responsible for obtaining proper training and qualification from their employer before performing operations described in this SWP

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
2/7/2012	Chris McClain Denny Cox	2/7/2012	Update from 2008 format
July 2020	Amber Bill Chris McClain	09/2020	Updated to include Roles and Responsibilities, Emergency Response Procedures, Record Keeping Requirements, and Cold Stress Definitions.

Appendix A
Effects of Windspeed and Temperature

Air temperature and air speed play important roles in cold stress. The following tables illustrates the effects of air temperature and air speed on exposed flesh, expressed as Equivalent Chill Temperature (ECT), also known as the wind chill index.

The ACGIH criteria, in the Fahrenheit scale:

Estimated wind speed (in mph)	Actual temperature reading (degrees Fahrenheit)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent chill temperature (degrees Fahrenheit)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
Wind speeds greater than 40 mph have little additional effect	**LITTLE DANGER** In < 1 hour with dry skin. Maximum danger of false sense of security.				**INCREASING DANGER** Danger from freezing of exposed flesh within one minute.				**GREAT DANGER** Flesh may freeze within 30 seconds.			
	Trench foot and Immersion foot may occur at any point on this chart.											

Note: Equivalent chill temperature requiring dry clothing to maintain core body temperature above 36 C (96.8 F) per cold stress TLV.

Wind Chill Temperature Index Celcius Scale:

WIND CHILL TEMPERATURE INDEX
Frostbite Times are for Exposed Facial Skin

Air Temperature (°C)

Wind Speed (km/h)	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

FROSTBITE GUIDE

Increasing risk of frostbite for most people in 10 to 30 minutes of exposure
High risk for most people in 5 to 10 minutes of exposure
High risk for most people in 2 to 5 minutes of exposure
High risk for most people in 2 minutes of exposure or less

APPENDIX B
COLD STRESS DISORDERS

The body's first response to cold stress is to conserve body heat by reducing blood circulation through the skin. This effectively makes the skin an insulating layer. A second physiological response is shivering, which increases the rate of metabolism. Shivering is a reliable sign that cold stress is significant and hypothermia may be present. However, these responses are relatively weak as a protection mechanism. Behavior is the primary human response to preventing excessive exposure to cold. These include increasing clothing insulation, increasing activities, and seeking warm locations.

Insulation is a critical characteristic of clothing designed to be worn in cold conditions. Clothing materials used for their insulation characteristics include cotton, wool, silk, nylon, down, and polyester. Better insulation is usually achieved by layering clothes rather than wearing one garment. Another advantage of layers is that a person can add or remove layers to adjust for differing insulation needs during the work period.

The insulating value of clothing is greatly diminished by moisture, either in the work environment or in the form of sweat. Once clothing is wet, it should be replaced immediately with dry clothing.

Disorders	Cause	Symptoms	Prevention	First Aid Procedure
Hypothermia	Overexposure, exhaustion, or dehydration; low tolerance (genetic or acquired); drug and alcohol use	Chills, pain in extremities, fatigue or drowsiness, euphoria, slow and weak pulse, slurred speech, collapse, shivering, loss of consciousness, core body temperature below 95°F (35°C)	Wear layered clothing; avoid moisture and stay dry; bring along extra dry clothes; carry blankets, matches, first aid kit; use buddy system if possible.	Move to warm area and remove any wet clothing; apply modest external warmth (external heat packs, blankets, etc.); drink warm, sweet fluids if conscious; transport to hospital.
Frostbite	Exposure to cold; vascular disease	Burning sensation at first, coldness, numbness, tingling; skin color white or grayish yellow to reddish violet to black, blisters; response to touch depends on depth of freezing	Wear layered clothing; protect the face, ears, nose, fingers, toes; avoid moisture and stay dry; wiggle toes and fingers if they begin to lose feeling or tingle; go inside and warm up.	Move to warm area and remove any wet clothing; apply modest external warmth (external heat packs, blankets, etc.); drink warm, sweet fluids if conscious; treat as a burn (do not rub the affected area); transport to hospital.
Frostnip	Exposure to cold (above freezing)	Possible itching or pain; skin turns white	Similar to Frostbite	Similar to Frostbite
Trench Foot	Exposure to cold (above freezing) and dampness	Severe pain, tingling, itching; edema, blisters; response to touch depends on depth of freezing	Similar to Frostbite	Similar to Frostbite
Chilblain	Inadequate clothing; exposure to cold and dampness; vascular disease	Recurrent, localized itching; painful inflammation; swelling; severe spasms	Similar to Frostbite	Remove to warm area and seek medical attention.
Raynaud's disease	Exposure to cold and vibrations; vascular disease	Fingers tingle; intermittent blanching and reddening; fingers blanch with cold exposure	Similar to Frostbite	Remove to warm area and seek medical attention.

APPENDIX C
WORK/WARM-UP SCHEDULE FOR A 4-HOUR SHIFT

A WORK/WARM-UP SCHEDULE IS AN EXAMPLE OF AN ADMINISTRATIVE CONTROL. THE ACGIH STANDARD CONTAINS A WORK/WARM-UP SCHEDULE FOR A 4-HOUR SHIFT FOR WORKERS WHO ARE PROPERLY CLOTHED.

Table 7-1: Work/Warm-up Schedule for a Four-Hour Shift

Air temperature (sunny sky)		No noticeable wind		8 km/h wind (5 mph)		16km/h wind (10 mph)		24 km/h wind (15 mph)		32 km/h wind (20 mph)	
°C (approx.)	°F (approx.)	Max work period	No. of breaks	Max work period	No. of breaks	Max work period	No. of breaks	Max work period	No. of breaks	Max work period	No. of breaks
-26° to -28°	-15° to -19°	Normal breaks	1	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4
-29° to -31°	-20° to -24°	Normal breaks	1	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5
-32° to -34°	-25° to -29°	75 minutes	2	55 minutes	3	40 minutes	4	30 minutes	5	**Non-emergency work should stop**	
-35° to -37°	-30° to -34°	55 minutes	3	40 minutes	4	30 minutes	5	**Non-emergency work should stop**			
-38° to -39°	-35° to -39°	40 minutes	4	30 minutes	5	**Non-emergency work should stop**					
-40° to -42°	-40° to -44°	30 minutes	5	**Non-emergency work should stop**							
-43° and below	-45° and below	**Non-emergency work should stop**									

Source: Adapted from Threshold Limit Values (TLV) and Biological Exposure Indices (BEI) booklet (ACGIH: Cincinnati) 2016, page 210.

NOTES

1. Applies to moderate to heavy physical work in any 4-hour period.
2. Warm-up breaks should be in a warm environment for 10 minutes.
3. Normal breaks means a break after 2 hours of work.
4. Guidelines apply to workers wearing dry clothing.
5. If there is limited physical activity, apply the schedule one step lower (more protective).

Biological hazards, or "biohazards," include plants, animals or their products, and parasitic or infectious agents that may present potential risks to worker health. This safe work practice (SWP) discusses procedures for working with biohazards, preventive guidelines, and first-aid procedures for the most common hazards field staff are likely to encounter. This SWP does not address biohazards such as those associated with medical waste. Procedures for working with this type of biohazard should be addressed in the site-specific health and safety plan (HASP), construction health and safety plan (C-HASP), job safety analyses (JSAs), activity hazard analyses (AHAs), or other health and safety project planning documents on a case-by-case basis.

During preparation for site work, the document preparer should consider which plants, animals, and other biological agents may be encountered; assess their potential risk to project personnel; and attach this SWP to the document if necessary. Office health and safety representatives should become familiar with biological hazards indigenous to the geographical area in which most of their office personnel work and assist in evaluating the risks to personnel on projects staffed from their offices. SWPs for insects, snakes, animals, plants, waterborne pathogens (giardia), and hantavirus are provided below.

1.0 INSECTS

SWPs for reducing the chance of insect bites or stings and for treating bites or stings are listed below.

- Workers should keep as much skin area covered as possible by wearing long-sleeved shirts, long pants, and a hat. Pant legs should be tucked into socks or boots and shirts into pants. In addition, workers should wear light colored clothing.
- A proven insect repellent should be used on bare skin and clothing.
- When possible, tall grasses and brush that could harbor ticks should be avoided.
- Several times during the day and at the end of the work day, each worker should perform a check for evidence of imbedded ticks or previous bites. Particular attention should be paid to the scalp, neck, ankles, back of the legs, and waist.

- When opening well covers, vaults, or other closed items, workers should watch for hornet or wasp nests and black widow or brown recluse spiders. Workers should never reach into spaces with unprotected arms.
- Workers should watch carefully for bees around open soft drinks or food.
- If a worker is stung by a bee, the stinger should be carefully removed, if present. The wound should be washed and a cold pack applied. Allergic reaction should be watched for and is evidenced by extreme swelling, redness, pain, or difficulty breathing.
- If a worker is stung or bit by a spider or scorpion, medical attention should be obtained immediately.

2.0 SNAKES

SWPs for encounters with snakes and for treating snakebites are listed below.

- Workers should avoid walking in areas known to harbor snakes. Workers should be cautious when picking up or moving items that have been on the ground.
- Workers should wear boots made of heavy material that protect the ankles and pants. Heavy work gloves should be worn for picking up items.
- If one snake is encountered, others may be present. Workers should leave the area by retracing their steps.
- If a worker is bitten, the wound should be washed and the injured area immobilized and kept lower than the heart, if possible. Ice or a tourniquet should not be applied to a snake bite. The wound should not be cut. If medical care is more than 30 minutes away from a work site, a snakebite kit should be available on site and workers should know how to use it.

3.0 ANIMALS

SWPs for encounters with animals and for treating associated wounds are listed below.

- If workers encounter a wild animal, the animal should be observed for unusual behavior such as a nocturnal animal out during the day, drooling, an appearance of partial paralysis, irritability, meanness, or a strangely quiet demeanor.
- Workers should never touch the body of a dead animal because certain diseases could be carried by fleas still on the body.
- Workers should avoid animal droppings (including bird droppings). Pathogens, some of which can become airborne, may still be present in the droppings.
- If a worker is bitten, he or she should get away from the animal to avoid further bites. Workers should not try to stop, hold, or catch the animal.
- If the wound is minor, it should be washed with soap and water. Any bleeding should then be controlled, and an antibiotic ointment and dressing should be applied. All animal bite wounds should be watched for signs of infection.
- If the wound is bleeding seriously, the bleeding should be controlled but the wound should not be cleaned. Medical assistance should be summoned immediately.
- If a rabid animal is suspected, immediate medical attention should be summoned. If possible, workers should try to remember what the rabid animal looked like and the area in which it was last seen. The animal should be reported by calling the local emergency number.

4.0 PLANTS

SWPs for plants are as follows:

- Workers should be aware of the types and appearances of poisonous plants in the work site area. Poison ivy, oak, and sumac are the most frequently encountered plants that can cause reaction from casual contact. If a worker is extremely sensitive to these plants, he or she should avoid the area entirely because airborne drift could be sufficient to cause a reaction. Other plants, such as fireweed, can cause painful, short-term irritation and should be avoided as well. Workers should avoid touching face and eye areas after contact with any suspicious plant.

- Workers should wear proper clothing if working in or near overgrown areas. Disposable outerwear should be used, if necessary, and workers should not touch the material with bare hands during removal if the outerwear may have contacted poisonous plants.

- If contact with a poisonous plant has occurred, the affected area should be immediately washed thoroughly with soap and water. If a rash or weeping sore has already begun to develop, a paste of baking soda and water should be applied to the area several times a day to reduce discomfort. Lotions such as Calamine or Caladryl should be applied to help soothe the area. If the condition gets worse and affects large areas of the body or the face, a doctor should be consulted.

- Bushy and wooded areas should be thoroughly checked for thorn-bearing trees, brush, and bramble. In some cases, impalement can cause severe pain or infection.

5.0 WATERBORNE PATHOGENS-GIARDIA

Giardia is a waterborne pathogen consisting of a protoplasmic parasite of the mammalian digestive tract. Giardia is present worldwide, with the highest occurrence in areas with poor sanitation. In the United States, most reported cases are in mountainous regions where drinking water is obtained from streams and is unfiltered or untreated.

Giardia is contracted by ingesting water contaminated with giardia cysts in the dormant state. Giardia parasites can only thrive in the digestive tracts of mammals. Dormant giardia organisms enter water through the feces of infected animals or humans. Giardia symptoms include severe diarrhea and upset stomach. Some people are asymptomatic but can transmit the disease to others. Medical treatment of giardia can be difficult and unpleasant; therefore, prevention is critical. Precautions for preventing exposure to giardia are listed below.

- Workers should assume that all fresh water streams are infected with the giardia organism and not drink any untreated water.

- Team members collecting sediment and water samples from streams should wash their hands thoroughly with soap and water after collecting the samples.

- Giardia parasites are relatively easy to destroy or filter. Water should be treated for drinking or cooking with iodine or another recommended giardia treatment before use.

6.0 HANTAVIRUS

Hantavirus pulmonary syndrome (HPS) is a potentially fatal infection caused by a rodent-borne hantavirus. HPS begins with a brief illness most commonly characterized by fever, muscle pain, headache, coughing, and nausea or vomiting. Other early symptoms include chills, diarrhea, shortness of breath, abdominal pain, and dizziness. In the first identified cases of HPS, this stage of the infection lasted 2 to 5 days before victims were hospitalized. Typically, by the time of hospitalization, victims were found to have tachycardia (a heart rate of greater than 100 beats per minute) and tachypnea (a breathing rate of greater than 20 breaths per minute). Fever was also common. In most cases, death occurred within 2 to 16 days of the onset of symptoms, and victims exhibited pulmonary edema and severe hypotension.

Currently, experts believe that HPS is spread by the deer mouse (*Peromyscus maniculatus*). Though the deer mouse has been found to be the primary host of hantavirus, several other rodent species have also tested positive for the virus. Pinon mice (*Peromyscus truei*), brush mice (*Peromyscus boylii*), and western chipmunks (*Tamia spp.*) are also likely to carry the virus. Also, cases of HPS have been reported in areas of the United States where these particular rodents are not indigenous.

Infected rodents shed the virus in their urine, feces, and saliva. Humans can be exposed to the virus through (1) inhalation of suspended rodent excreta or dust particles containing rodent excreta, (2) introduction of rodent excreta into the eyes or broken skin, and (3) ingestion of food or water contaminated by rodent excreta. HPS has a reported mortality rate of 55 percent. Transmission of hantavirus from infected individuals to healthy persons has not been documented.

Prevention of HPS infection is essential because no known antidote and no specific treatment exists for treating HPS. Therefore, employees should practice risk reduction and control measures. Guidelines for workers in locations that may have rodent infestations or habitats are listed below.

- The best approach for HPS control and prevention is through environmental hygiene practices that deter rodents from colonizing the work environment.

- Information about the symptoms of HPS and detailed guidance on preventive measures should be provided to all employees assigned to field activities.

- Medical attention should be sought immediately for workers who develop a febrile or respiratory illness within 45 days of the last potential exposure to rodents. Attending physicians should be advised of each worker's potential for occupational exposure to hantavirus. Physicians should contact local health authorities promptly if hantavirus-associated illness is suspected. A blood sample should be obtained from the affected worker and forwarded with the baseline serum sample through the state health department to the Centers for Disease Control and Prevention for hantavirus antibody testing.

- Respiratory protective equipment should be worn when handling rodents, when removing rodents from traps, and when working in areas with evidence of rodent droppings or hair. Respiratory protective equipment should include, at a minimum, a half-face air-purifying respirator (APR) or powered APR equipped with a high-efficiency particulate air (HEPA) filter (P100). Full-face regulators may be needed under some circumstances. Respiratory protective equipment should be used in accordance with Occupational Safety and Health Administration regulations.

- Dermal protection should be worn when handling rodents or traps containing rodents, or if contact with contaminated surfaces could occur. Dermal protection should include rubber or plastic gloves that should be washed and disinfected before removal.

- A trap contaminated with rodent urine or feces or in which a rodent was captured should be disinfected with a commercial disinfectant or a 0.4 percent bleach solution. A dead rodent should be disposed of by placing the carcass in a plastic bag containing enough general-purpose household disinfectant to thoroughly wet the carcass. The bag should be sealed and disposed of by burning or by burying it in a 2- to 3-foot-deep hole. Local and state health departments can also provide appropriate disposal methods.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

This safe work practice (SWP) presents procedures that must be followed for all permit-required confined space entries. If any of the space preparation or entry requirements discussed in this SWP cannot be met, entry shall not proceed until the space is evaluated by the project manager (PM)and the site safety coordinator (SSC).

This SWP supplements Document Control Number (DCN) 2-5, "Confined Space Entry Program," and provides specific procedures for permit-required confined space entry.

The entry permit, hazard inspection, atmospheric testing, ventilation, respiratory protection, pre-entry briefing, communication, evacuation, and rescue provisions for permit-required confined space entry are discussed below.

1.0 ENTRY PERMIT

Tetra Tech, Inc. (Tetra Tech) has established a confined space entry permit (CSEP) system to ensure safe entry and safe performance of work within a permit-required confined space. Before entry into a permit-required confined space can occur, a CSEP must be issued. The CSEP is a written authorization and approval that specifies the location of the confined space, specifies the type of work to be conducted in the space, certifies that all existing and potential hazards have been evaluated, and verifies that necessary protective measures have been taken to ensure the safety of each worker.

The CSEP (Form CS-1) must be completed in its entirety and signed by a permit authorizer (either the project manager or the SSC). Blank entries are not allowed, and all sections requesting a specific time or date must be completed. Additional sheets may be necessary.

The permit authorizer shall do the following:

- Determine that the entry permit contains the requisite information and that all tests specified by the permit have been conducted before endorsing the permit and allowing entry;
- Determine that the necessary procedures, practices, and equipment necessary for safe entry are in effect before allowing entry;
- Cancel entry authorization and terminate entry whenever unacceptable entry conditions are present;

- Take the necessary steps for concluding an entry operation, such as closing off a permit space and canceling the permit once the authorized work has been completed; and
- Ensure that confined space entrants are properly trained and that an authorized attendant will remain outside of the confined space to monitor the entrants throughout the entire entry.

The permit authorizer must be readily available for reviewing the permit and must personally inspect the confined space before the startup of the entry task. The permit authorizer shall then sign the permit.

The completed permit shall be posted at the entry portal or displayed by any other equally effective means before entry activities begin so that authorized entrants can confirm that all pre-entry preparations have been completed. All authorized entrants shall sign the CSEP after reviewing it.

A copy of the CSEP shall be furnished to the project manager. The original copy of the permit shall be retained as a permanent record in the project file. The CSEP posted at the work site shall be removed upon completion of the job or the end of the shift, whichever is first.

The date and time the permit has been authorized for shall be indicated on the permit. Permits are valid for a maximum of 8 hours. Reauthorization of the permit shall be required for each day of entry.

A CSEP becomes void under any of the following conditions:

- If work in the confined space does not start within 1 hour after atmospheric testing is performed;
- The job is interrupted for more than 60 minutes for any reason;
- Atmospheric testing of the confined space is discontinued;
- Atmospheric changes occur resulting in (1) an oxygen content below 19.5 percent or above 23.5 percent, (2) greater than 10 percent of the lower explosive limit (LEL) of combustible gases or vapors, or (3) concentration of a hazardous airborne contaminant exceeding its permissible exposure limit;
- Injury or illness of an entrant;

- A power failure affecting lighting or telephone usage; or
- Severe weather.

2.0 HAZARD INSPECTION

Before scheduling a confined space entry, the permit authorizer shall inspect the area around the confined space for (1) sources of combustion exhaust, (2) flammable gases, (3) sparks and fire, and (4) objects that might fall into the space.

The confined space and the scope of work within that space shall be evaluated to identify potential hazards and identify and implement appropriate hazard controls. The permit authorizer shall ensure that appropriate hazard controls are in place prior to entry activities. Such hazard controls can include, but are not limited to, the following:

- Lockout and tagout requirements;
- Confined space cleaning procedures;
- Equipment and tool requirements;
- Safe entry and exit procedures; and
- Physical hazard controls (such as hearing protection and heat stress controls.

Each hazard control identified above is specifically detailed in the DCN 2-5.

3.0 ATMOSPHERIC TESTING

Atmospheric testing shall be conducted to evaluate the potential hazards and verify that entry conditions for the space are acceptable. Atmospheric testing equipment is described in DCN 3-8, "Air Monitoring Program." The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise so that appropriate permit procedures can be developed to ensure safe entry.

The duration of testing for each atmospheric contaminant shall be made for at least the minimum response time of the test instrument as specified by the manufacturer plus an allowance for dead space in sampling lines.

Testing shall be conducted to ensure that all spaces are surveyed for hazardous conditions and shall include all sections of noncontiguous spaces and all levels of each space to account for stratification. When monitoring for entries involving descent into atmospheres that may be stratified, measurements shall be recorded at a distance of approximately 4 feet in the direction of travel and to each side. If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and the detector response.

Atmospheric testing shall be conducted in the following order:

- Oxygen content must be tested for first because most combustible gas meters are oxygen-dependent and will not provide reliable readings in an oxygen-deficient atmosphere;
- Combustible gases must be tested for next because the threat of fire or explosion is more immediate and life threatening in most cases than exposure to toxic gases and vapors; and
- Toxic gases and vapors must be tested for last for specific toxic gases and vapors as necessary.

Continuous monitoring for oxygen, combustible gases, and specific hazardous contaminants is required in all permit-required confined spaces unless lack of such monitoring is specifically approved by the operating unit health and safety manager (HSM). Results shall be noted regularly on Form CS-1.

Equipment for continuous monitoring of gases and vapors shall be explosion-proof (intrinsically safe) and equipped with an audible alarm that will alert personnel when a hazardous condition develops. Testing equipment shall be calibrated in accordance with the manufacturer's recommendations. Calibration parameters shall be recorded in the field logbook, and each piece of equipment will be tagged with its calibration results. Calibration records should be included in the permanent project file.

Pre-entry evaluation must, at a minimum, include remote atmospheric testing before employee entry and before validation or revalidation of a CSEP to ensure the following:

- An oxygen content between 19.5 and 23.5 percent;
- Less than 10 percent LEL of combustible gas; and
- The absence of other atmospheric contaminants, if the space contained toxic, corrosive, or irritant materials.

Pre-entry evaluation test data and entry procedures should be reviewed by or under the direction of a technically qualified individual such as a certified industrial hygienist, certified safety professional, or a certified marine chemist.

Verification testing of the atmosphere of the permit space shall be conducted for all contaminants identified during evaluation testing procedures at the time of entry in order to verify that concentrations are within the range of acceptable conditions. Testing results shall be recorded on the CSEP for the space.

4.0 VENTILATION

Natural ventilation of the confined space prior to initial entry and for the duration of the CSEP shall be provided. However, positive-pressure, forced mechanical ventilation may also be required. Before forced ventilation is initiated, information such as restricted areas within the confined space, voids, the nature of contaminants present, the size of the space, the type of work to be performed, and the number of entrants involved should be considered. The procedures listed below also apply.

- The confined space shall be ventilated before starting work and for the duration of the time that work is to be performed in the space.
- Ventilation air should not create an additional hazard resulting from recirculation of contaminants, improper arrangement of the inlet duct, or substitution of anything other than Grade D or fresh air.
- When air-moving equipment is used to provide ventilation, the equipment shall be tested before each shift and provided with an audible alarm to signal ventilation failure.
- Chemicals shall be removed from the vicinity of the air supply to prevent their introduction into the confined space by air-moving equipment or any other means.

- Vehicles shall not be left running near confined spaces or near air-moving equipment being used for confined space ventilation because vehicle exhaust can act as a source of carbon monoxide.

5.0 RESPIRATORY PROTECTION

Respiratory protection needed for confined space entry shall be determined by a technically qualified person such as a Tetra Tech health and safety specialist based on site conditions, air monitoring results for the confined space, and the work activity to be performed. Air-purifying respirators with appropriate cartridges can be worn only if (1) testing indicates that the atmosphere is not oxygen deficient, (2) the contaminants are at concentrations below the protection factor of the respirator selected, and (3) an approved respiratory hazard assessment has been completed (Form RP-2).

Self-contained breathing apparatuses (SCBA) or National Institute for Occupational Safety and Health-certified, positive-pressure, airline respirators equipped with a 5-minute emergency air supply (egress bottle) shall be used in any confined space when conditions have been determined to be immediately dangerous to life and health.

6.0 PRE-ENTRY BRIEFING

Immediately before entering a confined space, the authorized attendant and entrants shall again review all potential hazards and emergency procedures during a pre-entry briefing. The following topics shall be discussed:

- CSEP components;
- Work to be completed and the time period the CSEP shall remain in effect;
- Location of telephone and emergency numbers;
- Atmospheric, physical, electrical, and miscellaneous hazards expected in the space;
- Rescue provisions and procedures; and
- Reasons to evacuate the confined space.

7.0 COMMUNICATION

When visual monitoring of the entrants is not possible because of the layout of the confined space, the authorized attendant shall maintain voice contact as necessary to monitor entrant status and to alert entrants of the need to evacuate the space.

Attendants shall not enter the space to communicate with entrants. Passing of the head through the plane of the opening is not allowed. The attendant shall also know emergency telephone numbers. If a mobile telephone or radio is not available, other communication procedures must be arranged.

8.0 EVACUATION

Evacuation of the permit-required confined space will be initiated if any of the following conditions arise:

- Observation of a condition not allowed on the CSEP;
- Entrant exhibits signs or symptoms of hazardous exposure;
- Situation outside the space endangers entrants;
- Uncontrolled hazard (such as fire or spill);
- Loss of power or ventilation;
- Monitoring equipment malfunctions; or
- The authorized attendant must leave.

9.0 RESCUE PROVISIONS

Provisions must be made ***prior to permit-required confined space entry*** for rescue equipment and procedures. If a worker becomes ill or injured, the attendant will contact the nearest qualified and equipped emergency response team (by dialing 911 or a site-specific emergency telephone number). The attendant may then attempt to retrieve the ill or injured employee by retrieval line

until arrival of a rescue team. If rescue operations are provided by non-Tetra Tech personnel, the rescue personnel must be informed of the hazards they may confront during rescue.

Under no circumstances shall the attendant enter the confined space to attempt rescue unless trained and equipped for rescue operations and relieved of his or her attendant duties. The attendant must have appropriate rescue respiratory protection available for rescue teams. This equipment must include a positive pressure airline (with 5-minute escape bottle) or SCBA. Anyone using emergency respiratory equipment must have received training in its use.

To facilitate non-entry rescue, non-entry retrieval systems or methods shall be used when an authorized entrant enters a permit space unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. The authorized entrant shall be fitted with a full-body harness with a retrieval line attached at a suitable point so that if rescued, the employee easily fits through the entrance. Wristlets can be used when the use of a chest or full-body harness would present a hazard and the use of wristlets is the safest and most effective alternative.

A mechanical retrieval device shall be available to retrieve personnel from a vertical-type permit-required space more than 5 feet deep. The line will be at least 0.5-inch in diameter and tested for 2,000 pounds. Mechanical retrieval devices are not required for spaces less than 5 feet deep or during horizontal entries. A simple retrieval line on the entrant can be tied off outside the entrance for these spaces.

Revision Date	Document Authorizer	Revision Details
10/1/2008	Chris McClain	Update from 1998 format

1.0 PURPOSE

This program provides requirements for identification, location, and avoidance of underground utilities, appurtenances, and structures during intrusive activities. The program also addresses actions to be taken in response to encountering or contacting underground utilities.

2.0 SCOPE

These requirements are applicable to all Tetra Tech operations. The procedures address the requirements and recommendations for identifying and locating, working around, and encountering or contacting underground utilities.

3.0 MAINTENANCE

The Vice President, Corporate Health and Safety or designee is responsible for updating this procedure. Approval authority rests with Tetra Tech's Senior Vice President, Corporate Administration. Suggestions for revision shall be submitted to Corporate Administration department.

4.0 DEFINITIONS

4.1 Aggressive Methods

The use of mechanized equipment such as excavators, backhoes, drill rigs, directional drilling, road saws, etc. Non-Aggressive methods involve the use of manual or non-mechanized methods such as hand-digging with shovels and air/hydro/vacuum methods.

4.2 Buffer Zone

As defined in this procedure, the area around a utility where only non-aggressive excavation methods may be utilized, unless specific conditions are met.

The definition cited above, and the excavation requirements and restrictions associated with it, will vary depending on the particular state regulations. Tetra Tech requires the imposition of a four-foot

Buffer Zone on all sides of the utility as measured from the outside edges of the utility, both horizontally and vertically. Since most jurisdictions recognize Buffer Zones which vary somewhere in the range of 18 to 36 inches, this distance must be verified by consulting the applicable state regulations before excavating so that adjustments to surface markings can be made to achieve the required four-foot buffer zone.

Referred to as the "Tolerance Zone", "Safety Zone", or "Approximate Location of Underground Utilities" in some jurisdictions.

Information relative to excavation within the buffer zone is contained in Section 5.2.2.4.

4.3 Competent Person

A Competent Person has the ability to recognize hazards associated with underground utilities and the authority to stop or direct operations to ensure the safety of personnel and conformance with this procedure. The Competent Person has an understanding of this procedure, and the "One-Call" system requirements for the jurisdiction where excavation is occurring. The Competent Person must be capable of notifying One-Call agencies and maintaining and tracking One-Call Locate Numbers. Additionally, they must have knowledge of methods and work practices for utility identification, avoidance, and protection.

4.4 De-Energize

As applicable to a utility, to physically eliminate and/or prevent the presence, transmission, flow, or release of energy or materials which may cause harm to personnel or property.

4.5 Excavation

An operation for the purpose of movement or removal of earth, rock, or the materials in the ground, including but not limited to; digging, blasting, auguring, backfilling, test boring, drilling, pile driving, directional drilling, grading, plowing-in, hammering, pulling-in, jacking-in, trenching, tunneling, structural demolition, milling, scraping, tree and root removal (grubbing), fence or sign post installation. Tetra Tech requires that the designated One-Call agency for the applicable jurisdiction be contacted any time an intrusive activity is planned.

4.6 Jurisdiction

The authority having legal jurisdiction relative to regulations and requirements for notification of excavation activities and associated identification and marking. In the United States, the states have jurisdiction, and most consider the regulations applicable when excavation is to be performed in any location, including any public or private way, any company right-of-way or easement, or any public or privately owned land or way.

4.7 Locate

To indicate the existence of a utility by establishing a mark through the use of flags, pins, stakes, paint, or some other customary manner, that approximately determines the location of a line or facility.

4.8 Locate Request

A communication between an entity performing intrusive activities and a utility marking agency (One-Call, etc.).

4.9 Observer

The person assigned to visually monitor and, as needed, signal the operator during mechanized intrusive activity when the activity is occurring within four feet of the outside edge of the buffer zone. This person remains in close communication with the equipment operator(s) and will stop the activity if needed.

4.10 One-Call Agency

An entity that administers a system through which a person can notify owners/operators of underground lines or utilities of the intent to perform intrusive activities in proposed public areas.

4.11 Positive Response

Communication with the entity performing intrusive activities, prior to the activity, to ensure that all contacted (typically via the One-Call agency) owner/operators have located and marked the underground utilities.

4.12 Potholing

The practice of exposing an underground facility by safe, non-aggressive excavation methods in order to ascertain the precise horizontal and vertical position and orientation of underground lines or utilities.

4.13 Underground Utility

An underground or submerged conductor, pipe, or structure used in providing electric or communications service (including but not limited to, traffic control loops and similar underground or submerged devices), or an underground or submerged pipe used in carrying, providing, or gathering gas, oil or oil product, sewage, storm drainage, water or other liquid service (including, but not limited to, irrigation systems), and appurtenances thereto. As used in this procedure, utility includes all underground appurtenances and structures.

The following are examples of the types of underground utilities that may be present in a given location:

- Natural gas pipelines
- High voltage electric cables
- Water pipelines
- Fiber optic telecommunications lines
- Steam pipelines
- Gasoline, oil, or other fuels
- Sewer pipelines
- Hazardous Materials
- Underground Storage Tanks (USTs)
- Abandoned underground structures containing hazardous materials, hazardous wastes, and radioactive materials

Note: Electrical and pressurized mechanical underground utilities that are not energized shall be considered as applicable to the requirements of this procedure until they are disconnected and removed or protected by a lockout/tagout system approved by Tetra Tech (see Section 5.2.2.6)

4.14 Underground Utility Owner

Any person, utility, municipality, authority, political subdivision or other person or entity who owns, operates, or controls the operation of an underground line/facility.

4.15 White Lining

The practice whereby the entity which intends to perform intrusive activities pre-marks the site with an outline of the area where intrusive activities will occur. This involves the use of white paint, flags, stakes, or a combination thereof to mark the extent of where work is to be performed. The marking may vary depending on what intrusive activities are to be conducted. For example, for general excavation, an area outline of the excavation shall be marked, while for drilling, the individual boreholes shall be marked. Studies have shown that pre-marking is a practice that does prevent utility contact incidents.

5.0 DISCUSSION

5.1 Responsibilities

5.1.1 Competent Person

The Competent Person shall be responsible for:

- Obtaining a copy of, and understanding the applicable regulations for the state of jurisdiction where the excavation activities are to be performed.
- Contacting the appropriate One-Call agency or private locating service, as applicable.
- Recording One-Call locate numbers.
- If necessary, renewing One-Call locate numbers before expiration.
- Ensuring that white-lining of the area to be excavated is performed.

- Ensuring that a "positive response" has been received from every utility owner/operator identified by the One-Call agency and that they have located their underground utilities and have appropriately marked any potential conflicts with the areas of planned intrusive activities.
- Completion of the Ground Disturbance Permit (Excavation/Utility Locates) or equivalent.
- Reviewing applicable AHAs or other client specific requirements with all project members before work begins.
- Conducting training on communication protocols to be used by the excavation observer and equipment operator.
- Ensuring Implementation of appropriate work practices during intrusive activities (including maintaining the prescribed buffer zone for use of aggressive methods).
- Conducting daily inspections of the excavation area to make sure that all markings are intact.
- Maintaining required records.
- Providing the Project Manager or Site Supervisor with all required documentation on a daily basis.

5.1.2 Observer

Whenever intrusive operations with mechanized equipment are being conducted within four feet of the outside edge of the buffer zone, horizontally and vertically, an observer must be assigned to monitor the activities. The observer is responsible for:

- Observing the operation to ensure that the operator stops operations if utilities are observed.
- Reviewing hand signals and other forms of communication with the operator.
- Properly signaling the operator.

- Stopping the operation immediately if the observer's attention must be diverted even momentarily.
- Stopping the operation immediately if a hand signal or other directive is not followed. Operations will not resume until the observer and operator mutually agree that the reason(s) for not complying with the directive(s) are/is identified and fully corrected.
- Maintaining required records, such as logbook entries, or other, as requested by line management.

5.1.3 Line Management

The Project Manager (PM) shall be responsible for:

- Ensuring compliance with this procedure.
- Providing the necessary resources for compliance with this procedure.
- Designating Competent Personnel in consultation with the Site Safety Coordinator prior to the start of work.

5.1.4 Site Safety Coordinator

The Site Safety Coordinator (SSC) shall be responsible for:

- Providing oversight on the implementation of the requirements contained in this procedure.
- Consulting with the PM and Competent Person on underground utility issues.

5.2 Procedure

The following sections provide the requirements and recommendations of this procedure, which are intended to prevent injury to personnel, damage to infrastructure, and associated indirect effects associated with encountering or contacting underground utilities during the execution of intrusive work. Underground utilities present multiple potential hazards that must be recognized before and during work which occurs near them, therefore, this procedure is divided into sections addressing underground utility identification and location, working around or near underground utilities, and actions to be taken in the event that underground utilities are encountered or

contacted. Hazards that may be presented by underground utilities include explosion and fire, electrocution, toxic exposures, pathogens, and drowning.

5.2.1 Identifying and Locating Underground Utilities

The possibility of the existence of underground utilities must be evaluated as early as possible in the planning phase for any project which involves intrusive activities. The Project Safety Checklist or equivalent should be used for documentation of the identification of this potential hazard and the procedures to be followed to address them. The following sections describe various methods for identifying and locating utilities on a site. Plans should be verified during the readiness review. The Ground Disturbance Permit (Excavations/Utility Locate) or equivalent must be completed before any activities meeting the definition of excavation are conducted. This document is intended to be used as a guide during the process of locating and marking utilities in the area and in the overall process of underground utilities management during the course of the project.

All underground utilities on a site involving excavation, must be located and identified before intrusive activities commence, by one or more of the following entities:

- The Utility Owner
- A Private or Public Utility Locating Service
- An Approved Tetra Tech Competent Person

These options are described in greater detail in the following Sub-Sections:

5.2.1.1 Pre-Planning and the Site Specific Health and Safety Plan

The Site-Specific Health and Safety Plan developed for the project must:

- Identify the location and types of underground utilities that are believed to be present on the site.
- Reference this procedure and describe how it will be implemented on the project.
- Contain an Activity Hazard Analysis in which the hazards associated with underground utilities are identified, as well as the measures used to control them.

- Contain, as an appendix, a copy of the applicable regulations from the state of jurisdiction where excavation activities are to be performed. These can usually be obtained via the Internet.
- Contain clear and concise procedures to be followed in the event that contact with underground utilities occurs.
- Address underground utilities and potential associated scenarios in the emergency response section.

5.2.1.2 "One-Call" Locating and Marking Services

Every state has utility marking service programs having various names such as "One-Call", "Dig-Safe", "Call-Before-You-Dig", "Dig-Safely", and many others. These services will identify the types and locations of any utility that may exist in an area to be excavated, as long as the property is in the public domain.

The appropriate One-Call service for the jurisdiction where the project is located must be contacted prior to beginning excavation work. The One-Call agency should be given as detailed a description of the property as possible; address, cross street, utility pole numbers, physical description, etc.

Notification to the One-Call service shall allow sufficient lead time for the agency to mark the utilities before excavation begins. The lead times vary, but range from two to ten days, depending on the state of jurisdiction.

A complete listing of One-Call agencies and telephone numbers for all states is available in the "Call-Before-You-Dig Call Center Directory", which can be accessed online.

Once notified, the One-Call agency will provide the contractor with a unique "locate number" or "reference number". This reference number must be kept in the project files by the Competent Person or designee. Additionally, the reference numbers have expiration dates, which may vary depending on the particular One-Call agency. The valid period of the locate number and required renew notification date shall be requested from the One-Call agency.

On a project with multiple contractors, each contractor must request a separate locate number. Under no circumstances will any other contractor or entity be allowed to work under our locate number. Subcontractors to Tetra Tech may excavate under the locate number secured by Tetra

Tech, provided that they are excavating within the area which was previously white-lined by Tetra Tech and subsequently marked. However, the One-Call agency must be contacted and notified of this arrangement so that the subcontractor can be recorded as working under the existing locate number. If a Tetra Tech subcontractor will be excavating in an area not white-lined by Tetra Tech, then the Tetra Tech subcontractor must request a new locate.

The area where work is to be performed shall be white-lined by Tetra Tech personnel before the locating service goes to the site.

It is good practice to arrange a pre-excavation meeting at the project site with the personnel performing the utility location and marking. This meeting will facilitate communications, coordinate the marking with actual excavation, and assure identification of high-priority utilities.

The One-Call agency should provide the identities of the utility owners that will be notified of the locate request. This information shall be recorded on the Ground Disturbance Permit maintained in the project files. The contact person and phone number for each utility owner shall also be recorded.

The utility owners should provide a “positive response” relative to the locate request, which can consist of two types of action by the utility owner. The facility owner or operator is required to 1) mark it’s underground utilities with stakes, paint, or flags, or 2) notify the excavator that the utility owner/operator has no underground utilities in the area of the excavation.

The positive responses shall be recorded on the Ground Disturbance Permit and cross-checked with the list of utility owners that the One-Call agency stated that they would notify. If it is discovered that a utility owner has not provided a positive response, then the One-Call agency must be notified.

Excavation shall not be conducted until positive responses have been received from all utility owners identified by the One-Call agency as having underground utilities on the property.

Before beginning excavation, the excavator must verify that the location marked was correct, and the distinct, color-coded markings of all utility owners are present.

Examine the site to check for any visible signs of underground utilities that have not been located and marked such as pedestals, risers, meters, warning signs, manholes, pull boxes, valve boxes,

patched asphalt or concrete pavement, areas of subsidence, fresh sod or grass, lack of grass or vegetation, and new trench lines.

The markings placed by the utility owners must be documented by Tetra Tech using a still, digital, or video camera. The photo-documentation shall be maintained with the project files indefinitely.

The markings placed by the utility owners or marking services shall follow the American Public Works Association Uniform Color Code as described in ANSI Standard Z 535.1. This code appears below.

American Public Works Association Uniform Color Code

Red - Electric Power Lines, Cables, Conduit

Orange - Communications, Telephone, Cable TV

Yellow - Gas, Oil, Steam, Petroleum or Gaseous Materials

Green - Sewers and Drains

Blue - Potable Water Systems

Purple - Reclaimed Water, Irrigation, Slurry Lines

Pink - Temporary Survey Markings

White - Proposed Excavation

5.2.1.3 Private Utility Locating and Marking Services

As discussed, One-Call agencies arrange for the identification and marking of underground utilities only on public property, up to the point of contact with private property. In the event that excavation activities are to be conducted on non-public properties, the presence, location, depth, and orientation of all underground utilities within the white-lined area shall be ascertained through records review, including any site plot plans, utility layout plans, and as-built drawings available from the property owner, as well as through interviews with knowledgeable personnel associated with the property. Additionally, the information gathered from these sources shall be verified by physical detection methods (non-aggressive), performance of a geophysical survey, or by procuring

the services of a private utility locating and marking service. If any detection methods are to be self-performed, the requirements of 5.2.1.4 must be followed.

The above requirements are also intended to address the potential presence of unknown or undocumented underground utilities, therefore, the area to be excavated must also be evaluated by the PM to determine if the potential for unknown or undocumented underground utilities exist. If the determination is made that the presence of these unknown or undocumented underground utilities is unlikely, then a variance should be requested to eliminate the requirement to identify them.

Variance to this requirement above must be approved by the PM and SSC.

5.2.1.4 Self-Performance of Utility Locating and Marking

The techniques and instruments used to locate and characterize underground utilities can be extremely complicated and difficult to use effectively. Additionally, interpretation of the data generated by this instrumentation can be difficult. The utility marking services described in 5.2.1.1 and 5.2.1.2 are staffed by well-trained, experienced professionals who perform locating activities on a regular basis. For these reasons, it is most desirable that these professional services are used for utility location and marking on projects.

In some instances, such as long-term projects where excavation is a primary task, and the presence of underground utilities is extensive, it may be prudent to self-perform locating and marking activities.

If locating and marking is to be self-performed, all personnel using instrumentation will be trained on the use of the equipment that will be used, and the interpretation of the data.

There are a variety of locating methods which may be utilized for self-performance of utility locating as categorized below:

- Magnetic field-based locators or path tracers
- Buried electronic marker systems (EMS)
- Ground penetration radar-based buried –structure detectors
- Acoustics-based plastic pipe locators

- Active probes or beacons for non-metallic pipes
- Magnetic polyethylene pipe

Before self-performing any underground utility locating on a project, approval must be obtained from the Operating Unit Health and Safety Manager.

5.2.2 Working Near or Around Underground Utilities

After the site has been properly evaluated for the presence of underground utilities, intrusive activities may begin. Since there is no perfect way of eliminating the hazards presented by underground utilities, an effort must be made to perform the tasks following the direction and guidance as described by the following best practices that should be implemented during the execution of the project.

5.2.2.1 Work Site Review

Before beginning intrusive activities, a meeting shall be held between all members of the project team. This shall consist of a review of the marked utility locations with the equipment operators, observers, laborers, etc.

5.2.2.2 Preservation of Marks

During excavation, efforts must be made to preserve the markings placed by the utility owners until they are no longer required. If any markings are obliterated, the One-Call agency must be contacted for re-marking. No intrusive activities are to take place if markings are not visible.

5.2.2.3 Excavation Observer

Whenever intrusive operations are being conducted within four feet of the edge of the buffer zone, an observer must be assigned to monitor the activities. The observer will be designated each day, and a review of hand signals and other forms of communication between the observer and operator will be conducted. The directives of the observer will be followed precisely and immediately by those operating equipment.

5.2.2.4 Excavation Within The Buffer Zone

Performing intrusive activities within the buffer zone requires careful adherence to proper guidelines and procedures to minimize the risk of contact with underground utilities.

The purpose of the buffer zone is to designate and define an area where careful, prudent, and reasonable excavation practices are to be used to prevent contact with underground utilities. However, there may be occasions where it is necessary to perform aggressive excavation methods in this designated area.

The boundaries of the buffer zone as defined in Section 4.2 will be observed at all times during intrusive activities. Aggressive excavation methods (excavators, backhoes, drill rigs) must be restricted to areas outside of the 4-foot buffer zone unless a special exemption to this requirement is obtained.

Consider whether the objective of the project can be completed without performing intrusive activities in the buffer zone at all. This will greatly reduce the risks presented by performing work in close proximity to underground utilities. If after consideration, the determination is made that intrusive activities in the buffer zone are necessary, then a formal exemption request shall be made to the PESM according to the guidelines below.

A request to utilize aggressive excavation methods in the buffer zone may be made if:

There is no other appropriate and reasonable alternative to using aggressive methods in the buffer zone; and

- The utility has been de-energized (and purged if necessary), verified as de-energized, and locked-out (per Section 5.2.2.6); or
- the depth and orientation of the utility has been adequately and visually determined through the use of non-aggressive methods such as air/hydro/vacuum excavation, potholing, probing, hand-digging, or a combination thereof; and
- for utilities containing electrical energy, the depth of the existing water table is below the location of the utility; and
- application for the exemption has been submitted to the SSC; and
- the exemption has been granted and approved in writing by the SSC.

The following conditions will apply to this request:

- Aggressive methods may be used in the buffer zone only to the extent allowed by the applicable state or other jurisdictional regulations.
- Appropriate physical protection measures for exposed utilities as described in Section 5.2.2.5 shall be implemented to eliminate the potential for equipment contact with utilities.
- The extent of the project excavation area to be covered by the exemption request must be specified.
- When evaluating the use of aggressive excavation methods in the buffer zone, the SSC will consider the type of utility involved and the associated risk potential.

Based on this evaluation, the SSC may impose further conditions and requirements, which will be detailed in the HASP.

Even if the above exemption conditions are met, the SSC has authority to deny the request, the reasons for which will be provided.

Unless exempted according to the above provisions of this procedure, only non-aggressive methods may be used within the buffer zone. Non-aggressive, or non-mechanized equipment is used in order to prevent mechanical contact with underground utilities which could result in damage to the utility and create the potential for personal injury and property damage. Following are examples of non-aggressive excavation methods:

- Hand-digging
- Non-conductive hand tools must be used when digging within the buffer zone surrounding underground electrical utilities.
- If conductive hand tools must be used near electrical lines, then the SSC shall be consulted to determine additional requirements relative to safe electrical practices, procedures, and equipment.
- Hydro-excavation (water pressure).
- Air excavation (air pressure).

- Vacuum extraction (soil excavation/removal).
- Air excavation/vacuum extraction combination.
- Aggressive methods may be used for the removal of pavement over a utility, if allowed by the state regulations.

5.2.2.5 Protection of Underground Utilities

It is very important that consideration be given to the protection of underground utilities when performing adjacent intrusive activities. This is necessary not only to prevent physical damage and associated indirect effects, but also to prevent the potential for injury to employees and the public.

When using aggressive excavation methods within the buffer zone around exposed underground utilities, physical protection may be appropriate. Basically, this involves creation of a physical barrier between the mechanized operation and the utility. The following are some possible types of physical protective measures:

- Heavy timbers, similar to swamp mats.
- Sheets of plywood.
- Blasting mats.
- Once exposed, underground utilities no longer have the support provided by surrounding soil and may need to be physically supported to prevent shifting, bending, separation, or collapse, which could result in damage to the utility, and possibly personnel. Following are suggested support methods:
- Timber shoring underneath the utility.
- Timbers or girders over the top of the excavation fitted with hangers that support the utility.
- Design by a PE for complicated or large applications.
- Utilities must also be protected from objects that may fall into the excavation such as rocks and equipment. This can be accomplished by following these guidelines:

- Cast spoils as far away from the excavation as possible. Excavated and loose materials shall be kept two feet from the edge of excavations, as required by OSHA.
- Relocate large rocks, cobbles, and boulders away from the excavation and sloped spoils piles.
- When vehicles and machinery are operating adjacent to excavations, warning systems such as soil berms, stop logs or barricades shall be utilized to prevent vehicles from entering the excavation or trench.
- Scaling or barricades shall be used to prevent rock and soils from falling into the excavation.
- Barriers shall be provided to prevent personnel from inadvertently falling into an excavation.

5.2.2.6 De-Energizing Utilities

Utilities can carry many types of potential energy, including electricity, flowing liquids, liquids under pressure, gasses under pressure, etc. A release, such as may happen if a utility conveyance is compromised, could result in personal injury, property damage, and other indirect effects. If the white lines of the proposed excavation area overlaps or extends into the buffer zone of a known underground utility, then if at all possible, that utility shall be de-energized to physically prevent the transmission, flow, or release of energy. Conversely, if the buffer zone of the known utility lies outside of the white-lined, proposed excavation area, then de-energization is not required.

The owner of the utility shall be contacted to determine the feasibility and methodology of de-energizing the utility. Plenty of lead-time should be provided for this since it may take utility companies weeks to de-energize some utilities.

Depending on the utility and the material being conveyed, isolation points which may be suitable for de-energizing include but are not limited to the following:

- Electrical circuit breakers
- Slide gate

- Disconnect switches
- Piping flanges
- Other similar devices

When utilities are de-energized, it must be verified by demonstration. This can be accomplished by testing equipment, switching on a machine or lighting, opening a valve, etc. For any current-carrying electrical equipment, such as cables, electrical panels, etc., successful de-energization must be certified through the use of appropriate electrical testing equipment.

Whenever a utility is de-energized, a means of ensuring that the energy isolation device and equipment cannot be operated until the device is removed must be provided. Typically, this is achieved by utilizing a lockout device, accompanied by a written tag that physically controls the configuration of the energy isolation point. Lockout devices include but are not limited to the following:

- Locks
- Chains
- Valve covers
- Circuit breaker hasps
- Blind flanges
- Slip blinds, and
- Multiple lock hasps

When de-energizing and locking out of utilities is practiced, the provisions of DCN 2-16 Control of Hazardous Energy Lockout/Tagout, shall be followed, as applicable.

In the event that a utility is de-energized, but there is no means of adequately providing a physical locking-out of the utility, then a spotter must be posted at the point of isolation to ensure that the utility is not re-energized. The spotter must be supplied with a communication device such as a site radio.

5.2.2.7 Damage Discovery

During excavation, utility damage may be discovered which is pre-existing or otherwise not related to a known contact. Disclosure to the utility owner is very important because the possibility of utility failure or endangerment of the surrounding population increases when damage has occurred. The utility may not immediately fail as a result of damage, but the utility owner or operator must be afforded the opportunity to inspect the utility and make a damage assessment and effect repairs if necessary. The following guidance applies:

- Observe and photograph the utility from a safe distance and determine in there is damage. Damage would be all breaks, leaks, nicks, dents, gouges, grooves, or other damages to utility lines, conduits, coatings, or cathodic protection systems.
- The One-Call agency or private location service must be contacted immediately.

5.2.3 Encountering or Contacting Underground Utilities

In the event that encountering or contacting an underground utility occurs, it is imperative that the appropriate actions are taken to minimize damage to the utility, prevent personal injury, and minimize indirect effects.

5.2.3.1 Encountering Underground Utilities

It is possible that underground utilities will be encountered in locations that have previously been "cleared" of having underground utilities by the locating service, or are found outside of the area which has been marked as having underground utilities. In either case, if this occurs, the following applies:

- Intrusive activities must be curtailed
- The One-Call agency or private location service must be contacted immediately
- The PM and PESM must be notified
- No further intrusive activities may be conducted until:
- The One-Call agency/private location service and/or the subject utility owner visit the site;

- Identification of the utility owner and the type of material/energy being conveyed by the utility has been made; and
- The orientation and depth of the subject utility has been determined and suitably marked.
- A Tetra Tech Incident Report and Investigation form must be completed per DCN 2-2 Incident Reporting and Investigation Program. The report should be accompanied by photographs clearly showing the marking(s), and the actual location, with a distance gauge to document how far off the mark the utility was encountered.

5.2.3.2 Contacting Underground Utilities

If excavation or other equipment being used for intrusive activities makes contact with an underground utility, the following guidelines apply:

- Intrusive activities must be stopped immediately.
- Observe the utility from a safe distance and determine if there is damage. Damage would be all breaks, leaks, nicks, dents, gouges, grooves, scratched coatings, cathodic protection compromise, material leakage, obvious electrical energy.
- Move all personnel to the evacuation meeting point as described in the SSHP.

EXCEPTION: If an electrical line has been contacted and it is your belief that equipment (such as an excavator) is electrically energized, do not approach the equipment. Order the operator to remain in the equipment until emergency personnel can de-energize the source (unless the equipment is on fire, at which time the operator should jump off of the vehicle and shuffle along the ground to a safe area). Shuffling is required because current flows outward through the soil in a ripple pattern called a power gradient, creating a pattern of high and low potential, Shuffling decreases the chance that these gradients could be bridged, causing current to flow through the body, resulting in electrocution.

- Secure the area to prevent the public from entering.
- Contact emergency responders as specified in the SSHP.
- The One-Call agency or if known, the utility owner must be contacted immediately.

- The PM and SSC must be notified.
- No further intrusive activities may be conducted until:
- The utility owner inspects the scene and after repairs, verifies that all danger has passed.
- The orientation and depth of the subject utility has been determined and suitably marked.
- Permission from the emergency responders to resume work has been given.

A Tetra Tech Incident Report and Investigation form must be completed per DCN 2-2. The report should be accompanied by photographs clearly showing the marking(s), and the actual location, with a distance gauge to document how far off the mark the utility was encountered.

State and Local regulations must be reviewed to determine if reporting to any additional agencies is required.

5.3 Training

Competent Persons shall have adequate experience and/or training to carry out the requirements of this procedure.

6.0 SOURCES OF INFORMATION

6.1 Organizations

- Common Ground Alliance
- Center for Subsurface Strategic Action (CSSA)
- DigSafely
- National Utility Contractors Association (NUCA)
- National Utility Locating Contractors Association (NULCA)
- Underground Focus Magazine

- NUCA State Listing of One-Call centers
- Utility Safety Magazine

6.2 Vendors and Commercial Sites

- RadioDetection, Inc. (Detection Instruments)
- Heath Consultants (Detection Instruments)
- Ben Meadows Company (Detection Instruments)
- So-Deep, Inc. (Complete Utilities Services)
- Concept Engineering Group, Inc. (Air Excavation Equipment)
- Rycom Instruments, Inc. (Detection Instruments)
- Schonstedt Instrument Company (Detection Instruments)
- Forestry Suppliers, Inc. (Fiberglass Probe – "Fiberglass Tile Probe", Part #77543, Approx. $20.00, Telephone 800-647-5368)

7.0 REFERENCES

Common Ground Study of One-Call Systems and Damage Prevention Best Practices, August, 1999, Sponsored by US DOT.

Revision Date	Document Authorizer Name	Revision Details
10/01/2011	Chris McClain	Update

	TETRA TECH, INC. GROUND DISTURBANCE PERMIT (EXCAVATIONS/UTILITY LOCATE)	Document Control Number: FORM 5-35 Ground Disturbance Page 1 of 6

Valid for 1 day / shift maximum

Date / Time Permit Initiated:_____ Date / Time Permit Expires:_____

Location Name and Address:

Issuing Competent Person: _____ Phone Number: _____

Tt Project Manager: _____ Phone Number: _____

Emergency Phone Number: _____Alternative Phone Number: _____

Person Requesting Line Locate:_____ Phone Number: _____

Locate Performed By: _____ Phone Number: _____

Description of Project Work to be Performed:
(May be cut from another document and posted below, or permanently attached [with a staple] on a separate page.)

Indicate status of items 1-18. Item answered "No", must be addressed as an attachment or a Job Hazard Assessment before work can proceed.

1. Within the last 10 days, and no less than 48 hours from the initiation of this task, contacts were notified that a One Call was made to confirm the existence and location of underground facilities near the work area.	Yes	No	N/A
2. Available records have been referenced, and a plot plan indicating the location of all underground facilities (including those installed horizontally) has been provided and is available for reference at the work site.	Yes	No	N/A
3. All approvals, notifications and agreements have been obtained and are attached to this document.	Yes	No	N/A
4. A Competent Person (CP) has conducted a pre-job safety meeting, including a job hazard analysis.	Yes	No	N/A
5. Everyone involved in the work has reviewed the health and safety plan and the emergency response plan, and the plans are available on site for anyone to review at any time.	Yes	No	N/A
6. The proposed ground disturbance area(s) have been identified, and CPs have correctly marked all underground facilities in the dig zone and the search zone.	Yes	No	N/A
7. Competencies of the line locator, and a calibration of the relevant equipment, have been verified. Proof of competencies and calibration records is attached to the permit.	Yes	No	N/A
8. Approved techniques for exposing underground facilities within 2' (0.61m) of ground disturbance have been (or will be) used to verify the location of all known underground facilities.	Yes	No	N/A
9. Other work permits (confined space, hot work, lifting operations, overhead utilities, working at heights), as applicable, are attached.	Yes	No	N/A
10. Precautions have been taken to prevent contact with overhead (**refer to Overhead Utilities Program**) or below-ground power lines (**Ground Disturbance Program**).	Yes	No	N/A
11. Possible environmental and archeological issues have been conducted and addressed.	Yes	No	N/A
12. Appropriate internal communications (e.g., business unit, PM, environmental business manager), if applicable, have taken place.	Yes	No	N/A
13. New nonmetallic underground facilities are being installed with line-locating capability.	Yes	No	N/A
14. All personnel involved with the excavation have reviewed and discussed the Ground Disturbance Program. The valid certifications of the qualified equipment operator have been reviewed and are attached to this permit.	Yes	No	N/A
15. The excavation design and construction checklist for trenching has been completed for the initial ground disturbance.	Yes	No	N/A
16. A trench safety daily field report shall be completed each day prior to the start of work. (**Refer to the Ground Disturbance Program**.)	Yes	No	N/A
17. All personnel involved in drilling have reviewed and discussed the Environmental Drilling Practice. (**Refer to Safe Drilling Practices**.)	Yes	No	N/A
18. Risk has been adequately assessed, and provisions have been or will be made to address unattended open excavations to verify the safety of the general public, livestock and wildlife until the site is remediated.	Yes	No	N/A

Once this form has been fully completed, the PM or SSHO must authorize it.

Other Potential Underground Structures
Extra consideration should be given to horizontally installed facilities.

Applicable? ____Yes ____ No

Name of City Engineer Or Utility Representative: _____ Signature: _____ Telephone Number: _____

Date Notified: _____ / _____ / _____ Cleared: ____ Yes ____ No Maps: ____Yes ____ No

Completed Site Walk-Through
With Site manager or designated alternate or owner or tenant representative.

Applicable? ____ Yes ____ No

Site Manager Name: _____ Signature: _____

Property Owner or Tenant Representative Name: _____ Property Owner or Tenant Representative Signature: _____

Building utility service line connections identified: ____ Yes ____ No Cleared: ____ Yes ____ No

**Hand-sketch the proposed boring locations and most likely utility trench location(s) on the site map. (Refer to the last page.)*

Above Ground Services

Utility	Name	Height (in feet)	Telephone Number	Notified		Date	Marked	
Cable				Yes	No		Yes	No
Electric				Yes	No		Yes	No
Overhead Supports				Yes	No		Yes	No
Telephone				Yes	No		Yes	No
Traffic Light Cables				Yes	No		Yes	No

Below-Ground Services

Utility	Name	Depth (in feet)	Telephone Number	Notified		Date	Marked	
Cable				**Yes**	**No**		**Yes**	**No**
Electric				Yes	No		Yes	No
Gas				Yes	No		Yes	No
Others				Yes	No		Yes	No
Pipeline Companies				Yes	No		Yes	No
Possible horizontally installed facilities				Yes	No		Yes	No
Sanitary / Sewer				Yes	No		Yes	No
Steam				Yes	No		Yes	No
Storm water				Yes	No		Yes	No
Telephone				Yes	No		Yes	No
Underground Storage Tank System				Yes	No		Yes	No
Water				Yes	No		Yes	No

This permit shall be regarded as "void" and must be reissued if:

a. The permit expires (expiration time noted at top of form).
b. There is a change or a need for a change to the scope of work
c. Conditions change (weather, unexpected ground or soil conditions, etc.)

_____ _____

Competent Person (Printed Name) Project Manager (PM) (Printed Name)

_____ _____

Competent Person (for Ground Disturbance) Signature of Performing Authority Person

_____ _____

Closing Signature of Competent Person
I certify that the job site was left in a safe condition during all breaks and at days end.

Closing Signature of Project Manager

Note: A drawing or plot plan depicting the location of marked and unknown underground utilities must either be drawn on accompanying page or attached for all to review before, during and after the excavation. Mechanical ground disturbance may not proceed until facilities have been identified and plotted on a current drawing and communicated to all personnel involved in the ground disturbance task. Do not forget to consider horizontally installed facilities that may be poorly identified.

Utilities Key

Bridge:	Fence Line: //////////	Power Line: =O=	Water:
Cable Line: –C–	Flow Line: ~FL~	Power Pole: ○	Water Line: ...W...
Dig Zone:	North Direction: ↑	Railroad Crossing: X	Well-Head: ⊙

Color Key

Communication – Orange	Electrical – Red	Potable Water – Blue
Non-Potable Water – Purple	Oil and Gas – Yellow	Temporary Survey Markings - Pink
Search Zone Perimeter – White	Sewers and Drainage – Green	

This safe work practice (SWP) provides guidelines for operating vacuum trucks at active facilities where hazardous materials and/or petroleum products are present.

1.0 RESPONSIBILITIES

The project manager (PM) is responsible for ensuring that the work area is evaluated for the presence of hazards and ignition sources and that all precautions provided in this SWP are implemented. The PM is also responsible for ensuring that appropriate air monitoring procedures are defined in the site-specific health and safety plan (HASP), job safety analysis (JSA), work permit, or other site-specific health and safety documentation. The Project Manager and the Site Safety Officer are responsible for recognizing potential hazards and ignition sources, conducting air monitoring, posting warning signs, and notifying on-site workers of the hazards.

Only trained personnel will be allowed to operate vacuum trucks and associated equipment, and must obey all vehicle related restrictions at the facility (e.g., speed, off-limits areas). Prior to procurement of a vacuum truck subcontractor, the safety record (including driving records) and insurance will be verified. All vacuum truck subcontractors must provide records such as EMR, OSHA records, and information regarding any moving violations related to the equipment or personnel used.

Before starting any vacuum truck operations, all field personnel will receive a safety briefing, a daily tailgate briefing, and facility specific training, as required. These briefings will be conducted to ensure that workers understand the following:

- The physical hazards of the work area (e.g., equipment, trip and fall hazards)
- The hazards associated with the liquids or substances to be vacuumed or transferred
- Emergency procedures at the job location and the facility, including:
    - Alarm signals and communication
    - Evacuation routes and rally points
    - Rescue procedures and emergency response
    - Notification procedures

- Ensure that all equipment—including tank and vacuum trucks, and pumping equipment—is in safe working condition. Ensure that the tank interior, filter baghouse, and cyclone separators are clean and free of any substances that may react with the liquids to be vacuumed or transferred.

Prior to beginning any operations, the vacuum truck and all related equipment (e.g., hoses, tools etc.) must be inspected each day, and the inspection must be noted either on a standard form or in a project field logbook.

Proper precautions must be taken to protect against hazards, including air monitoring, grounding and bonding to protect against ignition sources, and proper chemical handling and transfer. These precautions are discussed below.

2.0 AIR MONITORING

Air monitoring procedures must be conducted during vacuum truck activities. Air monitoring is detailed in a site specific health and safety plan (HASP), work permit, or other site-specific health and safety documentation. Air monitoring typically consists of the following:

- Monitoring for flammable or explosive atmospheres at the extraction point and in the work area using a combustible gas indicator (CGI)

- Monitoring of the work area for harmful organic vapors using a photoionization detector (PID) or flame ionization detector (FID)

- Monitoring of the venting from the hose and the vacuum pump exhaust using a CGI and PID/FID.

Air monitoring of the work area is conducted prior to work activities, at a minimum of 15 minute intervals throughout the day, and during a change in working conditions (i.e., moving to a new extraction point). Monitoring of the vacuum pump exhaust should be conducted at the start of pumping and at regular intervals, not to exceed 15 minutes while the pump is operating. Should monitoring indicate flammable or ignitable conditions at the exhaust point, operations will cease, and alternate methods (i.e., submersible pumps) employed.

3.0 GROUNDING AND BONDING

One type of an ignition source results from the excessive build-up of static electricity. Static electricity may be created by fluid movement through hoses, pipes, or any container, either when loading or unloading. There are several potential locations for static electricity build-up on a vehicle which is typically a truck. For example, static electricity may build up on any of the metal protrusions or parts inside the tank which come into contact with moving fluid. In addition, static electricity may also build up on the hose connected to the truck.

To prevent excessive static electricity build-up within the tank, a grounding cable can be run from the truck chassis to the tank, vessel or extraction well being emptied or filled to ground the truck chassis. To prevent the hose from being the second potential ignition location, an internal wire on the hose or a separate wire, run externally and connected to the hose at coupled connection points, provides a ground flow path.

Trucks shall be grounded when they are being loaded or unloaded. The grounding shall be done by the Truck operator. Connectors for bonding and grounding such as copper wire and clamps must provide a good conductive path. To insure this, dirt, rust, paint, and corrosion must be removed. Connections must be metal to metal. Typical cables are woven or braided copper strands. Special purpose clamps (typically with pointed contacts and heavy duty springs) shall be used for temporary bonding and grounding.

When a temporary grounding rod is used, it must be made of copper and must be driven at least 2 feet into the ground. Rebar is not acceptable. Grounding clamps must also be made of copper.

No aluminum fittings or hoses are allowed to be used in hydrocarbon service due to aluminum's high arcing potential.

All components (funnels, collection pans, etc.) used in the collection of hydrocarbon-material during vacuum truck operations must be made of metal and be properly grounded. Collection funnels used to guide flowing liquids into a pan should extend to the bottom of the pan to help prevent an electrostatic discharge.

4.0 PROPER CHEMICAL HANDLING AND TRANSFER

To prevent exposure to toxic gases or liquids during transfer operations—

- Never transfer fluids from one truck to another unless it has been established that no chemical reaction will occur.
- Position trucks to minimize exposure to any discharged gases and fumes.
- Ensure that discharge lines are long enough and large enough for safe operation.
- Position vent lines away from workers and workstations, including control panels, valve handles, gauges, shut-offs, and hose attachment points. If possible, use a vertical exhaust stack to divert exhaust gases away from workers and ignition sources.
- To avoid exposure to high air temperatures or vapor concentrations, the truck and equipment should be positioned so that personnel are not working near the pump exhaust.
- Check air monitoring equipment during operations to confirm that venting is proceeding safely.
- Monitor the following:
    - tank level indicators to avoid overfilling
    - tank pressure gauges to avoid over-pressurizing receiving tanks or creating excessive vacuum in supply tanks
    - tank temperature gauges to help identify possible chemical reactions
- Minimize the air introduced into the system when pressure loading or unloading. Submerge the suction line in liquid, or reduce the vacuum pump speed when skimming or nearing the end of a load.
- Maintain a log of transported fluids and any potential residue.
- Use gravity loading and unloading whenever possible.

- Use a vapor recovery system—when available—to avoid venting tanks directly to the atmosphere.

Revision Date	Document Authorizer		Revision Details
	Name	Approval Date	
9/03/2013	Chris McClain	9/03/2013	Review, format changes
5/19/10	Bob Cantagallo	5/19/10	None
	Grey Coppi	5/19/10	

KOPPERS CO INC -- COAL TAR CREOSOTE-PRESS/NON-PRESS/GEN.APPLI -- 6840-00-257-2482

========== Product Identification ==========

Product ID:COAL TAR CREOSOTE-PRESS/NON-PRESS/GEN.APPLI
MSDS Date:08/01/1989
FSC:6840
NIIN:00-257-2482
MSDS Number: BJPKL
=== Responsible Party ===
Company Name:KOPPERS CO INC
Address:3000 KOPPERS BLDG
City:PITTSBURGH
State:PA
ZIP:15219-1818
Country:US
Info Phone Num:412-227-2884
Emergency Phone Num:800-553-5631
CAGE:80592
=== Contractor Identification ===
Company Name:KOPPERS CO INC
Address:3000 KOPPERS BLDG
Box:City:PITTSBURGH
State:PA
ZIP:15219-1818
Country:US
CAGE:80592

========== Composition/Information on Ingredients ==========

Ingred Name:CREOSOTE (SARA III)
CAS:8001-58-9
RTECS #:GF8615000
Other REC Limits:NONE SPECIFIED
EPA Rpt Qty:1 LB
DOT Rpt Qty:1 LB

Ingred Name:INDENE
CAS:95-13-6
RTECS #:NK8225000
Fraction by Wt: <10%
Other REC Limits:NONE SPECIFIED
OSHA PEL:10 PPM
ACGIH TLV:10 PPM; 9192

Ingred Name:NAPHTHALENE (SARA III)
CAS:91-20-3
RTECS #:QJ0525000
Fraction by Wt: <15%
Other REC Limits:NONE SPECIFIED
OSHA PEL:10 PPM/15 STEL
ACGIH TLV:10 PPM/15 STEL; 9192
EPA Rpt Qty:100 LBS
DOT Rpt Qty:100 LBS

Ingred Name:DIPHENYL (BIPHENYL) (SARA III)
CAS:92-52-4
RTECS #:DU8050000
Fraction by Wt: <5%
Other REC Limits:NONE SPECIFIED
OSHA PEL:0.2 PPM
ACGIH TLV:0.2 PPM; 9192
EPA Rpt Qty:1 LB

DOT Rpt Qty:1 LB

Ingred Name:BENZENE (SARA III)
CAS:71-43-2
RTECS #:CY1400000
Fraction by Wt: <1%
Other REC Limits:NONE SPECIFIED
OSHA PEL:1PPM/5STEL;1910.1028
ACGIH TLV:10 PPM; A2; 9192
EPA Rpt Qty:10 LBS
DOT Rpt Qty:10 LBS

Ingred Name:ALKYL NAPHTHALENE
Fraction by Wt: <10%
Other REC Limits:NONE SPECIFIED

========== Hazards Identification ==========

LD50 LC50 Mixture:LD50 (ORAL RAT) IS 1,700 MG/KG
Routes of Entry: Inhalation:YES Skin:YES Ingestion:NO
Reports of Carcinogenicity:NTP:YES IARC:YES OSHA:YES
Health Hazards Acute and Chronic:ACUTE-EYE:MAY CAUSE MODERATE
    IRRITATION.SKIN:CAN RESULT IN SEVERE IRRITATION WHICH WHEN
    ACCENTUATED BY SUNLIGHT MAY RESULT IN PHOTOTOXIC SKIN
    REACTION.INHALATION:IRRITATION,CNS EFFECTS,SUCH AS HEADACH
    E,DIZZINESS,COMA AND POSSIBLE
    DEATH.INGESTION:IRRITATION,NAUSEA,VOMITING & ABDOMINAL
    PAIN.CHRONIC-MAY CAUSE CANCER.
Explanation of Carcinogenicity:BENZENE. IARC LISTS CREOSOTE AS A
    POSSIBLE CARCINOGENIC AGENT TO HUMAN.
Effects of Overexposure:WARNING! MAY CAUSE CANCER. MAY BE FATAL IF
    SWALLOWED. HARMFUL TO THE SKIN OR IF INHALED. CAUSES EYE AND SKIN
    IRRITATION.
Medical Cond Aggravated by Exposure:PERSONS WITH PRE-EXISTING DISEASE
    IN OR A HISTORY OF AILMENTS INVOLVING THE SKIN OR BLOOD-FORMING
    ORGANS MAY BE AT A GREATER RISK OF DEVELOPING ADVERSE HEALTH
    EFFECTS WHEN EXPOSED TO THIS MATERIAL.

========== First Aid Measures ==========

First Aid:SEEK MEDICAL AID.EYE:FLUSH WITH WATER FOR 15
    MINUTES.SKIN:WIPE MATERIAL OFF.WASH THOROUGHLY WITH SOAP &
    WATER/WATERLESS HAND CLEANER.INHALATION:REMOVE TO FRESH AIR.GIVE
    CPR/OXYGEN IF NEEDED.INGESTION: GIVE 1-2 GLASSES OF WATER/MILK IF
    CONSCIOUS.INDUCE VOMITING USING IPECAC SYRUP.THEN,GIVE A SLURRY OF
    100 G OF ACTIVATED CHARCOAL IN 8 OZ OF WATER.

========== Fire Fighting Measures ==========

Flash Point Method:CC
Flash Point:>200F,>93C
Extinguishing Media:USE WATER FOG, CARBON DIOXIDE, FOAM, OR DRY
    CHEMICAL. WATER OR FOAM MAY CAUSE FROTHING, IF MOLTEN.
Fire Fighting Procedures:WEAR COMPLETE FIRE SERVICE PROTECTIVE
    EQUIPMENT,INCLUDING FULL-FACE MSHA/NIOSH APPROVED SELF-CONTAINED
    BREATHING APPARATUS.USE WATER TO COOL CONTAINERS BY FIRE.
Unusual Fire/Explosion Hazard:TOXIC VAPORS/DECOMPOSITION PRODUCTS MAY
    BE RELEASED FORMING FLAMMABLE/EXPLOSIVE MIXTURES IN AIR. CLOSED
    CONTAINERS MAY EXPLODE WHEN EXPOSED TO EXTREME HEAT.

========== Accidental Release Measures ==========

Spill Release Procedures:STOP LEAK IF NO RISK INVOLVED.STAY

UPWIND.SOLIDIFIED SPILL:SHOVEL INTO DRY CONTAINERS AND COVER.FLUSH AREA WITH WATER.SMALL WET SPILL:TAKE UP WITH SAND.FLUSH AREA WITH WATER.DIKE LARGE SPILLS FOR LATE R DISPOSAL.CONTAIN RUNOFF FROM FIRE CONTROL.

========== Handling and Storage ==========

Handling and Storage Precautions:STORE IN COOL,DRY AND WELL VENTILATED AREA.KEEP CONTAINER CLOSED WHEN NOT IN USE.
Other Precautions:AVOID PROLONGED/REPEATED BREATHING OF VAPORS,MISTS/FUMES.AVOID PROLONGED/REPEATED CONTACT WITH SKIN/EYES.APPLICATION OF CERTAIN PROTECTIVE CREAMS (SUN SCREENS FOR COAL TAR PRODUCTS) BEFORE WORKING/SEV ERAL TIMES DURING WORK MAY BE BENEFICIAL

========== Exposure Controls/Personal Protection ==========

Respiratory Protection:NONE NORMALLY REQUIRED.IF EXPOSURES ARE NOT BELOW TLV(PEL),USE NIOSH/MSHA APPROVED UNITS AS PER CURRENT 29 CFR 1910.134 AND MANUFACTURERS' "INSTRUCTIONS" AND "WARNINGS".COMBINATION FILTER/ORGANIC VAPO R CARTRIDGES OR CANISTER MAY BE USED.
Ventilation:PROVIDE SUFFICIENT GENERAL/LOCAL EXHAUST VENTILATION IN PATTERN/VOLUME TO CONTROL INHALATION EXPOSURE < EXPOSURE LIMITS.
Protective Gloves:IMPERVIOUS
Eye Protection:SAFETY GLASSES/GOGGLES
Other Protective Equipment:IMPERVIOUS PROTECTIVE GARMENTS SUCH AS HEAD/NECK COVER,APRONS,JACKETS,PANTS,BOOTS,ETC.EYE-WASH FACILITIES,SAFETY SHOWER.
Work Hygienic Practices:AVOID CONTACT WITH EYES AND SKIN;DO NOT BREATHE VAPORS/MIST.WASH THOROUGHLY AFTER EACH USE.
Supplemental Safety and Health
DO NOT USE UNTIL MANUFACTURER'S PRECAUTIONS HAVE BEEN READ & UNDERSTOOD. WASH EXPOSED AREAS PROMPTLY AND THOROUGHLY AFTER SKIN CONTACT FROM WORKING WITH THIS PRODUCT AND BEFORE EATING,DRINKING OR USIN G REST ROOMS.DO NOT WEAR CONTACT LENS WITHOUT PROPER EYE PROTECTION WHEN USING THIS PRODUCT.

========== Physical/Chemical Properties ==========

HCC:T2
Boiling Pt:B.P. Text:>355
Vapor Pres:1 @ 30C
Vapor Density:>1
Spec Gravity:1.050
Evaporation Rate & Reference:SLOW (N-BUTYL ACETATE=1)
Solubility in Water:SLIGHT
Appearance and Odor:BROWN TO BLACK LIQUID WITH CREOSOTE OR TARRY ODOR

========== Stability and Reactivity Data ==========

Stability Indicator/Materials to Avoid:YES
NONE KNOWN
Stability Condition to Avoid:HIGH TEMPERATURES AND OPEN FLAMES
Hazardous Decomposition Products:OXIDES OF CARBON

========== Disposal Considerations ==========

Waste Disposal Methods:CONSULT LOCAL AUTHORITIES;DISPOSAL MUST BE IN ACCORDANCE WITH LOCAL,STATE AND FEDERAL REGULATIONS. THIS PRODUCT RELEASED INTO THE ENVIRONMENT MUST BE REPORTED TO THE NATIONAL RESPONSE CENTER (800-424- 8802).WHEN SPILLED,REPORTABLE QUANTITY IS 1 LB.

VOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-1	MW-101	MW-102	P-103	MW-104	MW-105	MW-107	MW-107 Dup
	PAL	ES	1/30/20	2/3/20	1/28/20	1/28/20	1/28/20	1/28/20	2/3/20	2/3/20
1,1,1,2-Tetrachloroethane	*7*	**70**	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<9.2	<9.2
1,1,1-Trichloroethane	*40*	**200**	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<7.6	<7.6
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<8.0
1,1,2-Trichloroethane	*0.5*	**5**	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<7.0
1,1-Dichloroethane	*85*	**850**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<8.2	<8.2
1,1-Dichloroethene	*0.7*	**7**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<7.8
1,1-Dichloropropene			<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<5.9	<5.9
1,2,3-Trichlorobenzene			<0.46	<0.46	<0.46	<0.46	<0.46	<0.46	<9.2	<9.2
1,2,3-Trichloropropane	*12*	**60**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	*<8.3*	*<8.3*
1,2,4-Trichlorobenzene	*14*	**70**	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34	<6.8	<6.8
1,2,4-Trimethylbenzene	*96*	**480**	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	*260*	*220*
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<40	<40
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.7	<7.7
1,2-Dichlorobenzene	*60*	**600**	<0.33	<0.33	<0.33	<0.33	<0.33	<0.33	<6.7	<6.7
1,2-Dichloroethane	*0.5*	**5**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<7.8
1,2-Dichloropropane	*0.5*	**5**	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<8.6	<8.6
1,3,5-Trimethylbenzene	*96*	**480**	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	47	41
1,3-Dichlorobenzene	*125*	**1250**	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<8.0
1,3-Dichloropropane	*0.02*	**0.2**	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<7.2
1,4-Dichlorobenzene	*15*	**75**	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<7.3	<7.3
2,2-Dichloropropane			<0.44	<0.44	<0.44	<0.44	<0.44	<0.44	<8.9	<8.9
2-Chlorotoluene			<0.31	<0.31	<0.31	<0.31	<0.31	<0.31	<6.3	<6.3
4-Chlorotoluene			<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<7.0
Benzene	*0.5*	**5**	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	**1700**	**1400**
Bromobenzene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<7.1	<7.1
Bromochloromethane			<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<8.6	<8.6
Bromodichloromethane	*0.06*	**0.6**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<7.4
Bromoform	*0.44*	**4.4**	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48	<9.7	<9.7
Bromomethane	*1*	**10**	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80	<16	<16
Carbon tetrachloride	*0.5*	**5**	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38	<7.7	<7.7
Chlorobenzene			<0.39	<0.39	<0.39	0.45	<0.39	<0.39	<7.7	<7.7
Chloroethane	*80*	**400**	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51	<10	<10
Chloroform	*0.6*	**6**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<7.4
Chloromethane	*0.3*	**3**	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32	<6.4	<6.4
cis-1,2-Dichloroethene	*7*	**70**	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<8.2	<8.2
cis-1,3-Dichloropropene			<0.42	<0.42	<0.42	<0.42	<0.42	<0.42	<8.3	<8.3
Dibromochloromethane			<0.49	<0.49	<0.49	<0.49	<0.49	<0.49	<9.8	<9.8
Dibromomethane			<0.27	<0.27	<0.27	<0.27	<0.27	<0.27	<5.4	<5.4
Dichlorodifluoromethane	*200*	**1000**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<13	<13
Ethylbenzene	*140*	**700**	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18	*400*	*360*
Hexachlorobutadiene			<0.45	<0.45	<0.45	<0.45	<0.45	<0.45	<8.9	<8.9
Isopropyl ether			<0.28	<0.28	<0.28	<0.28	<0.28	<0.28	<5.5	<5.5
Isopropylbenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	20	17
Methyl tert-butyl ether	*12*	**60**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.9	<7.9
Methylene Chloride	*0.5*	**5**	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	<33	<33
Naphthalene	*10*	**100**	<0.34	0.95	<0.23	0.34	0.35	0.34	**7200**	**7200**
n-Butylbenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<7.8
N-Propylbenzene			<0.41	<0.41	<0.41	<0.41	<0.41	<0.41	<8.3	<8.3
p-Isopropyltoluene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<7.2
sec-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<8.0
Styrene	*10*	**100**	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39	<7.7	<7.7
tert-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<8.0
Tetrachloroethene	*0.5*	**5**	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<7.4
Toluene	*200*	**1000**	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	43	34
trans-1,2-Dichloroethene	*20*	**100**	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<7.0
trans-1,3-Dichloropropene			<0.36	<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<7.2
Trichloroethene	*0.5*	**5**	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16	<3.3	<3.3
Trichlorofluoromethane			<0.43	<0.43	<0.43	<0.43	<0.43	<0.43	<8.5	<8.5
Vinyl chloride	*0.02*	**0.2**	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<4.1	<4.1
Xylenes, Total	*1000*	**10000**	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22	910	790

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate

VOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-108	MW-111	MW-112	MW-115	MW-116	MW-117	MW-118	MW-122
	PAL	ES	1/29/20	1/28/20	1/30/20	1/29/20	1/29/20	1/29/20	1/29/20	1/30/20
1,1,1,2-Tetrachloroethane	*7*	**70**	<0.46	<0.46	<0.46	<0.46	<0.46	<9.2	<0.46	<0.92
1,1,1-Trichloroethane	*40*	**200**	<0.38	<0.38	<0.38	<0.38	<0.38	<7.6	<0.38	<0.76
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<0.40	<0.80
1,1,2-Trichloroethane	*0.5*	**5**	<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<0.35	<0.70
1,1-Dichloroethane	*85*	**850**	<0.41	<0.41	<0.41	<0.41	<0.41	<8.2	<0.41	<0.82
1,1-Dichloroethene	*0.7*	**7**	<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<0.39	<0.78
1,1-Dichloropropene			<0.30	<0.30	<0.30	<0.30	<0.30	<5.9	<0.30	<0.59
1,2,3-Trichlorobenzene			<0.46	<0.46	<0.46	<0.46	<0.46	<9.2	<0.46	<0.92
1,2,3-Trichloropropane	*12*	**60**	<0.41	<0.41	<0.41	<0.41	<0.41	<8.3	<0.41	<0.83
1,2,4-Trichlorobenzene	*14*	**70**	<0.34	<0.34	<0.34	<0.34	<0.34	<6.8	<0.34	<0.68
1,2,4-Trimethylbenzene	*96*	**480**	<0.36	<0.36	<0.36	<0.36	<0.36	*440*	<0.36	12
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<2.0	<2.0	<2.0	<2.0	<2.0	<40	<2.0	<4.0
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<0.39	<0.39	<0.39	<0.39	<0.39	<7.7	<0.39	<0.77
1,2-Dichlorobenzene	*60*	**600**	<0.33	<0.33	<0.33	<0.33	<0.33	<6.7	<0.33	<0.67
1,2-Dichloroethane	*0.5*	**5**	<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<0.39	<0.78
1,2-Dichloropropane	*0.5*	**5**	<0.43	<0.43	<0.43	<0.43	<0.43	<8.6	<0.43	<0.86
1,3,5-Trimethylbenzene	*96*	**480**	<0.25	<0.25	<0.25	<0.25	<0.25	*180*	<0.25	6.6
1,3-Dichlorobenzene	*125*	**1250**	<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<0.40	<0.80
1,3-Dichloropropane	*0.02*	**0.2**	<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<0.36	<0.72
1,4-Dichlorobenzene	*15*	**75**	<0.36	<0.36	<0.36	<0.36	<0.36	<7.3	<0.36	<0.73
2,2-Dichloropropane			<0.44	<0.44	<0.44	<0.44	<0.44	<8.9	<0.44	<0.89
2-Chlorotoluene			<0.31	<0.31	<0.31	<0.31	<0.31	<6.3	<0.31	<0.63
4-Chlorotoluene			<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<0.35	<0.70
Benzene	*0.5*	**5**	<0.15	<0.15	<0.15	<0.15	<0.15	**3200**	<0.15	**18**
Bromobenzene			<0.36	<0.36	<0.36	<0.36	<0.36	<7.1	<0.36	<0.71
Bromochloromethane			<0.43	<0.43	<0.43	<0.43	<0.43	<8.6	<0.43	<0.86
Bromodichloromethane	*0.06*	**0.6**	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<0.37	<0.74
Bromoform	*0.44*	**4.4**	<0.48	<0.48	<0.48	<0.48	<0.48	<9.7	<0.48	<0.97
Bromomethane	*1*	**10**	<0.80	<0.80	<0.80	<0.80	<0.80	<16	<0.80	<1.6
Carbon tetrachloride	*0.5*	**5**	<0.38	<0.38	<0.38	<0.38	<0.38	<7.7	<0.38	<0.77
Chlorobenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<7.7	<0.39	<0.77
Chloroethane	*80*	**400**	<0.51	<0.51	<0.51	<0.51	<0.51	<10	<0.51	<1.0
Chloroform	*0.6*	**6**	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<0.37	<0.74
Chloromethane	*0.3*	**3**	<0.32	<0.32	<0.32	<0.32	<0.32	<6.4	<0.32	<0.64
cis-1,2-Dichloroethene	*7*	**70**	<0.41	<0.41	<0.41	<0.41	<0.41	<8.2	<0.41	<0.82
cis-1,3-Dichloropropene			<0.42	<0.42	<0.42	<0.42	<0.42	<8.3	<0.42	<0.83
Dibromochloromethane			<0.49	<0.49	<0.49	<0.49	<0.49	<9.8	<0.49	<0.98
Dibromomethane			<0.27	<0.27	<0.27	<0.27	<0.27	<5.4	<0.27	<0.54
Dichlorodifluoromethane	*200*	**1000**	<0.67	<0.67	<0.67	<0.67	<0.67	<13	<0.67	<1.3
Ethylbenzene	*140*	**700**	<0.18	<0.18	<0.18	<0.18	<0.18	*340*	<0.18	51
Hexachlorobutadiene			<0.45	<0.45	<0.45	<0.45	<0.45	<8.9	<0.45	<0.89
Isopropyl ether			<0.28	<0.28	<0.28	<0.28	<0.28	<5.5	<0.28	<0.55
Isopropylbenzene			<0.39	<0.39	<0.39	<0.39	<0.39	20	<0.39	5.3
Methyl tert-butyl ether	*12*	**60**	<0.39	<0.39	<0.39	<0.39	<0.39	<7.9	<0.39	<0.79
Methylene Chloride	*0.5*	**5**	<1.6	<1.6	<1.6	<1.6	<1.6	<33	<1.6	<3.3
Naphthalene	*10*	**100**	<0.34	<0.34	<0.34	<0.34	<0.34	**36000**	<0.34	**890**
n-Butylbenzene			<0.39	<0.39	<0.39	<0.39	<0.39	<7.8	<0.39	<0.78
N-Propylbenzene			<0.41	<0.41	<0.41	<0.41	<0.41	9.5	<0.41	<0.83
p-Isopropyltoluene			<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<0.36	<0.72
sec-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<0.40	<0.80
Styrene	*10*	**100**	<0.39	<0.39	<0.39	<0.39	<0.39	<7.7	<0.39	<0.77
tert-Butylbenzene			<0.40	<0.40	<0.40	<0.40	<0.40	<8.0	<0.40	<0.80
Tetrachloroethene	*0.5*	**5**	<0.37	<0.37	<0.37	<0.37	<0.37	<7.4	<0.37	<0.74
Toluene	*200*	**1000**	<0.15	<0.15	<0.15	<0.15	<0.15	**2800**	<0.15	2.5
trans-1,2-Dichloroethene	*20*	**100**	<0.35	<0.35	<0.35	<0.35	<0.35	<7.0	<0.35	<0.70
trans-1,3-Dichloropropene			<0.36	<0.36	<0.36	<0.36	<0.36	<7.2	<0.36	<0.72
Trichloroethene	*0.5*	**5**	<0.16	<0.16	<0.16	<0.16	<0.16	<3.3	<0.16	<0.33
Trichlorofluoromethane			<0.43	<0.43	<0.43	<0.43	<0.43	*<8.5*	<0.43	<0.85
Vinyl chloride	*0.02*	**0.2**	<0.20	<0.20	<0.20	<0.20	<0.20	<4.1	<0.20	<0.41
Xylenes, Total	*1000*	**10000**	<0.22	<0.22	<0.22	<0.22	<0.22	*1800*	<0.22	14

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate

VOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-123	MW-125	MW-126	MW-127	MW-128	MW-129	MW-131	MW-132
	PAL	ES	1/30/20	1/29/20	02/03/20	02/03/20	01/31/20	02/03/20	02/03/20	01/31/20
1,1,1,2-Tetrachloroethane	*7*	**70**	<4.6	<4.6	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46
1,1,1-Trichloroethane	*40*	**200**	<3.8	<3.8	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<4.0	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
1,1,2-Trichloroethane	*0.5*	**5**	<3.5	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
1,1-Dichloroethane	*85*	**850**	<4.1	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
1,1-Dichloroethene	*0.7*	**7**	<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
1,1-Dichloropropene			<3.0	<3.0	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
1,2,3-Trichlorobenzene			<4.6	<4.6	<0.46	<0.46	<0.46	<0.46	<0.46	<0.46
1,2,3-Trichloropropane	*12*	**60**	<4.1	*<4.1*	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
1,2,4-Trichlorobenzene	*14*	**70**	<3.4	<3.4	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
1,2,4-Trimethylbenzene	*96*	**480**	*110*	*99*	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<20	<20	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
1,2-Dichlorobenzene	*60*	**600**	<3.3	<3.3	<0.33	<0.33	<0.33	<0.33	<0.33	1.9
1,2-Dichloroethane	*0.5*	**5**	<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
1,2-Dichloropropane	*0.5*	**5**	<4.3	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43
1,3,5-Trimethylbenzene	*96*	**480**	34	40	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
1,3-Dichlorobenzene	*125*	**1250**	<4.0	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	2.7
1,3-Dichloropropane	*0.02*	**0.2**	<3.6	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
1,4-Dichlorobenzene	*15*	**75**	<3.6	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
2,2-Dichloropropane			<4.4	<4.4	<0.44	<0.44	<0.44	<0.44	<0.44	<0.44
2-Chlorotoluene			<3.1	<3.1	<0.31	<0.31	<0.31	<0.31	<0.31	<0.31
4-Chlorotoluene			<3.5	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
Benzene	*0.5*	**5**	**310**	**270**	<0.15	<0.15	<0.15	<0.15	0.18	<0.15
Bromobenzene			<3.6	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
Bromochloromethane			<4.3	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43
Bromodichloromethane	*0.06*	**0.6**	<3.7	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37
Bromoform	*0.44*	**4.4**	<4.8	<4.8	<0.48	<0.48	<0.48	<0.48	<0.48	<0.48
Bromomethane	*1*	**10**	<8.0	<8.0	<0.80	<0.80	<0.80	<0.80	<0.80	<0.80
Carbon tetrachloride	*0.5*	**5**	<3.8	<3.8	<0.38	<0.38	<0.38	<0.38	<0.38	<0.38
Chlorobenzene			<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
Chloroethane	*80*	**400**	<5.1	<5.1	<0.51	<0.51	<0.51	<0.51	<0.51	<0.51
Chloroform	*0.6*	**6**	<3.7	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37
Chloromethane	*0.3*	**3**	<3.2	<3.2	<0.32	<0.32	<0.32	<0.32	<0.32	<0.32
cis-1,2-Dichloroethene	*7*	**70**	<4.1	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
cis-1,3-Dichloropropene			<4.2	<4.2	<0.42	<0.42	<0.42	<0.42	<0.42	<0.42
Dibromochloromethane			<4.9	<4.9	<0.49	<0.49	<0.49	<0.49	<0.49	<0.49
Dibromomethane			<2.7	<2.7	<0.27	<0.27	<0.27	<0.27	<0.27	<0.27
Dichlorodifluoromethane	*200*	**1000**	<6.7	<6.7	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
Ethylbenzene	*140*	**700**	66	91	<0.18	<0.18	<0.18	<0.18	<0.18	<0.18
Hexachlorobutadiene			<4.5	<4.5	<0.45	<0.45	<0.45	<0.45	<0.45	<0.45
Isopropyl ether			<2.8	<2.8	<0.28	<0.28	<0.28	<0.28	<0.28	<0.28
Isopropylbenzene			8.8	5.1	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
Methyl tert-butyl ether	*12*	**60**	<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
Methylene Chloride	*0.5*	**5**	<16	<16	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6
Naphthalene	*10*	**100**	**9800**	**11000**	<0.34	<0.34	<0.34	<0.34	<0.34	<0.34
n-Butylbenzene			<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
N-Propylbenzene			4.7	<4.1	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
p-Isopropyltoluene			<3.6	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
sec-Butylbenzene			<4.0	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Styrene	*10*	**100**	<3.9	<3.9	<0.39	<0.39	<0.39	<0.39	<0.39	<0.39
tert-Butylbenzene			<4.0	<4.0	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40
Tetrachloroethene	*0.5*	**5**	<3.7	<3.7	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37
Toluene	*200*	**1000**	69	160	<0.15	0.17	<0.15	<0.15	0.17	<0.15
trans-1,2-Dichloroethene	*20*	**100**	<3.5	<3.5	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35
trans-1,3-Dichloropropene			<3.6	<3.6	<0.36	<0.36	<0.36	<0.36	<0.36	<0.36
Trichloroethene	*0.5*	**5**	<1.6	<1.6	<0.16	<0.16	<0.16	<0.16	<0.16	<0.16
Trichlorofluoromethane			<4.3	<4.3	<0.43	<0.43	<0.43	<0.43	<0.43	<0.43
Vinyl chloride	*0.02*	**0.2**	<2.0	<2.0	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Xylenes, Total	*1000*	**10000**	150	430	<0.22	<0.22	<0.22	<0.22	<0.22	<0.22

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate

VOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-136	MW-2	P-110	P-113	P-120	P-121
	PAL	ES	03/02/20	2/3/20	1/28/20	1/30/20	1/29/20	1/28/20
1,1,1,2-Tetrachloroethane	*7*	**70**	<0.46	<0.46	<9.2	<0.46	<0.46	<0.46
1,1,1-Trichloroethane	*40*	**200**	<0.38	<0.38	<7.6	<0.38	<0.38	<0.38
1,1,2,2-Tetrachloroethane	*0.02*	**0.2**	<0.40	<0.40	<8.0	<0.40	<0.40	<0.40
1,1,2-Trichloroethane	*0.5*	**5**	<0.35	<0.35	<7.0	<0.35	<0.35	<0.35
1,1-Dichloroethane	*85*	**850**	<0.41	<0.41	<8.2	<0.41	<0.41	<0.41
1,1-Dichloroethene	*0.7*	**7**	<0.39	<0.39	<7.8	<0.39	<0.39	<0.39
1,1-Dichloropropene			<0.30	<0.30	<5.9	<0.30	<0.30	<0.30
1,2,3-Trichlorobenzene			<0.46	<0.46	<9.2	<0.46	<0.46	<0.46
1,2,3-Trichloropropane	*12*	**60**	<0.41	<0.41	<8.3	<0.41	<0.41	<0.41
1,2,4-Trichlorobenzene	*14*	**70**	<0.34	<0.34	<6.8	<0.34	<0.34	<0.34
1,2,4-Trimethylbenzene	*96*	**480**	<0.36	<0.36	*250*	<0.36	<0.36	<0.36
1,2-Dibromo-3-Chloropropane	*0.02*	**0.2**	<2.0	<2.0	**55**	<2.0	<2.0	<2.0
1,2-Dibromoethane (EDB)	*0.005*	**0.05**	<0.39	<0.39	<7.7	<0.39	<0.39	<0.39
1,2-Dichlorobenzene	*60*	**600**	<0.33	<0.33	<6.7	<0.33	<0.33	<0.33
1,2-Dichloroethane	*0.5*	**5**	<0.39	<0.39	<7.8	<0.39	<0.39	<0.39
1,2-Dichloropropane	*0.5*	**5**	<0.43	<0.43	<8.6	<0.43	<0.43	<0.43
1,3,5-Trimethylbenzene	*96*	**480**	<0.25	<0.25	*120*	<0.25	<0.25	<0.25
1,3-Dichlorobenzene	*125*	**1250**	<0.40	<0.40	<8.0	<0.40	<0.40	<0.40
1,3-Dichloropropane	*0.02*	**0.2**	<0.36	<0.36	<7.2	<0.36	<0.36	<0.36
1,4-Dichlorobenzene	*15*	**75**	<0.36	<0.36	<7.3	<0.36	<0.36	<0.36
2,2-Dichloropropane			<0.44	<0.44	<8.9	<0.44	<0.44	<0.44
2-Chlorotoluene			<0.31	<0.31	<6.3	<0.31	<0.31	<0.31
4-Chlorotoluene			<0.35	<0.35	<7.0	<0.35	<0.35	<0.35
Benzene	*0.5*	**5**	0.47 J	**6.2**	**940**	<0.15	<0.15	<0.15
Bromobenzene			<0.36	<0.36	<7.1	<0.36	<0.36	<0.36
Bromochloromethane			<0.43	<0.43	<8.6	<0.43	<0.43	<0.43
Bromodichloromethane	*0.06*	**0.6**	<0.37	<0.37	<7.4	<0.37	<0.37	<0.37
Bromoform	*0.44*	**4.4**	<0.48	<0.48	<9.7	<0.48	<0.48	<0.48
Bromomethane	*1*	**10**	<0.80	<0.80	<16	<0.80	<0.80	<0.80
Carbon tetrachloride	*0.5*	**5**	<0.38	<0.38	<7.7	<0.38	<0.38	<0.38
Chlorobenzene			<0.39	<0.39	<7.7	<0.39	<0.39	<0.39
Chloroethane	*80*	**400**	<0.51	<0.51	<10	<0.51	<0.51	<0.51
Chloroform	*0.6*	**6**	<0.37	<0.37	<7.4	<0.37	<0.37	<0.37
Chloromethane	*0.3*	**3**	<0.32	<0.32	<6.4	<0.32	<0.32	<0.32
cis-1,2-Dichloroethene	*7*	**70**	<0.41	<0.41	<8.2	<0.41	<0.41	<0.41
cis-1,3-Dichloropropene			<0.42	<0.42	<8.3	<0.42	<0.42	<0.42
Dibromochloromethane			<0.49	<0.49	<9.8	<0.49	<0.49	<0.49
Dibromomethane			<0.27	<0.27	<5.4	<0.27	<0.27	<0.27
Dichlorodifluoromethane	*200*	**1000**	<0.67	<0.67	<13	<0.67	<0.67	<0.67
Ethylbenzene	*140*	**700**	<0.18	8.3	*430*	<0.18	<0.18	<0.18
Hexachlorobutadiene			<0.45	<0.45	<8.9	<0.45	<0.45	<0.45
Isopropyl ether			<0.28	<0.28	<5.5	<0.28	<0.28	<0.28
Isopropylbenzene			<0.39	1.5	38	<0.39	<0.39	<0.39
Methyl tert-butyl ether	*12*	**60**	<0.39	<0.39	<7.9	<0.39	<0.39	<0.39
Methylene Chloride	*0.5*	**5**	<1.6	<1.6	<33	<1.6	<1.6	<1.6
Naphthalene	*10*	**100**	<0.34	7.9	**18000**	<0.34	1.8	<0.34
n-Butylbenzene			<0.39	<0.39	<7.8	<0.39	<0.39	<0.39
N-Propylbenzene			<0.41	0.51	<8.3	<0.41	<0.41	<0.41
p-Isopropyltoluene			<0.36	<0.36	<7.2	<0.36	<0.36	<0.36
sec-Butylbenzene			<0.40	<0.40	<8.0	<0.40	<0.40	<0.40
Styrene	*10*	**100**	<0.39	<0.39	*36*	<0.39	<0.39	<0.39
tert-Butylbenzene			<0.40	<0.40	<8.0	<0.40	<0.40	<0.40
Tetrachloroethene	*0.5*	**5**	<0.37	<0.37	<7.4	<0.37	<0.37	<0.37
Toluene	*200*	**1000**	<0.15	1	*750*	<0.15	<0.15	<0.15
trans-1,2-Dichloroethene	*20*	**100**	<0.35	<0.35	<7.0	<0.35	<0.35	<0.35
trans-1,3-Dichloropropene			<0.36	<0.36	<7.2	<0.36	<0.36	<0.36
Trichloroethene	*0.5*	**5**	<0.16	<0.16	<3.3	<0.16	<0.16	<0.16
Trichlorofluoromethane			<0.43	<0.43	<8.5	<0.43	<0.43	<0.43
Vinyl chloride	*0.02*	**0.2**	<0.20	<0.20	<4.1	<0.20	<0.20	<0.20
Xylenes, Total	*1000*	**10000**	<0.22	2.7	990	<0.22	<0.22	<0.22

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SVOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-1	MW-2	MW-102	P-103	MW-101	MW-104	MW-105	MW-107
	PAL	ES	1/30/20	2/3/20	1/28/20	1/28/20	2/3/20	1/28/20	1/28/20	2/3/20
1-Methylnaphthalene			<0.23	9.5	<0.25	<0.25	0.29	<0.25	<0.26	430
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene			<0.051	0.17	0.084	<0.055	0.49	0.15	0.13	900
2-Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene			<0.24	23	<0.26	<0.26	<0.28	<0.26	<0.26	260
Acenaphthylene			<0.21	2	<0.22	<0.23	<0.24	<0.23	<0.23	2.6
Anthracene	*600*	**3000**	0.85	0.41	<0.28	<0.28	<0.31	<0.28	<0.28	12
Benzo[a]anthracene			0.12	<0.049	0.14	<0.048	0.2	<0.048	0.072	0.69
Benzo[a]pyrene	*0.02*	**0.2**	**0.23**	<0.085	*0.16*	<0.084	**0.36**	<0.084	<0.084	**0.43**
Benzo[b]fluoranthene	*0.02*	**0.2**	**0.2**	<0.069	*0.17*	<0.068	**0.66**	<0.068	<0.069	**0.41**
Benzo[g,h,i]perylene			0.34	<0.32	<0.31	<0.32	0.44	<0.32	<0.32	<0.34
Benzo[k]fluoranthene			0.14	<0.055	<0.053	<0.054	0.26	<0.054	<0.054	0.24
Benzoic acid			NA	NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	*0.15*	<0.059	*0.12*	<0.058	**0.48**	<0.058	<0.058	**0.51**
Dibenz(a,h)anthracene			<0.040	<0.044	0.051	<0.043	<0.046	<0.043	<0.043	<0.046
Dibenzofuran			NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	0.47	1.3	<0.38	<0.38	0.86	<0.38	<0.39	9.2
Fluorene	*80*	**400**	<0.19	9	<0.20	<0.21	<0.22	<0.21	<0.21	*120*
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			0.18	<0.064	0.093	<0.063	0.37	<0.063	<0.064	0.21
Isophorone			NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	<0.24	7.6	<0.26	<0.26	6.6	<0.26	0.82	**8300**
Nitrobenzene			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene			0.37	3.3	<0.25	<0.25	0.28	<0.25	<0.26	100
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	0.66	0.74	<0.35	<0.36	0.72	<0.36	<0.36	5.4

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SVOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-107 Dup	MW-108	MW-111	MW-112	MW-115	MW-116	MW-117	MW-118
	PAL	ES	2/3/20	1/29/20	1/28/20	1/30/20	1/29/20	1/29/20	1/29/20	1/29/20
1-Methylnaphthalene			580	<0.25	<0.27	<0.27	<0.27	0.73	780	<0.25
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene			1000	0.089	0.55	<0.058	0.35	0.2	1700	<0.055
2-Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene			320	<0.25	<0.28	<0.28	<0.27	0.85	250	<0.26
Acenaphthylene			2.6	<0.22	<0.24	<0.24	<0.24	<0.23	32	<0.22
Anthracene	*600*	**3000**	12	<0.27	<0.30	0.96	<0.30	0.92	<27	0.95
Benzo[a]anthracene			1	<0.046	<0.051	0.1	0.06	<0.048	5.6	0.14
Benzo[a]pyrene	*0.02*	**0.2**	**0.78**	<0.080	<0.089	**0.22**	<0.088	<0.083	<8.1	**0.34**
Benzo[b]fluoranthene	*0.02*	**0.2**	**0.81**	<0.066	<0.073	*0.15*	<0.071	<0.068	<6.6	**0.31**
Benzo[g,h,i]perylene			0.46	<0.31	<0.34	<0.33	<0.33	<0.32	<31	0.43
Benzo[k]fluoranthene			0.41	<0.052	<0.058	0.085	<0.057	<0.054	<5.3	0.13
Benzoic acid			NA	NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	**0.91**	<0.055	<0.061	*0.13*	<0.060	<0.057	<5.6	**0.24**
Dibenz(a,h)anthracene			<0.046	<0.041	<0.046	<0.045	<0.045	<0.043	<4.2	<0.043
Dibenzofuran			NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	11	<0.37	<0.41	0.52	<0.40	<0.38	<37	0.86
Fluorene	*80*	**400**	*150*	<0.20	<0.22	<0.22	<0.22	0.34	*140*	<0.20
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			0.47	<0.061	<0.067	<0.067	<0.066	<0.063	<6.1	0.25
Isophorone			NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	**11000**	0.97	8	0.79	5	0.73	**12000**	<0.26
Nitrobenzene			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene			130	<0.25	<0.27	0.45	<0.27	0.29	110	0.68
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	6.8	<0.35	<0.38	0.77	<0.38	<0.36	<35	0.89

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Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-122	MW-123	MW-125	MW-126	MW-127	MW-128	MW-129	MW-131
	PAL	ES	1/30/20	1/30/20	1/29/20	02/03/20	02/03/20	01/31/20	02/03/20	02/03/20
1-Methylnaphthalene			59	210	64	<0.27	<0.25	<0.25	<0.26	<0.25
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene			3.5	200	84	<0.058	<0.054	<0.054	<0.057	<0.053
2-Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA	NA	NA	NA
Acenaphthene			63	150	60	<0.27	<0.26	<0.26	<0.27	0.36
Acenaphthylene			2	9.2	4.5	<0.24	<0.22	<0.22	<0.23	<0.22
Anthracene	*600*	**3000**	3	7.5	4.5	<0.30	<0.28	<0.28	<0.29	<0.27
Benzo[a]anthracene			0.13	0.66	0.96	<0.050	<0.047	<0.047	<0.049	<0.047
Benzo[a]pyrene	*0.02*	**0.2**	<0.088	**0.75**	**0.93**	<0.088	<0.082	<0.082	<0.086	<0.081
Benzo[b]fluoranthene	*0.02*	**0.2**	<0.071	**0.81**	**0.67**	<0.072	<0.067	<0.067	<0.070	<0.066
Benzo[g,h,i]perylene			<0.33	0.46	<1.6	<0.33	<0.31	<0.31	<0.33	<0.31
Benzo[k]fluoranthene			<0.057	0.32	0.28	<0.057	<0.053	<0.053	<0.056	<0.053
Benzoic acid			NA	NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	*0.14*	**0.73**	**0.88**	<0.061	<0.057	<0.057	<0.059	<0.056
Dibenz(a,h)anthracene			<0.045	0.07	<0.21	<0.045	<0.042	<0.042	<0.044	<0.042
Dibenzofuran			NA	NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	2.6	9.2	7.6	<0.40	<0.38	<0.38	<0.40	0.58
Fluorene	*80*	**400**	29	*85*	32	<0.22	<0.20	<0.20	<0.21	<0.20
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			<0.066	0.35	0.34	<0.067	<0.062	<0.062	<0.065	<0.061
Isophorone			NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	**660**	**3200**	**2500**	<0.27	<0.26	<0.26	<0.27	<0.25
Nitrobenzene			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA	NA
Phenanthrene			22	65	32	<0.27	<0.25	<0.25	<0.26	<0.25
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	1.2	4.2	6.2	<0.38	<0.35	<0.36	<0.37	0.39

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate

SVOC Feb 2020 Results
Former Koppers Tar Plant and Wabash Alloys Site
Beazer Oak Creek VPLE
BRRTS #:06-41-561509/06-41-561426

	WDNR NR140		MW-132	MW-136	P-110	P-113	P-113 Dup	P-120	P-121
	PAL	ES	01/31/20	03/02/20	1/28/20	1/30/20	1/30/20	1/29/20	1/28/20
1-Methylnaphthalene			<0.26	<0.23	420	<0.26	<0.25	0.41	<0.26
1,2,4-Trichlorobenzene	*14*	**70**	NA	NA	NA	NA	NA	NA	NA
1,2-Dichlorobenzene	*60*	**600**	NA	NA	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	*125*	**1250**	NA	NA	NA	NA	NA	NA	NA
1,4-Dichlorobenzene	*15*	**75**	NA	NA	NA	NA	NA	NA	NA
2,2'-oxybis[1-chloropropane]			NA	NA	NA	NA	NA	NA	NA
2,4,5-Trichlorophenol	*5*	**50**	NA	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol			NA	NA	NA	NA	NA	NA	NA
2,4-Dichlorophenol			NA	NA	NA	NA	NA	NA	NA
2,4-Dimethylphenol			NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrophenol			NA	NA	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA
2,6-Dinitrotoluene	*0.005*	**0.05**	NA	NA	NA	NA	NA	NA	NA
2-Chloronaphthalene			NA	NA	NA	NA	NA	NA	NA
2-Chlorophenol			NA	NA	NA	NA	NA	NA	NA
2-Methylnaphthalene			<0.056	<0.050	750	<0.056	<0.053	0.79	<0.056
2-Methylphenol			NA	NA	NA	NA	NA	NA	NA
2-Nitroaniline			NA	NA	NA	NA	NA	NA	NA
2-Nitrophenol			NA	NA	NA	NA	NA	NA	NA
3 & 4 Methylphenol			NA	NA	NA	NA	NA	NA	NA
3,3'-Dichlorobenzidine			NA	NA	NA	NA	NA	NA	NA
3-Nitroaniline			NA	NA	NA	NA	NA	NA	NA
4,6-Dinitro-2-methylphenol			NA	NA	NA	NA	NA	NA	NA
4-Bromophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol			NA	NA	NA	NA	NA	NA	NA
4-Chloroaniline			NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether			NA	NA	NA	NA	NA	NA	NA
4-Nitroaniline			NA	NA	NA	NA	NA	NA	NA
4-Nitrophenol			NA	NA	NA	NA	NA	NA	NA
Acenaphthene			<0.26	<0.24	370	<0.26	0.82	0.39	<0.27
Acenaphthylene			<0.23	<0.20	14	<0.23	<0.22	<0.21	<0.23
Anthracene	*600*	**3000**	<0.29	<0.25	20	<0.28	0.95	0.3	<0.29
Benzo[a]anthracene			0.28	<0.043	5.8	<0.048	0.42	0.32	0.11
Benzo[a]pyrene	*0.02*	**0.2**	**0.27**	<0.076	**4.1**	<0.084	**0.52**	**0.27**	<0.085
Benzo[b]fluoranthene	*0.02*	**0.2**	**0.39**	<0.062	**3.8**	<0.069	**0.65**	**0.27**	<0.070
Benzo[g,h,i]perylene			<0.32	<0.29	<5.8	<0.32	0.55	<0.29	<0.32
Benzo[k]fluoranthene			0.19	<0.049	3.7	<0.055	0.27	0.14	<0.055
Benzoic acid			NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol			NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethoxy)methane			NA	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether			NA	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl) phthalate	*0.6*	**6**	NA	NA	NA	NA	NA	NA	NA
Butyl benzyl phthalate			NA	NA	NA	NA	NA	NA	NA
Carbazole			NA	NA	NA	NA	NA	NA	NA
Chrysene	*0.02*	**0.2**	**0.28**	<0.052	**4.4**	<0.058	**0.53**	**0.2**	<0.059
Dibenz(a,h)anthracene			0.056	<0.039	<0.78	<0.043	0.17	0.041	<0.044
Dibenzofuran			NA	NA	NA	NA	NA	NA	NA
Diethyl phthalate			NA	NA	NA	NA	NA	NA	NA
Dimethyl phthalate			NA	NA	NA	NA	NA	NA	NA
Di-n-butyl phthalate	*20*	**100**	NA	NA	NA	NA	NA	NA	NA
Di-n-octyl phthalate			NA	NA	NA	NA	NA	NA	NA
Fluoranthene	*80*	**400**	0.56	<0.35	33	<0.39	1.5	0.67	<0.39
Fluorene	*80*	**400**	<0.21	<0.19	*190*	<0.21	0.31	0.54	<0.21
Hexachlorobenzene	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA
Hexachlorobutadiene			NA	NA	NA	NA	NA	NA	NA
Hexachlorocyclopentadiene			NA	NA	NA	NA	NA	NA	NA
Hexachloroethane			NA	NA	NA	NA	NA	NA	NA
Indeno[1,2,3-cd]pyrene			0.23	<0.057	2.5	<0.064	0.37	0.15	<0.065
Isophorone			NA	NA	NA	NA	NA	NA	NA
Naphthalene	*10*	**100**	0.46	<0.24	**11000**	0.67	0.67	3	<0.27
Nitrobenzene			NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine			NA	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine			NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	*0.1*	**1**	NA	NA	NA	NA	NA	NA	NA
Phenanthrene			0.27	<0.23	170	<0.26	1.4	1.5	<0.26
Phenol	*1200*	**6000**	NA	NA	NA	NA	NA	NA	NA
Pyrene	*50*	**250**	0.45	<0.33	23	<0.36	1.2	0.52	<0.37

Italic: Value exceeds NR140 Preventive Action Limit
Bold: Value exceeds NR140 Enforcement Standard
J: Result is <RL but >MDL; concentration is approximate