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Final Design

OU2 – Northern Areas - Tar Lake Superfund Site
Mancelona, Michigan

Prepared for:

U.S. Environmental Protection Agency
Region 5
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Chicago, IL 60604

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ACRONYMS AND ABBREVIATIONS

µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
56th Century	Fifty-Sixth Century Antrim Iron Works Company
AIW	Antrim Iron Works
amsl	Above mean sea level
AOC	Administrative Order on Consent
ARAR	Applicable or relevant and appropriate
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLSM	Controlled low strength material
COC	Contaminant of concern
CFR	Code of federal regulations
CY	Cubic yard
DCC	Direct Contact Criterion
ENSAFE	Environmental and Safety Designs, Inc.
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
ETA	East tailings area
FS	Feasibility study
ft	Feet
FYR	Five-year review
HDNM	Health Department of Northwest Michigan
HMI	Human machine interface
IC	Institutional control
MAWSA	Mancelona Area Water and Sewer Authority
MCACES	Micro-Computer Aided Cost Estimating System
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
MAC	Michigan Administrative Code
MII	Second generation
mg/kg	Milligrams per kilogram
mg/L	Milligram per liter
NAAQS	National Ambient Air Quality Standards
NPL	National Priorities List

ACRONYMS AND ABBREVIATIONS (continued)

O&M	Operation and maintenance
OM&M	Operations, Monitoring and Maintenance
ORP	Oxidation-reduction potential
OU	Operable unit
PAH	Polynuclear aromatic hydrocarbon
PEA	Preliminary endangerment assessment
PEX	Cross-linked polyethylene
P&ID	Piping and instrumentation diagram
PID	Photoionization detector
PLC	Programmable logic control
PRG	Preliminary remediation goal
psi	Pounds per square inch
PVC	Polyvinyl chloride
RAC	Remedial action contract
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RDWC	Residential drinking water criteria
RDWPC	Residential drinking water protection criteria
RES	3.48-acre residential area
RI	Remedial investigation
ROD	Record of Decision
scfm	Standard cubic feet per minute
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
UAO	Unilateral Administrative Order
UE	Unlimited exposure
UU	Unrestricted use
VFD	Variable frequency drive
VOC	Volatile organic compound
XRF	X-ray fluorescence

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

SulTRAC, a joint venture of Tetra Tech, Inc. (Tetra Tech) and SCST, Inc., prepared this Final Design for Operable Unit (OU)2 – Northern Areas of the Tar Lake Site in Mancelona Township, Antrim County, Michigan. OU2 includes soil below previously excavated tar and tar debris (OU1), groundwater, and other operations at the site. OU2 – Northern Areas includes the Smoke Tunnel and Creosote Areas and any residual contaminated soil and groundwater present within the Tar Lake Depression Area (Figure 1). This design was prepared under the U.S. Environmental Protection Agency (EPA) Remedial Action Contract (RAC) 2 for Region 5, Contract No. EP-S5-06-02, Work Assignment (WA) No. 194-RDRD-0571 in accordance with the EPA Remedial Design/Remedial Action Handbook (EPA 1995).

EPA, with concurrence from the Michigan Department of Environmental Quality (MDEQ), amended the current cleanup remedy in the 2013 Explanation of Significant Difference (ESD) (EPA 2013) in order to address impacted soils identified during investigations conducted in the northern areas of OU2 to determine the source of increasing groundwater contamination and potential additional contamination sources at the site. Remedial actions proposed in the 2013 ESD include additional soil excavation and expansion of the current biosparge system at the site. EPA has determined that the additional remedial action is required to address residual contamination left in place following soil excavation work performed as part of the 2002 Record of Decision (ROD) and 2004 ESD. This action is necessary to meet the 2002 ROD and 2013 ESD remedial action objectives (RAO) for soil and groundwater at the site.

This design presents the methods, assumptions, and criteria for the selected remedy, as identified in the ESD issued for the site in 2013 (EPA 2013).

1.2 SELECTED REMEDIAL ACTION

The components of the remedy selected for the site as identified in the 2013 ESD (EPA 2013) are:

- Excavating approximately 138,000 additional tons of contaminated unsaturated soil from the Tar Lake area, the adjacent smoke tunnel area and the creosote area of the site.

- Expanding the north end of the biosparge groundwater treatment system approximately 225 feet (ft) to the northwest, across Elder Road (approximately six sparge wells).

- Expanding the biosparge system approximately 550 ft upgradient into the low-lying Tar Lake area of the site (approximately 15 sparge wells).

- Updating the cleanup standards in the 2002 ROD to 2012 Michigan Part 201 criteria.

- Adding cleanup standards for additional volatile organic compounds (VOC), semivolatile organic compounds (SVOC) and inorganic chemicals in soil; and for additional VOC and SVOC chemicals in groundwater.

Cleanup criteria for site soil and groundwater were documented in the 2013 ESD, are listed in Table 1-1, and have been derived from the 2012 MDEQ Residential Drinking Water Protection Criteria (RDWPC) and Residential Drinking Water Criteria (RDWC).

TABLE 1-1. CLEANUP CRITERIA FOR SOIL AND GROUNDWATER

Contaminant	**2013 ESD Cleanup Criteria Based on September 28, 2012 MDEQ Cleanup Criteria**	
	Soil (µg/kg)	**Groundwater (µg/L)**
Volatile Organic Compounds		
Benzene	100	5
2-Butanone	260,000	NC
Ethylbenzene	1,500	700 (health-based)
4-Methyl-2-pentanone	36,000	NC
1,2,4-Trimethylbenzene	2,100	NC
Styrene	2,100	100
Tetrachloroethene	100	5
Toluene	16,000	1,000 (health-based)
Trichloroethene	100	5
Xylene	5,600	10,000 (health-based)
Semivolatile Organic Compounds		
Acenaphthene	300,000	NC
Acenaphthylene	5,900	52
Anthracene	41,000	NC
Benzo(a)anthracene	80,000 (DCC)	NC
Benzo(a)pyrene	8,000 (DCC)	NC
Benzo(b)fluoranthene	80,000 (DCC)	NC
Benzo(k)fluoranthene	800,000 (DCC)	NC
Bis(2-ethylhexyl)phthalate	10,000,000 (Csat)	6
Chrysene	8,000,000 (DCC)	NC
Dibenz(a,h)anthracene	8,000 (DCC)	NC
2,4-Dimethylphenol	7,400	370
Di-n-butylphthalate	760,000	NC
Fluoranthene	730,000	NC
2-Methylnaphthalene	57,000	260

Contaminant	2013 ESD Cleanup Criteria Based on September 28, 2012 MDEQ Cleanup Criteria	
	Soil (µg/kg)	**Groundwater (µg/L)**
Methylphenols (total)	7,400	370
Naphthalene	35,000	520
Phenanthrene	56,000	52
Phenol	88,000	4,400
Pyrene	480,000	NC
Inorganics (soil in mg/kg)		
Aluminum	6,900	NC
Antimony	4.3	NC
Arsenic	5.8	NC
Cadmium	6	NC
Chromium	30	NC
Copper	5,800	NC
Iron	12,000	NC
Lead	700	NC
Magnesium	8,000	NC
Manganese	440	NC
Nickel	100	NC
Silver	4.5	NC
Vanadium	72	NC

Notes:

Csat	Soil saturation concentration screening level
DCC	Direct Contact Criteria
ESD	Explanation of Significant Differences
MDEQ	Michigan Department of Environmental Quality
mg/kg	Milligram per kilogram
NC	No criteria listed in 2013 ESD
RDWC	Residential Drinking Water Criteria
RDWPC	Residential Drinking Water Protection Criteria
µg/kg	Microgram per kilogram
µg/L	Microgram per liter

1.3 OVERVIEW OF SELECTED REMEDY

The additional remedial measures identified in the 2013 ESD and modified based on the results of the 2015 pre-design investigation (SulTRAC 2018) were selected to achieve the cleanup criteria documented in the 2013 ESD and includes:

- Excavating approximately 223,814 additional tons of contaminated soil from the Tar Lake area, adjacent smoke tunnel area, and creosote area.

- Expanding the north end of the existing biosparge groundwater treatment system to the northwest, across Elder Road (7-10 sparge wells).
- Expanding the biosparge system approximately 550 ft upgradient (east) into the low-lying Tar Lake area of the site (21 sparge wells).

The tonnage of soil and number of biosparge wells was altered from the 2013 ESD estimates based on the results of the 2015 pre-design investigation. Specifically, the amount of soil to be excavated from:

- Area A was increased from 833 tons to 1,410 tons (accounts for elevation changes and required sloping).
- Area B was increased from 124,667 tons to 151,690 tons (accounts for elevation changes and required sloping and shoring).
- Area C was increased from 2,611 tons to 48,474 tons (depth of excavation changed from 12 to 47 feet based on results, accounts for required sloping and shoring).
- Area D was increased from 444 tons to 2,421 tons (area of excavation enlarged based on results, accounts for elevation changes and required sloping).
- Area E was increased from 1,333 tons to 2,675 tons (accounts for elevation changes and required sloping).
- Area F (as shown) was not included in 2013 ESD. The area was added based on pre-design investigation results and includes 5,876 tons.
- Area G was increased from 5,000 tons to 8,746 tons (accounts for elevation changes and required sloping and shoring).
- Area H was increased from 694 tons to 955 tons (area of excavation enlarged based on results, accounts for elevation changes and required sloping).
- Area I was increased from 611 tons to 1,305 tons (area of excavation enlarged based on results, accounts for elevation changes and required sloping).
- Area J (as shown) was included in 2013 ESD as Area F. No changes have been made to this Area, which includes 263 tons.

In addition, the number of biosparge wells were increased based on engineer recommendations to better remediate any residual source material and to more adequately mitigate downgradient groundwater contamination.

1.4 PROJECT TEAM AND STAKEHOLDERS

SulTRAC has prepared this design on behalf of EPA. The remedial cleanup at the Tar Lake site will proceed under oversight of EPA. The remedy has been developed in coordination with MDEQ.

1.5 REPORT ORGANIZATION

This design presents the criteria and design for the selected remedy at the site. The detailed design for the final remedy was based on these criteria. The organization of this report generally follows the format suggested in EPA's Remedial Design/Remedial Action Handbook (EPA 1995). The design is organized as follows:

- Section 2.0 conveys site background information.
- Section 3.0 outlines the remedial design including objectives, assumptions, criteria, and considerations for the selected remedy.
- Section 4.0 summarizes compliance with access, regulatory, and permitting requirements.
- Section 5.0 presents results of value engineering screening.
- Section 6.0 lists remedial design submittals, including a list of technical specifications and design drawings.
- Section 7.0 presents the remedial action schedule and contracting strategy.
- Section 8.0 presents the cost estimate.
- Section 9.0 lists sources referenced in this document.

Appendix A includes figures, Appendix B presents design drawings, Appendix C provides a project schedule, Appendix D includes the estimated costs to complete the remedy, and Appendix E provides technical specifications.

2.0 BACKGROUND

2.1 SITE LOCATION AND LAND USE

The Tar Lake site is a former iron manufacturing facility (Antrim Iron Works [AIW]) and its predecessor Mancelona Furnace Company) that operated from about 1882 to 1945. The site is in a rural area east of Route 131 and is bisected by Elder Road about 1 mile south of Mancelona, Michigan (Figure 1). Surrounding land uses at the site include agricultural, light commercial/industrial, and residential. The entire Tar Lake site currently includes about 118 acres and covers 12 properties (Figure 2). The site does not include (1) the 45-acre east tailings area (ETA) that EPA determined was acceptable for unrestricted use/unlimited exposure (UU/UE) and deleted from the site in 2005 (EPA 2005), and (2) 75 acres of land adjacent to the ETA deleted from the site in 2012 (EPA 2012). Approximately 12 acres of the site is fenced and includes a groundwater treatment and monitoring system.

The Tar Lake site has several steep hills and valleys and includes two on-site lakes: Peckham Lake and the western part of Nelson Lake. As a result of remedial activities at the site, Tar Lake itself is currently a large depression within which minor stormwater accumulations occur during periods of heavy precipitation. No rivers, streams, or creeks are present at the site. The Tar Lake site is mostly vacant and heavily vegetated.

2.2 SITE HISTORY

AIW produced iron at the site using the charcoal method. AIW made the charcoal from wood in sealed retorts. The process created a pyroligneous (made by destructive distillation of wood) liquor. AIW recovered the pyroligneous liquor and used it in secondary chemical manufacturing processes to produce calcium acetate, methanol, acetone, and creosote oil. The secondary processes created a tar-like waste residue (tar), which AIW discharged to a low-lying area called Tar Lake. From 1957 to 1967, a metal products company (Mt. Clemens Metal Products) also disposed of waste in the Tar Lake area of the site.

Other major operations areas of the site included the iron production area, creosote area, and the retort and chemical production area. Peckham Lake and Nelson Lake were also used as sources from which to withdraw cooling water, and subsequently as locations to accept discharge of that same water at higher temperatures.

Records indicate wells in the Mancelona area were tested for groundwater contamination in 1909. However, locations of the wells and sampling results are not available. Sometime before 1949, the Mancelona water supply was extended to the residential area northwest of the site (formerly Antrim). In 1949, the Michigan Geological Survey Division collected groundwater samples from three private wells and one school well west-northwest of Antrim farther downgradient of the Tar Lake site. Two of the private well samples and the sample from the school well contained phenol (cresol and o-cresol) at concentrations ranging from 40 to 60 micrograms per liter (µg/L).

The Michigan Department of Natural Resources (MDNR) inspected Tar Lake in 1967. The water in Tar Lake was black and the sample collected from the lake was yellow with a creosote odor. In 1969, Tar Lake caught fire and burned for several months before the fire naturally expired.

In 1979, the Antrim County Health Department contacted MDNR about Tar Lake. A new subdivision had been proposed west of Tar Lake, and the health department was concerned about groundwater contamination from Tar Lake. MDNR began a hydrogeological study of the site and discovered Gulf and Western Stamping Company (formerly Mt. Clemens Metal Products) had disposed of 41 barrels of sludge in the Tar Lake area.

Gulf and Western Stamping Company removed the barrels of sludge from Tar Lake in 1980. In 1981, Gulf and Western Stamping Company submitted a notification of hazardous waste site form for the Tar Lake site. EPA reviewed the Tar Lake site and proposed the site to the National Priorities List (NPL) in December 1982. EPA listed the Tar Lake site on the NPL in 1983.

2.3 PREVIOUS SITE INVESTIGATIONS AND REMEDIAL ACTIONS

In 1986, EPA entered into an Administrative Order on Consent (AOC) with Fifty-Sixth Century Antrim Iron Works Company (56^{th} Century) (formerly Gulf and Western) to conduct a preliminary endangerment assessment (PEA) and remedial investigation (RI) at the site. 56^{th} Century constructed a fence around the 4-acre Tar Lake area and 10 acres of the retort and chemical production area on which were structures and waste piles.

56^{th} Century completed the PEA for the Tar Lake site in 1988 (56^{th} Century 1988). The PEA concluded that groundwater contaminants did not pose a threat. EPA reviewed the PEA and determined the PEA had been based on incomplete data obtained via inadequate procedures. EPA did not approve the PEA and required 56^{th} Century to conduct additional investigation and sampling.

56th Century conducted the additional investigation and sampling in 1989 (Gradient Corporation 1989). The sampling showed the groundwater contained over 50 chemicals associated with tar, and that benzene and styrene were in the groundwater above Maximum Contaminant Levels (MCL) (Gradient Corporation and others 1990a). EPA determined source control and groundwater containment were appropriate for the tar and tar debris (OU1).

In 1990, EPA and 56th Century amended the AOC to have 56th Century conduct a phased feasibility study (FS) of OU1 (Gradient Corporation and others 1990b). The phased FS was based on the risk assessment from the unapproved PEA. EPA disapproved of 56th Century's phased FS and completed the FS in 1992 (EPA 1992a).

EPA issued a ROD for OU1 of the Tar Lake site in 1992 (EPA 1992b). EPA's cleanup remedy for OU1 was to consolidate tar and contaminated soil in on-site containment cells and install an interim groundwater treatment system at the site. EPA would determine a final groundwater cleanup plan for the site that was to include soil beneath the excavated tar, groundwater, and other site areas (OU2). 56th Century conducted pre-design studies for the OU1 remedy in 1993-1994. 56th Century's pre-design studies (Environmental and Safety Designs, Inc. [ENSAFE] 1995) indicated that recycling and/or reusing the tar at the site for energy recovery would be viable and more cost-effective than constructing on-site containment cells.

EPA signed an action memorandum and issued a unilateral administrative order (UAO) to 56th Century to remove the tar at the site in 1998. 56th Century did not conduct the work, but agreed to pay a portion of EPA's fund-lead removal costs in a 1999 settlement agreement.

EPA selected recycling/reusing the tar for energy recovery in a 1998 ESD (EPA 1998). EPA began a fund-lead removal action at the site in 1998 (EPA 2000). A total of 47,043 tons of tar and tar debris was removed from Tar Lake and taken to an energy recovery facility as part of OU1. EPA backfilled the excavation with 1 foot of clean soil and installed a temporary liner in the lower areas of the excavation. In 1998, EPA also began a fund-lead RI/FS for OU2 to address the soil below the excavated tar, groundwater, and other site areas.

In 1998, MDEQ installed an on-site, in-situ biosparge groundwater treatment system downgradient of the tar removal area. The groundwater treatment system injects air into the groundwater and enhances conditions for biodegradation of benzene and 2,4-dimethylphenol. MDEQ also installed a network of groundwater monitoring wells upgradient and downgradient of the biosparge system. MDEQ has been sampling these wells since 1998 to monitor contaminant concentrations in the groundwater and evaluate the effectiveness of the system.

During the RI/FS, EPA detected site-related iron and manganese in residential wells above MDEQ aesthetic drinking water levels (CH2MHILL 1999). Benzene and 2,4-dimethylphenol were not detected in any of the residential wells. MDEQ provided bottled water to residents from 1999 until 2002. In 2002, MDEQ connected residents to the Mancelona water supply through a state-funded water supply expansion. A water line was also installed along Elder Road east of Route 131 to provide water for future site development. In 1999, EPA awarded a grant to Antrim County to evaluate redevelopment options for the Tar Lake site. Antrim County completed the Tar Lake Superfund Site Redevelopment Plan in 2000. The county's plan proposed recreational, civic, and commercial uses of the site, with residential use of less contaminated portions of the site.

EPA completed the RI/FS for OU2 in 2000. The main findings of the 2000 RI/FS were:

- MDEQ's groundwater monitoring data obtained after the tar removal indicated contamination of shallow on-site groundwater below the tar excavation with benzene, 2,4-dimethylphenol, and other chemicals. The maximum concentration of benzene detected in the groundwater was 52 µg/L, and the maximum concentration of 2,4-dimethylphenol was 54,000 µg/L. These concentrations exceeded the MCL and MDEQ RDWC for benzene of 5 µg/L and the MDEQ RDWC for phenol of 370 µg/L. The benzene concentration in the farthest downgradient on-site monitoring well (MW-06, downgradient of the air sparging system and about 100 ft from the site boundary) was still above the MCL and MDEQ RDWC at a concentration of 9 µg/L.

- Soil below the tar excavation was in close proximity to groundwater and was contaminated with high levels of VOCs, SVOCs, and metals. The chemicals in soil exceeded MDEQ RDWPC and were a continuing source of groundwater contamination. 2,4-dimethylphenol was detected in subsurface soil at a maximum concentration of 82,000 micrograms per kilogram (µg/kg)—above the MDEQ RDWPC for 2,4-dimethylphenol of 7,400 µg/kg. Other chemicals detected in subsurface soil above MDEQ RDWPC included 4-methylphenol, phenanthrene, and xylene.

- The creosote area contained a surface area of tar (approximately 100 ft by 100 ft by 1 foot thick) similar to the tar excavated from Tar Lake. The tar contained polynuclear aromatic hydrocarbons (PAH) and phenols at concentrations as high as 360,000 µg/kg. 2,4-dimethylphenol was detected in the surface tar at a concentration of 190,000 µg/kg—above the MDEQ RDWPC for 2,4-dimethylphenol of 7,400 µg/kg. Other chemicals detected in the creosote area tar above MDEQ DWPCs included 2-methylphenol, 4-methylphenol, phenanthrene, and phenol.

- Off-site groundwater samples collected from residential wells in the shallow drinking water aquifer were contaminated with iron at concentrations as high as 6,320 µg/L and manganese at levels as high as 186 µg/L. These concentrations exceeded MDEQ aesthetic drinking water standards but were not above EPA health-based risk levels. It should be noted, however, that these iron concentrations detected in the plume exceed the current State of Michigan drinking water standard of 2,000 µg/L. The groundwater from Tar Lake flowed off-site to the northwest and discharged to Saloon Creek about 5 miles downgradient of the site. Phenols were not detected in Saloon Creek surface water or sediment samples. Surface water sample concentrations in Saloon Creek did not exceed state or federal water quality standards.

- The iron production area, retort, chemical production area, and drainage ditch area did not pose any unacceptable risks to commercial/industrial workers (CH2MHILL 1999).

EPA signed the OU2 ROD for the site in 2002 (EPA 2002). EPA's selected remedy for OU2 was based on commercial, industrial, and recreational use, and includes the following major components:

- Continue to operate MDEQ's biosparge groundwater treatment system to prevent VOC and SVOC groundwater contaminants from moving off-site and to help return on-site groundwater to drinking water levels.

- Install groundwater circulation and soil bioventing systems in the Tar Lake excavation to increase air flow through soil and groundwater and the aerobic degradation of VOC and SVOC soil and groundwater contaminants. Restore soil to Michigan Part 201 soil criteria for residential drinking water protection and to site-specific values calculated for chemicals for which Michigan Part 201 criteria are not available for VOCs, SVOCs, arsenic and lead. Restore groundwater in the Tar Lake excavation to MCLs and Michigan Part 201 residential drinking water criteria for VOCs and SVOCs.

- Excavate VOC and SVOC-contaminated tar in the creosote area and transport it to an off-site energy recovery facility.

- Conduct long-term groundwater monitoring to verify effectiveness of the remedial action and monitor groundwater conditions over time.

- Implement institutional controls (IC) such as restrictive covenants to reduce the potential for exposure to on-site groundwater and restrict residential use at the site. The restrictions on groundwater use will apply until the groundwater is demonstrated to be below MCLs and Michigan Part 201 RDWC. The restrictions on residential use will apply until risks associated with residential use are properly assessed and determined to be acceptable.

EPA conducted a predesign investigation in 2002-2003 (Tetra Tech 2003). The predesign data indicated presence of approximately 21,000 tons of contaminated soil below the Tar Lake excavation instead of the estimated 45,000 tons. The amount of surface tar in the creosote area was 225 tons instead of 15,000 tons.

EPA collected additional soil samples from 1-3 ft below ground surface (bgs) and 6-8 ft bgs at seven locations in the ETA. Low VOC concentrations (less than 100 µg/kg total VOCs) were detected above background levels in each sample, including low concentrations (less than 10 μg/kg) of 1,2-dichloroethane and 1,1,2-trichloroethane in each sample. Low concentrations of SVOCs (less than 750 μg/kg total SVOCs) were detected above background levels in the 1-3 foot bgs and 6-8 foot bgs samples at one location (ET3). Cobalt was detected in one sample (ET1-0103) at a concentration (2.0 milligrams per kilogram [mg/kg]) greater than its background level. Copper was detected in six samples (ET1-0103, ET1-0608, ET2-0103, ET2-0608, ET3-0103, and ET5-0103) at concentrations above background levels. The concentrations ranged from 6.5 to 18.6 mg/kg. None of the cobalt and copper concentrations exceeded MDEQ statewide default background levels. None of the contaminants in the 2002 ETA samples exceeded its EPA Region 9 preliminary remediation goal (PRG) or MDEQ Residential Direct Contact Criterion (DCC).

In 2004, EPA determined it would be more cost effective to remove the contaminated soil from the Tar Lake area than to construct groundwater circulation and soil bioventing systems in the excavation. EPA issued an ESD (EPA 2004a) and began the remedial action.

In 2004, EPA conducted a remedial action to address the remaining tar identified during the 2002-2003 predesign investigation (EPA 2004b). EPA excavated 4,000 cubic yards (CY) of top soil and 8,000 CY of overburden (uncontaminated soil and slag) above contaminated subsurface soil in the Tar Lake excavation area. EPA removed the temporary liner over contaminated subsurface soil in the Tar Lake excavation area, on-site foundations, and other debris impeding remediation. A total of 21,482 tons of contaminated soil in the Tar Lake excavation area and tar in the creosote area was excavated and disposed of at a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill in Frederic, Michigan. This EPA remedial action did not address the tar in the ST area.

MDEQ continues to operate the biosparge system downgradient of Tar Lake. Semi-annual groundwater sampling occurs only at those monitoring wells considered part of the operation and maintenance (O&M) system in order to evaluate the effectiveness of the biosparge system. In 2009, EPA issued an ESD (EPA 2009a) clarifying that, under certain conditions, potable and non-potable groundwater use at the site would be acceptable.

EPA conducted the first five-year review (FYR) for the site in 2009 (EPA 2009b). EPA's FYR concluded that remedial actions in the Tar Lake area of the site (tar and soil removal, biosparge groundwater treatment system) would be protective in the short term. However, chemical concentrations in the groundwater within the north part of the Tar Lake area were continuing to increase, not having decreased to MCLs and MDEQ drinking water criteria as expected. At the time of the FYR, the data indicated that the increased chemical concentrations in the groundwater were not spreading downgradient because of the effectiveness of the biosparge system. However, more recent data (April 2010) indicated that downgradient chemical concentrations in MW3A-S had increased following the 2008 adjustments to the biosparge system.

Long-term protectiveness at the OU2 – Northern Areas portion of the Tar Lake site requires compliance with effective ICs, which EPA and MDEQ are still working to implement. Also, EPA's 2007 title search indicated AIW ownership of some areas of the approximately 200-acre site that had not been included in previous investigations. The FYR concluded that for the site to be protective in the long term, acquisition of additional information would be necessary, including:

- Data to demonstrate the on-site potable well on PIN 05-11-130-003-00 does not contain any chemicals above applicable or relevant and appropriate (ARAR) drinking water criteria (i.e., MCLs and MDEQ industrial/commercial criteria).
- Data to demonstrate the 3.48-acre residential (RES) area northeast of the original operations area does not contain site-related contamination above residential standards, and can be deleted and designated as UU/UE with the rest of the adjacent ETA.
- Data to determine whether the tar in AIW's underground smoke tunnels under and adjacent to Elder Road is a source of groundwater contamination.

In 2011-2012, EPA conducted additional soil and groundwater investigations to obtain the necessary information listed above, determine the cause of increasing groundwater contamination in the Tar Lake area of the site, and determine if other sources of groundwater contamination were present in this area. The investigations demonstrated the presence of approximately 138,000 tons of contaminated soil at the site above the remediation objectives documented in the 2002 ROD for the site.

In the low-lying Tar Lake area of the site, upgradient of the biosparge system, the contaminated material extends to 10 ft below the water table. Groundwater in this area is highly contaminated due to the presence of the saturated source material. Some of the groundwater contamination has moved beyond the northern extent of the biosparge system, across Elder Road and toward the site boundary.

EPA and MDEQ evaluated a range of cleanup options for addressing the additional soil and groundwater contamination. EPA selected an expanded cleanup remedy for these areas in an ESD EPA issued on September 19, 2013 (EPA 2013). The expanded remedy includes excavating the contaminated soil for off-site disposal and expanding the biosparge system to the north, across Elder Road, and farther upgradient into the low-lying Tar Lake area. The ESD also updated the remediation objectives to match applicable current MDEQ objectives and add additional remediation objectives for compounds not included in the 2002 ROD.

An EPA audit of the laboratory used to perform soil and groundwater analysis on the August 2012 samples determined that some organic sample results did not meet EPA quality standards and were therefore rejected. In 2014, EPA directed SulTRAC to re-collect soil and groundwater samples that were pertinent to the remedy evaluation. The re-sampling also determined that RES area does not contain site-related contamination above residential standards and has since been designated as UU/UE.

EPA conducted the second FYR for the site in 2014 (EPA 2014). EPA's FYR concluded that remedial actions completed in the Tar Lake area of the site are protective in the short term. There are no uses of the site or on-site groundwater that are inconsistent with the short-term protectiveness of the remedy or the RAOs in the 2002 ROD, 2009 ESD, or 2013 ESD. However, additional actions necessary for the site to be protective in the long term were identified. These actions included:

- Implementing the 2013 ESD for the additional soil excavation and biosparge groundwater treatment system expansion in the Tar Lake, smoke tunnel, and creosote areas of the site. Determine if slag exceeds cleanup criteria and requires excavation.

- Work with the Health Department of Northwest Michigan (HDNM) and the Mancelona Area Water and Sewer Authority (MAWSA) to identify any additional well users downgradient of the site. Evaluate which wells should be sampled during upcoming investigations or monitoring.

2.4 GEOLOGY AND HYDROGEOLOGY

According to the 1999 RI report (CH2MHILL 1999), two principal aquifers are within the glacial drift present at the site. The upper unconfined aquifer is within approximately 100-foot-thick deposits of glacial outwash composed of sand and sandy gravel. The underlying confined aquifer is approximately 150 ft bgs in sand deposited within the less permeable, clayey glacial moraine material. The uppermost bedrock unit is the Antrim Shale. Between 2009 and 2012, the groundwater table in the unconfined glacial outwash aquifer (as determined from shallow MDEQ biosparge system monitoring wells MW-1A through MW-3C) has ranged from approximately 41 to 70 ft bgs (1,047 to 1,049 ft above mean sea level [amsl]). Groundwater within the upper unconfined aquifer at the site flows to the northwest and discharges to Saloon Creek about 5 miles downgradient of the site.

2.5 GROUNDWATER

The horizontal groundwater flow direction in the upper unconfined sand aquifer is from east-southeast to west-northwest across the site (toward Saloon Creek) with an average horizontal groundwater gradient of 0.009 foot/foot (ft/ft) (as calculated using MDEQ April 2015 groundwater elevation data).

Based on a site-specific hydraulic conductivity of 24.4 feet per day (ft/day) (CH2MHILL 1999) and an effective porosity of 0.3 (unitless), and assuming the April 2015 hydraulic gradient cited above, the calculated groundwater seepage velocity is 0.73 ft/day (approximately 267 ft/year).

2.6 SURFACE WATER

Peckham Lake is located east of Tar Lake and within the site boundary. According to the 1999 RI report (CH2MHILL 1999), it is up to 70 ft deep and in direct hydraulic connection with groundwater.

A small portion of Nelson Lake is also located within the site boundary. It is located north of Tar Lake across Elder Road and is approximately 30 ft deep (CH2MHILL 1999).

2.7 NATURE AND EXTENT OF CONTAMINATION

This section discusses the current nature and extent of contamination in subsurface soil and groundwater as determined from the previous field investigations summarized in Section 2.3.

2.7.1 Previous Field Investigations

Remedial actions for the site occurred in 1998 and 2004. In addition, the biosparge system has been operating at the site since 1998. These activities led to current conditions at the site, further discussed as:

(1) Subsurface soil

Excavations in 1998 and 2004 removed soil containing contaminant of concern concentrations exceeding site-specific RAOs specified in the 1992 ROD. The 2011-2012 investigation focused on determining contaminant concentrations within remaining soil at the site that is contributing to groundwater contamination. As documented in the 2013 ESD, approximately 138,000 tons of soil above cleanup criteria was determined to remain at the site.

(2) Groundwater

Results of the MDEQ groundwater monitoring indicate that groundwater concentrations of benzene, 2,4-dimethylphenol, and total methylphenols have not decreased to below cleanup criteria as anticipated.

2.7.2 Recent Field Investigation

A subsurface investigation was performed by SulTRAC in October 2015 as part of the remedial design. The primary objectives of the pre-design investigation were to conduct the following:

- An investigation of subsurface soil in and adjacent to proposed excavation areas to refine the extent of contaminated soil requiring removal (as identified during previous sampling events)
- An investigation of groundwater immediately upgradient of the Tar Lake depression to verify proper horizontal and vertical expansion of the biosparge system
- An investigation of groundwater near the proposed north end biosparge groundwater treatment system expansion to verify proper horizontal and vertical extents of system design
- An investigation of slag present within the Tar Lake and Smoke Tunnel areas to determine if it is a contributing source to inorganic groundwater contamination.

The investigation identified some excavation areas that required expansion, verified that the proposed biosparge expansion extents are correct, and determined that slag is not a contributing source to inorganic groundwater contamination. The results of the pre-design investigation were documented in a Data Evaluation Summary and Basis of Design Report submitted June 1, 2018 (SulTRAC 2018).

3.0 REMEDIAL DESIGN METHODS, ASSUMPTIONS, AND CRITERIA

The following sections discuss the basis for the remedial design of the site. The basis of the analysis and assumptions that support the design were derived from the 2002 ROD (EPA 2002), 2004 ESD (EPA 2004), 2013 ESD (EPA 2013), Investigation Report and Remedial Alternatives Evaluation (SulTRAC 2013), and the Data Evaluation Summary and Basis of Design Report (SulTRAC 2018).

3.1 DESIGN BASIS

EPA's 2013 ESD specifies that the selected remedy for northern portion of OU2 is Alternatives Combination 1 of the Investigation Report and Remedial Alternatives Evaluation (SulTRAC 2013). The report presented a conceptual design of the system components selected. Conceptual design included contracting, soil excavation, passive groundwater treatment via biosparge system expansion, and groundwater monitoring.

3.2 BIOSAPRGE REMEDIAL ENHANCEMENT

This section presents a basis of design for the remediation enhancements and combinations of enhancements to be incorporated into the site remedy as supplementary to the selected soil and groundwater alternatives specified in the final FS report for the site, dated August 7, 2000 (CH2MHILL 2000). Residual soil contamination in unsaturated and saturated areas at the site is a continuing source of groundwater contamination. These remediation enhancements involve source area remediation via excavation of contaminated soils and biosparging to ultimately reduce contaminant of concern (COC) concentrations in the groundwater contamination plume below MCLs.

3.3 BIOSPARGING BACKGROUND

The existing in situ biosparge groundwater remediation system was installed downgradient of the source removal area in 1998 and has been operating at the site since. The biosparge system was designed to contain the groundwater contamination plume and eliminate further migration by treating the contaminated groundwater as it naturally passes through the system. Biosparging enhances biological degradation of aerobically biodegradable organic COCs by injecting air into the groundwater, thereby increasing dissolved oxygen (DO) concentrations in the groundwater and oxygen gas concentration in the vadose zone. Biosparging differs from conventional air sparging in that the air injection rates are typically lower and the primary goal is to increase DO concentrations in groundwater and minimize volatilization of contaminants. Because of the lower air flow rates used in biosparge, compared to air sparging, less stripping of dissolved contaminants occurs, biosparging is often conducted without vapor recovery by a soil vapor extraction (SVE) system, especially when vapor intrusion into nearby structures is unlikely.

Biosparging has long been demonstrated as effective for reducing concentrations of benzene, naphthalene and other petroleum hydrocarbons. Biosparging's effectiveness at reducing concentrations of the other organic COCs, 2,4-dimethylphenol and total methylphenols is less well-documented mostly because they are less common groundwater contaminants than petroleum hydrocarbons), but aerobic biodegradation of 2,4-dimethylphenol and methylphenols is well-documented (EPA 1999).

In addition, the mobility of inorganic COCs can be reduced via oxidation and subsequent precipitation and adsorption as unstable ferric oxide or oxyhydroxides. However, precipitated inorganic COCs that do not sorb to the aquifer material in the vicinity of the biosparge system and continue to migrate as colloidal particles downgradient with groundwater flow can revert back to their unoxidized state downgradient of the biosparge system, as soon as oxygen levels decrease or if the biosparge system is turned off. Thus, in the presence of decreasing oxygen levels in the groundwater, as the groundwater migrates downgradient of the oxygenated zone created by the biosparge system, the inorganic COCs not directly sorbed but present as colloidal particles of unstable ferric oxide or oxyhydroxides may release the oxygen and revert back to their dissolved and more mobile states.

In addition, biodegradation of organic COCs produces increased concentrations of dissolved iron and manganese as byproducts of the biological process. Thus, the biosparge system increases available oxygen to enhance the natural biological activity, thereby biodegrading the organic COCs. This increased biological activity uses up oxygen and produces dissolved iron and manganese in the biological reaction zone, which will then migrate downgradient from the biosparge system with natural groundwater flow. Concentrations of dissolved iron and manganese are expected to increase in the groundwater downgradient of the biosparge system as a result of the biodegradation occurring because of increased oxygen levels in the groundwater. Iron and manganese may temporarily precipitate out in unstable ferric oxide or oxyhydroxides forms in the immediate vicinity of the biosparge system, but may revert back to the dissolved states as oxygen gets used up by the microbes, and groundwater becomes less oxygenated further downgradient of the biosparge system. This may increase dissolved iron and manganese concentrations downgradient of the biosparge system due to the production of biodegradation byproducts and the uptake of oxygen from the unstable ferric oxide and oxyhydroxide forms of the inorganic COCs. Therefore, dissolved iron and manganese are not expected to be fully remediated by the biosparge system, and concentrations of these may increase downgradient of the biosparge system due to biodegradation of the organic COCs releasing the byproducts of dissolved iron and manganese. When the biosparge system is turned off, groundwater will revert back to its natural reduced (low or no oxygen) condition, and the less stable iron oxide and oxyhydroxide precipitates formed in the biosparge area may release oxygen and revert back to the dissolved iron and manganese. The dissolved iron and manganese will then migrate downgradient.

3.4 EXISTING BIOSPARGE SYSTEM

The existing biosparge system consists of 20 sparge wells installed to depths of approximately 85 ft bgs (elevation of bottom of sparge wells is approximately 1,020 ft). The biosparge wells are spaced approximately 40 ft apart, in a north-south transect downgradient of the OU1 source area (see Figure 2). The biosparge wells are screened approximately 30 ft below the historical groundwater table.

Each biosparge well is individually piped, and air flow is controlled via ball valves located in the biosparge building. Each biosparge well is finished at grade in a standard flush-mount manhole. The piping is installed in a lateral piping trench leading to the compressor building.

The biosparge system is housed in the compressor building. The equipment in the compressor building is cooled by fans and vents in the summer and heated by an electric heater in the winter. Ambient air enters the compressor through an inlet filter and a 30-horsepower Kaeser Compressor Model AS-36 rotary screw compressor compresses the air to approximately 120 pounds per square inch (psi). The compressed air is then conditioned and cleaned as it then flows into a 200-gallon air receiver tank, then through an oil coalescer and desiccant dryer, and a charcoal filter. Because the compressor's rotary screws are lubricated with oil, the air contains a mist of oil, which must be removed from the air stream. Additionally, as the compressed air pressure is reduced from 120 psi, to the manifold pressure of approximately 28 psi, condensation of water vapor occurs, and condensate accumulates in the receiver tank and the air dryer. This oil/water mixture is collected in a 185-gallon condensate storage tank and disposed of off-site. According to O&M personnel, the system generates approximately 250 gallons of condensate per year. The condensate is disposed of off-site as nonhazardous condensate water and oil (AMEC 2015).

A dial-up speaker phone in the compressor building allows monitoring of the system from a remote location by dialing in to hear whether or not the system is running. Four pairs of sparge system monitoring wells (SPW) are installed near SP-1, SP-4, SP-9, and SP-14. These SPWs consist of nested pairs installed at distances of 5 ft and 15 ft from the sparge wells. These monitoring wells are installed at depth intervals that are 10 ft apart to allow acquisition of monitoring data at designated spacings.

3.4.1 Existing Biosparge System Operational History

For the past several years, the system has injected air into the aquifer at approximately 8 standard cubic feet per minute (scfm) per well for 10 hours per day. The biosparge system is on a timer and runs 10 hours on and 14 hours off per day, 7 days per week. The system is currently operated and maintained by MDEQ and its contractor.

The 10 hours on, 14 hours off schedule is based on MDEQ optimization tests conducted during system startup in 1998. The tests indicated that 10 hours of operation increased dissolved oxygen levels in the groundwater above the 1 milligram per liter (mg/L) range needed for biodegradation, and that after 14 hours of downtime, oxygen levels decrease back to zero. The operation schedule was intended to provide enough oxygen to the aquifer to enhance conditions for biodegradation, without leaving excess oxygen in the groundwater to cause iron and manganese to precipitate out and foul the biosparge wells. During the first few years of operation, it was determined that the wells SP-15 through SP-19 were outside of the VOC plume and their operation was no longer needed. Groundwater levels at the site have fluctuated by approximately 6 ft since 1998 as shown on Figure 3.

3.5 BIOSPARGE SYSTEM EXPANSION

Biosparge system expansion is necessary to reduce VOC mass near the northern end of the existing biosparge system, reduce the potential for VOC mass to migrate around the system, and reduce the mass of VOCs present in groundwater in the source area.

The proposed biosparge system expansion is focused on two main areas, (1) extension of the northern portion of the existing biosparge system with 8 new biosparge wells and (2) extension into the source area with 21 new biosparge wells. The biosparge system expansion will include a total of 28 new biosparge wells.

The basis of design for the proposed biosparge system will be based primarily on the existing system, as that system has operated successfully for over 15 years. The proposed biosparge wells will be screened approximately 30 ft below the groundwater table, with flow rates of 8 scfm, injection pressures of 10 to 20 psi, and a radius of influence of approximately 25 ft. Because the site groundwater elevations have fluctuated by approximately 6 ft since 1998 (Figure 3), the proposed system will be designed with spare injection pressure capacity to accommodate a 10-foot increase in groundwater elevation (approximately 4.3 psi).

3.5.1 Biosparge Expansion

The proposed biosparge expansion well layout includes 28 wells and is shown on Figure 4 and Drawing C-2. The 28-well expansion layout includes 21 wells located in the OU1 (Tar Lake depression) area, while the remaining 7 biosparge wells extend north across Elder Road. The design is consistent with the operating biosparge system (AMEC 2015).

The biosparge well layout in the northern end of the site consists of two rows of biosparge wells extending north from SP-0 across Elder Road. The spacing of these biosparge wells is approximately 40 ft, to allow their ROIs to overlap and reduce the potential for gaps. The extension is approximately 25 ft further north than the anticipated extent of contamination.

The proposed biosparge treatment system expansion includes 21 biosparge wells in the OU1 area. These 21 proposed biosparge wells are placed in groups of three or four wells along six rows (see Figure 4 and Drawing C-2). The rows are placed roughly perpendicular to the local hydraulic gradient and in alignment with the organic COC plume. The rows are more closely spaced (approximately 75 ft apart) where plume concentrations are highest. The rows are spaced approximately 100 ft apart where plume concentrations are lower.

The natural groundwater gradient will advect and disperse groundwater containing high DO concentrations downgradient to treat organic COCs.

3.6 BIOSPARGE SYSTEM CONSTRUCTION

The biosparge system will be fabricated off-site by a company specializing in air sparge system fabrication. Similar to the existing biosparge system, the planned biosparge system will be housed in a skid-mounted building or shipping container, the minimum dimension will be 8 ft by 24 ft. Construction of the building will likely be similar to a mobile home, with a steel frame on the bottom and standard two-by-four construction. The construction specifications will also allow the contractor to potentially re-use a steel shipping container, however, standard shipping container dimensions are 8 ft by 20 ft or 8 ft by 40 ft, with some nonstandard 8 ft by 30 ft units available.

The biosparge system will be mounted level on six reinforced concrete piers. The piers will likely be 2 ft in diameter and 4 ft deep. Anchor bolts will be sized to hold the unit in place and resist the appropriate design wind and seismic loads in accordance with local building codes.

The proposed location of the biosparge system is approximately in the center of the biosparge well field, to minimize the length of trenching and piping. The location also minimizes the length of the new electrical service and water service.

The biosparge system operation will be controlled by a programmable logic controller (PLC) that will be used to monitor operations, open and close solenoid valves to pulse air flow to different biosparge wells and activate automatic system shutdown if necessary. The PLC and the biosparge system operational status will be accessed by a touch screen human machine interface (HMI) and password-protected internet access via land-line telephone. The following sections detail each major piece of biosparge equipment and instrumentation, starting from the air compressor to the biosparge wells. Drawing I-2 shows the piping and instrumentation diagram (P&ID) for the system and Drawing M-1 shows the general proposed layout of the equipment in the biosparge building.

3.6.1 Biosparge System Heating, Ventilation, and Air Conditioning

The biosparge building will be insulated with R-21insulation, as required by the Michigan Uniform Energy Code. The building will be equipped with a thermostat-controlled louvered vent to provide cooling during the summer months and a thermostat-controlled heater for heating during the winter months. The biosparge equipment, especially the air compressor, typically requires an operating environment between 32 and 104 degrees Fahrenheit (^{0}F), although exact temperatures may vary slightly from manufacturer to manufacturer. Despite the building ventilation, the biosparge building temperature may exceed 104^{0}F on hot sunny afternoons. During the hot temperature periods, the biosparge system will automatically shut down, until the building temperature decreases to 94^{0}F, when the system will automatically re-start.

The heat generated by the air compressor will usually be sufficient to maintain the building temperature above 32 degrees. If necessary during very cold periods, the thermostat-controlled heater will maintain the building termperature at minimum of 40^{0}F, which is the above the rated temperature for the air compressor. Additionally, during periods when the air compressor is off, the thermostat controlled heater will heat the building to 40^{0}F and prevent freezing of water that may be in the equipment or piping, which could potentially damage the equipment.

3.6.2 Biosparge System Air Compressor (C-101)

The main component of the proposed biosparge system will be a rotary claw air compressor (C-101). The air compressor will be a 20-horsepower unit capable of producing 150 scfm at 32 psi, likely an Elmo-

Rietcshle DLR-250. An inlet filter on the unit (F-100) will filter the incoming air to 10 microns. Inlet air will be from outside the building to maintain a lower inlet air temperature.

A rotary claw compressor is recommended instead of a screw compressor that is used in the existing boundary barrier biosparge system because it is more energy efficient. According the boundary barrier biosparge system operating records, the existing biosparge wells have a backpressure of 10 to 21 psi at flowrates of 8 scfm. The existing biosparge air compressor (and most typical screw air compressors) are designed for a discharge pressure of 120 psi, which is significantly higher than needed and results in wasted energy. A rotary claw compressor discharge pressure of 32 psi is lower, resulting in less wasted energy. Thus, a 20-horsepower rotary claw compressor produces the same air flow rate as a 30-horsepower screw compressor, for a 33 percent reduction in energy usage. Additionally, the proposed biosparge system will be equipped with a variable frequency drive (VFD), so that its operating speed rate can be modulated to closely match the desired pressure and air flow rate, resulting in even higher energy efficiency.

An analog pressure gauge (PI-101) and a pressure indicating transmitter (PIT-101) will monitor the discharge pressure of the air compressor. A high pressure alarm (PAH-101) will activate at 31 psi and shut the system down to prevent damage from overpressure. The air compressor will also be equipped with a pressure relief valve (PSV-101) that will activate at 32 psi as a redundant control to prevent the air compressor from overpressure damage. An analog temperature gauge (TI-101) will be used to monitor the discharge temperature of the air compressor.

Another advantage of a rotary claw compressor is that the compressed air does not contact any coolant or lubricating oils, as it does in a rotary screw compressor. Thus, there is need for oil coalescing filters and the condensate generated by the compressor will be oil free and can be discharged to the ground, whereas the existing screw compressor generates approximately 250 gallons of oily water, requiring off-site disposal as nonhazardous waste.

Noise from the air compressor will be near 85 decibels and O&M personnel inside the biosparge building will be required to wear hearing protection. The compressor and other equipment will be enclosed in an insulated building, which will attenuate the noise and will not likely be noticeable to any nearby residents or businesses.

3.6.3 Air Compressor Heat Exchanger (H-102)

The air coming out of the air compressor will range from approximately 300 to 380^{0}F and requires cooling to protect downstream instrumentation and equipment from damage by the high temperature. The hot discharge from the air compressor travels through the finned tubes of the heat exchanger (H-102). A fan continuously blows cooler ambient air through the finned tubes, cooling the compressed air. Pipe upstream of the heat exchanger will be hot. The length of exposed hot pipe will be minimized to the extent possible, guards or insulation will be installed on the pipe, and warning signs will be placed on the pipe to reduce the potential for O&M personnel to touch the hot pipe.

Thermostat-controlled dampers on the heat exchanger will open or close as needed to direct the hot heat exchanger air back into the biosparge building during cold weather or outside the biosparge building during warm weather. This will reduce the need for supplemental heating and cooling of the building. Both the air intake and discharge of the heat exchanger will be located on the southern side of the building, directing noise away from nearby residences and businesses.

A manual temperature gauge (TI-102) and temperature transmitter and associated high temperature alarm (TIT/TAH-102) will be used to monitor the temperature of the heat exchanger discharge and will shut down the system in the event of a high temperature alarm.

3.6.4 Air Receiver (T-103)

A 120-gallon air receiver will be located downstream from the heat exchanger. Condensate and moisture from the heat exchange will drop out in the air receiver. A timer-activated drain valve will periodically drain any accumulated condensate to the ground under the biosparge system building. Because the air compressor is oil-less, the condensate will consist of only water and contain no oil. The condensate generation rate is expected to be similar to the existing system, at approximately 250 gallons annually, with most of this condensate being generated during the summer months, when there is more moisture in the ambient air. A 2-foot deep gravel pit will be installed below the biosparge building will allow the discharged condensate to infiltrate into the soil without ponding.

3.6.5 Manifold Instrumentation

Instrumentation and valving upstream of the manifold includes a manifold pressure gauge (PI-103) and transmitter (PIT-103), a total air flow meter (FI-103) and transmitter (FIT-103), a check valve, and a ball valve. The air flow meter will measure the total air flow rate to the wells and will be a venturi-type flowmeter that is low-cost, good accuracy, and low pressure drop. The pressure transmitter and flow transmitter will transmit system pressure and flow to the PLC for datalogging and allow O&M personnel to remotely monitor system operations.

The check valve will be a dual-disk wafer style valve that has very low pressure drop and will prevent the accidental or inadvertent backflow of groundwater into the blower.

All piping between the blower discharge and the individual wells will be 3-inch galvanized steel piping. Galvanized steel piping is compatible for compressed air service, readily available, inexpensive, easy to fabricate, and compatible with high temperatures.

3.6.6 Manifold and Solenoid Valves

Compressed air will be distributed to the 28 biosparge wells by a 3-inch diameter manifold. The manifold will distribute air to eight groups of three or four wells. Each group of wells will have a solenoid valve that can be set to open and close based on a user-adjustable schedule to deliver air to the aquifer at user-set intervals.

Pulsing airflow in a sparge system can improve distribution of air in the aquifer as continuous air flow can be channelized along preferential pathways and reduce uniform distribution of sparged air in the aquifer. By pulsing the system, the air pathways are more likely to open and close and follow new pathways, reducing channelization of airflow and improving distribution of air and oxygen in the aquifer (USACE 2013).

It is anticipated that a sparging schedule of 12 hours on / 12 hours off will be used for each well. Thus, half of the new biosparge wells will be active from 12:00 a.m. to 12:00 p.m., then the solenoid valves will open to the previously inactive wells, and the solenoid valves will close for the previously active wells from 12:00 p.m. to 12:00 a.m. This proposed operating schedule is similar to the schedule of 14 hours on/10 hours off schedule will be used for the original biosparge system operation and was successful in limiting precipitate fouling of the biosparge wells. Operating the system in this manner will allow the use of a smaller air compressor and ancillary equipment, reducing capital and O&M costs.

Adjustments to the operating schedule will be made, if necessary, based on observations in the monitoring wells or signs of sparge well fouling (such as increased injection pressure and reduce air flow rate).

The solenoid schedule will automatically overlap the open and close times of the solenoid valves by 1 minute. That is, the solenoid valve for the next set of wells will be open for 1-minute before the solenoid valve for the previous set of wells closes—this will prevent a potential high pressure alarm.

The flexible cross-linked polyethylene (PEX) tubing to each sparge well can be easily disconnected and connected using the push-fit connections to different solenoid valve by O&M for additional operational flexibility. For example, if it is determined that a certain group of wells require longer sparge times to increase the biodegradation rate in a certain portion of the plume, the tubing to these wells can be connected to the same solenoid valve and that solenoid valve could be programmed to operate for longer periods, such as 16 hours on, 8 hours off.

3.6.7 Individual Biosparge Well Instrumentation

Each of the 28 biosparge wells will be equipped with identical valving and instrumentation. First, a 1-inch ball valve will be used to manually adjust the air flow rate to each well, or shut off the well entirely. Ball valves have low pressure drop and adequate throttling characteristics to adjust the flow rate to each well to the desired flow rate of 8 scfm.

A variable area rotameter (FI-101 through F-128) will be used to monitor air flow rate to each well. Rotameters provide accurate and simple visual indication of air flow rates. Lastly, an analog pressure gauge (PI-101 through PI-128).

3.6.8 Biosparge System Distribution Piping

The piping to each biosparge well will be PEX tubing. The proposed routing of the piping to each well from the biosparge system is shown on Drawing C-2. PEX tubing is inexpensive, flexible, and has a pressure rating of 80 psi at 200^{0}F, which well exceeds the maximum pressure and temperature of the sparged air (following the aftercooler). PEX comes in 100- to 1,000-foot rolls, reducing the number of couplings, which reduces the potential for leaks and speeds construction time. The ability to bend PEX tubing also reduces the need for elbow fittings to change direction. PEX is easier to join than high density polyethylene piping, which must be joined by a heat butt fusion machine or expensive electrofusion couplings. PEX tubing can be joined by a number of inexpensive and reliable push-fit fittings. PEX tubing is more durable and less prone to breakage than polyvinyl chloride (PVC) pipe and fittings. The push-fit fittings will be specified to be compatible for long-term direct-bury, underground service or will be protected using the manufacturer's specified wrap for underground service.

The biosparge conveyance piping will be installed in 42-inch deep trenches, which is the frost depth in northern lower Michigan. This burial depth will be sufficient to reduce the potential for pipe damage resulting from freezing of any accumulated condensation in the PEX piping. The trench width will be only as wide as necessary for the piping installation and will be backfill to grade with excavated trench spoils compacted to 92 percent maximum dry density in accordance with ASTM D 698 (standard Proctor). Under East Elder Road, the trench will be backfilled with controlled low strength material (CLSM), a self-compacting lean concrete that will protect the piping from road loading, minimize settlement, and provide quick construction minimize the period of time needed for road shutdowns. The trench will be topped with asphalt to match existing thickness and meet Michigan Department of Transportation specifications (see Drawing C-4).

Three spare PEX tubes will be run across Elder Road and terminated in an irrigation box on the north side of Elder Road. Additionally, a 6-inch diameter PVC pipe will be installed under Elder road. If future expansion of the biosparge system north of Elder Road is needed, the three spare tubes could be used to connect additional biosparge wells without trenching across Elder Road. Furthermore, if northern expansion with more than three additional biosparge wells is necessary, the 6-inch PVC pipe could be used as a conduit to install additional biosparge tubing under Elder Road.

3.6.9 Biosparge System Wells

The biosparge wells will be installed to depths similar to the existing biosparge wells, approximately 30 ft below the current water table at an elevation of approximately 1,022 ft amsl at the southern end of the biosparge well field to 1,017 ft amsl at the northern end of the biosparge well field. Biosparge wells will be installed via an 8-inch diameter hollow stem auger. The borehole will be logged during installation and the field geologist will confirm that the biosparge screen interval is in permeable lithology suitable for air sparging. If low permeability clay or silt is present at the proposed screen depth, the field geologist will make a field change and install the sparge screen in a more suitable, higher permeability lithology.

Biosparge well construction details are shown on Drawing C-3. The biosparge well screens will be 2-foot long, 2-inch diameter, 0.020-inch slot size PVC wire-wrapped well screens. This screen size is the same as the existing biosparge system.

A 2-foot long silt sump will be installed below the biosparge well screen to collect sediment or precipitate that may accumulate in the well. A 4-foot long 20 by 8 mesh sand pack will be installed 1 foot above and below the biosparge wells screen. Schedule 40 flush-threaded well riser pipe will extend to the surface. Above the sand pack, will be a 2-foot thick bentonite seal, and then bentonite grout to the surface.

The compressed air piping connection to the well will be made 42-inches underground. A 1-inch brass curb stop valve will be used to isolate the air sparge well for pressure testing. A valve box will allow O&M personnel to open or close the valve with a standard water service valve key. A schedule 80 PVC 2-inch socket x 2-inch socket x 1-inch threaded tee will be installed on the riser of the biosparge well, to connect the biosparge well to the compressed air conveyance piping. On top of the tee, a schedule 80 PVC pipe will be capped with a threaded cap inside a 12-inch diameter well vault. The airtight, but removable cap will allow access to the biosparge well, for potential water level measurements, groundwater sampling, or well rehabilitation. The surface completion of the biosparge wells will be a 3-foot by 3-foot concrete pad installed approximately 3-inches above surrounding grade.

3.6.10 Control System

A PLC will control all system operations, including system startup, solenoid valve operation, and system alarms and shutdown. An HMI screen in the biosparge building will provide O&M personnel access to system operating conditions. A land-line telephone will allow the O&M personnel password protected access to the PLC to monitor system status, manifold pressure, manifold flow rate, injection temperature, and active sparge wells. The PLC will cumulatively log the total system run time in hours, and the cumulative sparge time for each 4-well solenoid valve group.

The system startup sequence will be to open the desired biosparge solenoid valves, turn on the heat exchanger (H-102), and start the air compressor (C-102).

Two alarm conditions and an emergency stop button will activate the emergency shutdown interlock sequence. These conditions are:

1. High Pressure Alarm (PAH-101). If a high pressure incident is detected (where the air compressor discharge pressure is near its deadhead pressure, the emergency shutdown interlock will be activated.
2. High Discharge Temperature Alarm (TAH-103). If the temperature of the air entering the manifold exceeds 140^{o}F, the emergency shutdown interlock will be activated.

The emergency shutdown interlock will shut off the air compressor (C-101) first. After 5 minutes, the heat exchanger (H-102) will shut off (this delay will allow the heat exchanger to fully cool down the air in the heat exchanger. An autodialer on the PLC will send an email or a text message to O&M personnel indicating the time, date, and cause of the shutdown.

An automatic re-start sequence will be programmed into the PLC, to safety re-start the system and resume biosparging system after a power outage occurs. This will reduce unnecessary system downtime and personnel trips to re-start the system after a power outage.

3.7 BIOSPARGE SYSTEM O&M

The biosparge system has been designed to minimize system O&M, while maintaining cost-effectiveness and simplicity. A complete biosparge system O&M manual will be prepared after system construction, and the O&M requirements could change based on the equipment and instrumentation used. However, the anticipated system O&M requirements of the biosparge system are summarized in Table 3-1 below. In general, O&M is anticipated to take approximately 3 hours on site each month, and 6 hours on site during the annual visit.

TABLE 3-1. BIOSPARGE O&M REQUIREMENTS

Item	Frequency	O&M Task
System Pressure and Flow Rate	Weekly	System PLC will automatically send an email to O&M personnel summarizing system operations, including manifold average pressure, and air flow rate, average sparged air injection temperature, system uptime, and cumulative sparge hours for each four-well sparge zone.
Inlet Air Filter (F-100)	Monthly	Inspect air filter element, clean if dirty, replace if necessary. Cleaning and replacement are dependent on dustiness of ambient air, it is anticipated that the filter will require changeout every 6 months.
Air Compressor (C-101) Oil Level	Monthly	Check air compressor oil level, top off if needed, investigate possible cause of oil consumption
Heat Exchanger (H-102) and Biosparge Well Flow Rate and Pressure	Monthly	Cycle through all solenoid valve zones, allowing pressure and flow to equilibrate for 5 minutes, record pressure and flow rate to each well. Adjust pressure and flow rate, if necessary. Record all adjustments.
General System Checks	Monthly	Check biosparge system for proper operations. Inspect for air leaks, proper solenoid valve operations, abnormal noises, proper HVAC system operation, signs of vandalism, etc.
Air Compressor (C-101) Oil Change	Every 8,000 hours of operation (annually)	Change gearbox oil

Item	Frequency	O&M Task
Biosparge Wellheads	Annually	Inspect each wellhead for signs of damage or leakage, repair if necessary.

During the 16 years of the boundary biosparge system, the pulsed operation of the biosparge wells was largely successful in limiting clogging of the biosparge wells by precipitation. Figure 5 shows the average injection pressure to the operating biosparge wells in the boundary biosparge system. An increase in biosparge pressure (with air flow rate constant, as is the case here), indicates that the groundwater level has increased or the wells is becoming clogged. As shown in Figure 5, most of the biosparge wells have shown a slight increase in injection pressure that strongly correlates to the increase in groundwater levels (Figure 3). However, since 2010, two biosparge wells, SP-9 and SP-14, clogged and were replaced with new wells. Despite the intention of continuing a similar pulsed operation to minimize precipitation formation, it is likely that some wells will clog and may require rehabilitation by either acid washing or replacement well installation.

3.8 BIOSPARGE SYSTEM PERFORMANCE MONITORING

The proposed biosparge system performance in progressing toward remedial action objectives will be monitored by groundwater monitoring that will be conducted at a network of existing and proposed monitoring wells at the site. Five nested groundwater monitoring wells (MW-BS5 through MW-BS9) designed to be part of the biosparge system O&M have already been installed at the site. Monitoring well nests MW-BS5 and MW-BS6 (and existing monitoring well MW-13, if water is present) will be used to confirm that the expanded biosparge system is successfully treating organic COC at the northern end of the biosparge system barrier. Monitoring well nest MW-BS7 was installed 115 ft sidegradient (north) of the new proposed biosparge wells. This monitoring well nest will be used to confirm that organic COCs are not migrating around the expanded biosparge system. Monitoring well nests MW-BS8 and MW-BS9 were installed downgradient (425 ft and 210 ft, respectively) of the new proposed biosparge wells to confirm that the expanded biosparge system is successfully treating organic COC to below remediation objectives at the western site boundary.

Up to five new nested groundwater monitoring wells, MW-BS1 through MW-BS4 and MW-BS10, will be installed near the new biosparge wells and screened at three different depths (approximately 70, 90, and 120 feet bgs). Well nests MW-BS1 and MW-BS3 will be installed approximately 25 ft downgradient of new proposed biosparge wells. These monitoring wells will provide an indication of system ROI (as measured by DO and ORP concentrations) as well as contaminant reduction. Well nests MW-BS2 and

MW-BS4 will be installed approximately 50 ft downgradient of new proposed biosparge wells. These monitoring wells will provide an indication of the success of the system in increasing system DO and ORP outside of the biosparge well of ROI. Well nest MW-BS10 will be installed at a location to be determined at a later date, if deemed necessary.

Monitoring wells will be sampled quarterly for VOCs, SVOCs, and metals to measure progress toward the remedial action objectives. Two field parameters, DO and oxidation-reduction potential (ORP), will be monitored closely as these indicate the effectiveness of the biosparge system in increasing DO concentrations in the aquifer and producing positive ORP conditions, both of which are essential for successful aerobic biodegradation of the organic COCs present in site groundwater. Details regarding the monitoring frequency, monitoring well network, and analyses will be included in a subsequent biosparge system monitoring plan.

3.9 SOIL EXCAVATION

Soil excavation and off-site disposal will be performed to address the residual organic and inorganic contamination at the site. Removal of soil containing residual organic and inorganic contamination will reduce the volume of contaminated soil at the site and will also reduce the dissolved organic and inorganic COCs that are present due to leaching from the soil. A total of 159,867 CY (approximately 223,814 tons) of soil requires excavation.

Drawing C-5 shows the areas to be excavated and includes a table summarizing the excavation area footprint. Drawings C-6 through C-14 include cross-sections of the excavation areas and a table summarizing the excavation area footprint, the targeted depth interval, and the estimated volume of soil to be removed. The estimated volume for each area includes added soil volume to account for sloping where appropriate. As discussed in Section 3.9.9, a slope stability/protection plan shall be required and sealed by a Michigan licensed geotechnical engineer experienced in slope stability. The table below includes which contaminants are being remediated for each excavation area.

TABLE 3-2. EXCAVATION AREA SUMMARY

Area	Inorganic Volume (CY)	Inorganic Tonnage	Organic Volume (CY)	Organic Tonnage	Contaminants of Concern
A	1,007	1,410	0	0	Aluminum, Arsenic, Iron, and Manganese
B1	0	0	34,889	48,845	Benzene, ethylbenzene, styrene, tetrachloroethene, toluene, xylenes, 2,4-dimethylphenol, 2-methylnaphthalene, methylphenols, acenaphthylene, and naphthalene
B2	0	0	70,438	98,613	Benzene, ethylbenzene, styrene, tetrachloroethene, toluene, xylenes, 2,4-dimethylphenol, 2-methylnaphthalene, methylphenols, acenaphthylene, and naphthalene
C	0	0	27,443	38,420	Benzene, ethylbenzene, xylenes, 2,4-dimethylphenol, naphthalene, and phenanthrene
D	0	0	1,729	2,421	Benzene, ethylbenzene, styrene, toluene, xylenes, 2,4-dimethylphenol, methylphenols, and naphthalene
E	1,911	2,675	0	0	Aluminum, iron, and manganese
F	0	0	4,197	5,876	2,4-dimethylphenol
G	6,247	8,746	5,332	7,465	Xylenes, 2,4-dimehtylphenol, 2-methylnaphthalene, methylphenols, acenaphthylene, naphthalene, phenanthrene, aluminum, antimony, arsenic, chromium, iron, and manganese
H	682	955	166	232	2,4-dimehtylphenol, methylphenols, copper, iron, manganese, selenium, and silver
I	932	1,305	91	127	2,4-dimethylphenol, methylphenols, arsenic, iron, lead, and manganese
J	188	263	0	0	Aluminum, iron, and manganese

Soil will be mechanically excavated using a backhoe and then will be loaded into dump trucks for transportation to an approved disposal facility. The soil is expected to be characterized as non-hazardous waste. Prior to transportation, the soil will be sampled for waste characterization parameters and a waste profile form will be completed for approval at the landfill. All loads of contaminated material will be manifested and tarped. A description of each excavation area is provided below.

3.9.1 Excavation Area A

Area A is located near the southern edge of the Tar Lake depression area (see C-5) and contains inorganics in soil above remediation objectives. The remediation area is approximately 113 feet long, 53 feet wide, and 6 feet deep, and is a volume of 1,007 cubic yards and 1,410 tons (see C-6). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is not located near any existing utilities or infrastructure and shoring is not required.

Additional sampling to delineate exceedances was not performed in this area; therefore, the proposed excavation area is only an estimate based on the existing data. Significant uncertainty to the north, east, and south exists because of lack of data. There is also uncertainty in the vertical extent of this area because of lack of data. It is anticipated that an x-ray fluorescence (XRF) device will be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 22-foot grid (approximately 15 samples) as determined using the unbiased grid-based methodology documented in MDEQ's "Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria, 2002" (S^3TM) (MDEQ 2002).

3.9.2 Excavation Areas B1 and B2

Area B1 is located within the base of the Tar Lake depression area. Area B2 includes the western slope of the depression and an upland area west (see C-5). Both areas contain organics in soil above remediation objectives.

The B1 remediation area is approximately 273 feet long, 256 feet wide, and up to 23.5 feet deep, and is a volume of 34,889 cubic yards and 48,845 tons (see C-7). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is present within the depth of excavation in this area and dewatering will be required and performed as described in Section 3.9.9. The excavation area is not located near any existing utilities or infrastructure and shoring is not required. A portion of the site fence will need to be removed and replaced in order to maintain appropriate slope required for the excavation.

The B2 remediation area is approximately 322 feet long, 300 feet wide, and up to 50.5 feet deep, and is a volume of 70,438 cubic yards and 98,613 tons (see C-8). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is present within the depth of excavation in this area and dewatering will be required and performed as described in Section 3.9.9. The excavation area is located near the existing biosparge system, and biosparge wells SP-4 through SP-9 will be removed and replaced once excavation is complete. A portion of the site fence will need to be removed and replaced. Existing monitoring well nest MW-1A will be removed.

Additional sampling to delineate these exceedances has been performed in this area. However, a flame ionization detector (FID) and photoionization detector (PID) will still be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of VOCs and SVOCs will be collected at a frequency of 1 per 37-foot grid (approximately 56 samples) for Area B1 and 1 per 44-foot grid (approximately 56 samples) for Area B2, as determined using the unbiased grid-based methodology documented in S^3TM. However, it is anticipated that these samples will be collected from the saturated zone and will only be used to document what levels of contamination (if any) remain after the practical extents of excavation have been completed.

3.9.3 Excavation Areas C and D

Areas C and D are located north of Area B2, at the top of the Tar Lake depression (see C-5) and contain organics in soil above remediation objectives.

The Area C remediation area is approximately 181.5 feet long, 251 feet wide, and 47 feet deep, and is a volume of 27,443 cubic yards and 38,420 tons (see C-9). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is present within the depth of excavation in this area and dewatering will be required and performed as described in Section 3.9.9. The excavation area is not located near any existing utilities or infrastructure and shoring is not required. A portion of the site fence will need to be removed and replaced.

The Area D remediation area is approximately 99 feet long, 79 feet wide, and 8 feet deep, and is a volume of 1,729 cubic yards and 2,421 tons (see C-6). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is not located near any existing utilities or infrastructure and shoring is not required.

Additional sampling to delineate these exceedances has been performed in this area. However, a FID/PID will still be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of VOCs and SVOCS will be collected at a frequency of 1 per 30-foot grid (approximately 54 samples) for Area C and 1 per 30-foot grid (approximately 16 samples) for Area D, as determined using the unbiased grid-based methodology documented in S^3TM. However, it is anticipated that the samples collected from Area C will be collected from the saturated zone and will only be used to document what levels of contamination (if any) remain after the practical extents of excavation have been completed.

3.9.4 Excavation Area E

Area E is located near the northern edge of the Tar Lake depression area (see C-5) and contains inorganics in soil above remediation objectives. The remediation area is approximately 86 feet long, 81 feet wide, and 12 feet deep, and is a volume of 1,911 cubic yards and 2,675 tons (see C-10). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is not located near any existing utilities or infrastructure and shoring is not required.

Additional sampling to delineate exceedances was not performed in this area; therefore, the proposed excavation area is only an estimate based on the existing data. Significant uncertainty to the north, east, and south exists because of lack of data. There is also uncertainty in the vertical extent of this area because of lack of data. It is anticipated that an XRF device will be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 24-foot grid (approximately 16 samples) as determined using the unbiased grid-based methodology documented in S^3TM.

3.9.5 Excavation Areas F, GA, and GB

Areas F and G are located west of the Tar Lake depression area and south of Elder Road (north end of the existing biosparge system - see C-5) and contain inorganics and organics in soil above remediation objectives.

The Area F remediation area contains organics in soil above remediation objectives and is approximately 101 feet long, 108 feet wide, and 22 feet deep, and is a volume of 4,197 cubic yards and 5,876 tons (see C-11). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is located near Elder Road and shoring is required. A portion of the site fence will need to be removed and replaced.

Additional sampling to delineate these exceedances has been performed in this area. However, a FID/PID will still be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of SVOCs will be collected at a frequency of 1 per 29-foot grid (approximately 16 samples) as determined using the unbiased grid-based methodology documented in S^3TM.

The Area GA (inorganics only) remediation area is approximately 95 feet long, 150 feet wide, and 20 feet deep, and is a volume of 6,247 cubic yards and 8,746 tons. The Area GB (organics only) remediation area is approximately 83 feet long, 150 feet wide, and 20 feet deep, and is a volume of 5,332 cubic yards and 7,465 tons (see C-12). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is located near Elder Road and shoring is required. As discussed in Section 3.9.9, a slope stability/protection plan shall be required and sealed by a Michigan licensed geotechnical engineer experienced in slope stability. A portion of the site fence will need to be removed and replaced. Caution near Elder Road and existing biosparge well SP-0 and existing monitoring wells SPW-1-55 and SP-1-65 will be necessary.

Additional sampling to delineate these exceedances has been performed in this area. However, a FID/PID will still be used during excavation to determine appropriate excavation extents for area GB as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 17-foot grid for Area GA (approximately 54 samples). Confirmation samples for analysis of VOCs and SVOCs will be collected at a frequency of 1 per 16-foot grid for Area GB (approximately 45 samples), as determined using the unbiased grid-based methodology documented in S^3TM. If Area G is excavated in its entirety, the volumes and sampling frequencies listed for Area GA would be appropriate for the entire area.

3.9.6 Excavation Areas HA and HB

Area H is located west of the Tar Lake depression area and north of Elder Road (north end of the existing biosparge system - see C-5) and contains inorganics and organics in soil above remediation objectives.

The Area HA (inorganics only) remediation area is approximately 95 feet long, 50 feet wide, and 5 feet deep, and is a volume of 682 cubic yards and 955 tons. The Area HB (organics only) remediation area is approximately 40 feet long, 35 feet wide, and 5 feet deep, and is a volume of 166 cubic yards and 232 tons (see C-13). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation areas. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is located near Elder Road; however, the planned extent of excavation depth is not expected to reach Elder Road. No known utilities are present on the north side of Elder Road. However, caution near Elder Road will be necessary.

Additional sampling to delineate these exceedances has been performed in this area. However, a FID/PID and XRF will still be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 19-foot grid for Area HA (approximately 15 samples). Confirmation samples for analysis of SVOCs will be collected at a frequency of 1 per 11-foot grid for Area HB (approximately 12 samples), as determined using the unbiased grid-based methodology documented in S^3TM. If Area H is excavated in its entirety, the volumes and sampling frequencies listed for Area HA would be appropriate for the entire area.

3.9.7 Excavation Areas IA and IB

Area I is located west of the Tar Lake depression area and north of Elder Road (north end of the existing biosparge system - see C-5) and contains inorganics and organics in soil above remediation objectives.

The Area IA (inorganics only) remediation area is approximately 146 feet long, 91 feet wide, and 2 feet deep, and is a volume of 932 cubic yards and 1,305 tons. The Area IB (organics only) remediation area is approximately 59 feet long, 49 feet wide, and 2 feet deep, and is a volume of 91 cubic yards and 127 tons (see C-13). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation areas. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is located near Elder Road; however, the planned extent of excavation depth is not expected to reach Elder Road. No known utilities are present on the north side of Elder Road. However, caution near Elder Road will be necessary.

Additional sampling to delineate these exceedances has been performed in this area. However, a FID/PID and XRF will still be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 16-foot grid for Area HA (approximately 54 samples). Confirmation samples for analysis of SVOCs will be collected at a frequency of 1 per 15-foot grid for Area HB (approximately 16 samples), as determined using the unbiased grid-based methodology documented in S^3TM. If Area I is excavated in its entirety, the volumes and sampling frequencies listed for Area IA would be appropriate for the entire area.

3.9.8 Excavation Area J

Area J is located north of Elder Road at the western edge of the site (see C-5) and contains inorganics in soil above remediation objectives. The remediation area is approximately 38 feet long, 38 feet wide, and 6 feet deep, and is a volume of 188 cubic yards and 263 tons (see C-10). A slope ratio of 1.5:1 was used to determine the horizontal extent of the excavation area. Groundwater is not present within the depth of excavation in this area and dewatering is not required. The excavation area is not located near any existing utilities or infrastructure and shoring is not required.

Additional sampling to delineate exceedances was not performed in this area; therefore, the proposed excavation area is only an estimate based on the existing data. Significant uncertainty to the north, east, and south exists because of lack of data. There is also uncertainty in the vertical extent of this area because of lack of data. It is anticipated that an XRF device will be used during excavation to determine appropriate excavation extents as discussed in Section 3.9.11. Confirmation samples for analysis of total metals will be collected at a frequency of 1 per 11-foot grid (approximately 16 samples) as determined using the unbiased grid-based methodology documented in S^3TM.

3.9.9 Design and Construction Technical Factors

The results of the previous soil investigations and the remedial design soil sampling were used to estimate the lateral and vertical extent of contaminated soil above the remediation goals. The remedial design investigation was performed to delineate the extent of impacts in the soil previously detected. The areas to be remediated are designated with alpha labels for identification. Actual vertical and horizontal extent of excavation areas will be determined based on soil screening and confirmation sampling during excavation. Excavation will proceed deeper than the groundwater table elevation in areas, as necessary, and the vertical extent of the excavation will be the practical depth achievable.

Excavation will be challenging because some of the soil contamination is present along a steep slope, at depth, beyond the reach of excavation equipment, and below the groundwater elevation table. In addition, the material is granular, and sides of the excavation will not be stable. Thus, significant engineering controls to include shoring, ramping, benching, and dewatering the excavation are necessary to excavate the material at the required depths.   Furthermore, excavating contaminated soil will necessitate shoring near the roadway, underground utilities, and the existing biosparge system to ensure no damage or undermining occurs during excavation work.

Due to the steep slopes and significant depths required to be excavated under this option, achieving the final depth requirements will be challenging. Confirmation soil sampling may indicate that the excavation areas are required to go deeper or to incorporate larger areas than expected, based on current soil sample laboratory analytical data. Thus, excavation alone, as proposed, may not fully achieve the cleanup criteria. Thus, the planned biosparge expansion system is being installed to address residual soil exceeding cleanup criteria.

Each excavation shall be shored or dug with appropriate benching/sloping to ensure competence of the excavation. Per Occupational Safety and Health Administration (OSHA) regulations, a "competent person" as defined in 29 *Code of Federal Regulations* (CFR) 1926.32(f) shall be on site at all times to monitor the slope stability.

The construction drawings and specifications will require the contractor to protect utilities, roadways, the biosparge system, and to provide slope stability. Protection of these features may include the design and installation of temporary sheet pile shoring between the excavation and the feature to be protected. In addition, the contractor will be required to provide a benching/sloping plan to ensure competence of the excavations. The slope stability/protection plan shall detail the materials, equipment and construction methods to be used to ensure that excavation activities do not undermine, damage or reduce the structural integrity of any existing utilities, roadways, or the biosparge system (except in areas where the system is planned to be removed and replaced). The slope stability/protection plan shall be prepared and sealed by a Michigan-licensed geotechnical engineer experienced in slope stability. Installation of temporary sheet pile shoring or construction of benching/sloping at many separate excavation areas will require significant effort and time. In addition, the volume of soil to be excavated will be much greater than just the contaminated soil volume in order to perform sloping and benching to access the soil at the required depths.

Dewatering within some excavation areas will be required. Localized sumps will be installed to remove water from excavations where the final proposed depth is below the existing water table. The water will be discharged on-site to an area upgradient of the existing biosparge system, so treatment will not be required.

3.9.10 Preparation for Excavation

Before any excavation is performed, the area will be cleared and grubbed to remove large vegetation and any general debris. The vegetation and debris shall be disposed of as general landscape or solid waste.

The horizontal limits of the excavation shall be staked and flagged by a licensed surveyor using the coordinates provided in the specifications. The coordinates are based on the soil sampling investigations performed at the site. Each area shall be excavated to the limits provided in the specifications or beyond the designated limits to the extent practicable if the confirmation samples exceed cleanup criteria.

3.9.11 Soil Field Screening

During excavation, soil excavation areas being remediated for inorganic compounds will be field screened with an XRF device. The XRF will be used to determine the final extents of the excavation. Once the final extents are achieved, and the XRF indicates that the remediation objectives are achieved, soil confirmation samples will be collected for laboratory analysis for the excavation area-specific COCs.

Soil excavation areas for volatile compounds will be field screened for VOCs using a FID/PID. The FID/PID will be used to determine the final extents of the excavation. Once the final extents are achieved, and the FID/PID readings indicate that VOCs are significantly removed, then soil confirmation samples will be collected for laboratory analysis for the excavation area specific COCs.

Excavation extents may be expanded horizontally and vertically during the remedial action based on the field observations, XRF readings and FID/PID readings (to the extent practicable).

3.9.12 Confirmation Soil Sampling

Soil confirmation samples will be collected from each excavation at a frequency as determined using the unbiased grid-based methodology documented in S^3TM. Confirmation soil samples will be laboratory analyzed for the analytes that exceeded cleanup criteria for each particular remediation area. Soil samples collected from the saturated zone will not be compared to remediation objectives and will be used to document concentrations of contaminants left in place after practical extents of excavation have been reached.

3.9.13 Excavation Documentation

The horizontal and vertical limits of each excavation shall be surveyed by a Michigan licensed surveyor. Drawings shall be produced to record the pre-excavation, post-excavation and final post-restoration surfaces for the site.

3.9.14 Erosion Control

Best management practices will be employed during excavation to minimize erosion of stockpiles and dust generated from operations, including lining and berming any stockpiles and covering stockpiles at the end of each work day.

3.9.15 Backfill

Excavation areas will be backfilled with clean imported soils. The soil will be laboratory analyzed prior to import to the site to demonstrate that it contains no compounds at concentrations exceeding remediation goals. Areas B1, B2, and C will be backfilled to three feet below existing grade as a cost savings measure. All other excavation areas will be backfilled to existing grade.

3.9.16 Site Restoration

Site restoration will be performed after all soil excavation and backfill has been completed. Restoration will include grading and smoothing to minimize slopes and potential erosion issues. The area will be seeded with an appropriate grass seed mix for the soils and the climate. Erosion control matting will be added as needed.

4.0 COMPLIANCE WITH ARARS, PERMITS, AND ACCESS REQUIREMENTS

The design will incorporate appropriate engineering and monitoring controls to ensure compliance with ARARs.

The following subsections describe the applicable ARARs (Section 4.1), permits (Section 4.2), access requirements (Section 4.3), and general constructability issues (Section 4.4) for the construction work at the site.

4.1 ARARs

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, states that remedial actions at CERCLA sites must attain (or the decision document must justify waiver of) any federal or more stringent state environmental standards, requirements, criteria, or limitations determined to be legally applicable or relevant and appropriate. In accordance with CERCLA, the remedial actions will accord with the substantive requirements of the ARAR identified in the 2013 ESD. CERCLA response actions are exempted by law from the requirement to obtain federal, state, or local permits related to any activities conducted completely on-site. This exemption does not remove the requirement to meet (or waive) the substantive provisions of permitting regulations that are ARARs. The remedial contractor will be responsible for complying with the substantive requirements of permit requirements.

The selected remedy at the site will comply with all applicable ARARs. Applicable chemical, location, and action-specific ARARs include the following:

Chemical-specific ARARs

- MCLs (40 CFR Part 141 Subpart B)
- Maximum Contaminant Level Goals (MCLG) (40 CFR 141.50, 141.51, 141.52)
- MDEQ Generic Groundwater Cleanup Criteria (*Michigan Administrative Code* [MAC] Rule 299.44)
- MDEQ Generic Soil Cleanup Criteria for residential category (MAC Rule 299.46)

Location-specific ARARs

- MAC Rule 324.1701 to 324.1706, Michigan Environmental Protection Act
- MAC Rule 324.20101 to 324.20142, Environmental Remediation

- MAC Rule 324.9101 to 324.9123a, Soil Erosion and Sedimentation Control

Action-specific ARARS

- Clean Air Act; National Ambient Air Quality Standards (NAAQS) Section 109, 40 CFR §§50-99
- RCRA 42 U.S.C. §321 et seq.
- 40 CFR §268 Land Disposal Restrictions
- MAC Rule 324.5524, Fugitive Dust Sources or Emissions
- MAC Rule 324.11501 to 324.11550, Solid Waste Management
- MAC Rule 324.14301 to 324.14306, Waste Minimization

4.2 PERMITS AND APPROVALS

All appropriate Antrim County construction, building, and right-of-way permits will be required to be obtained by the remediation subcontractor prior to beginning such work at the site. Required inspections as identified in Section 109 of the State Building Code will be scheduled, as appropriate. In addition, there will be continuous monitoring as the work progresses on-site. Below is a description of the air and water quality monitoring requirements.

4.2.1 Perimeter Air Sampling

During construction work, it is required that the operations do not generate air contamination exceeding applicable standards. Because air sampling conducted during site remediation of the source material (tar) indicated no exceedances of the NAAQS criteria for particulates (PM_{10}), air sampling along the site perimeter is deemed to be not necessary for this construction work. Dust control methods will be employed at the site to manage site dust propagation, and dust levels will be monitored downwind of active excavation areas throughout construction using a DustTrak (or similar) nephelometer.

4.2.2 Erosion Control

Silt fencing and other erosion control means will be installed around the perimeter of the site work areas before any site construction work is undertaken and will be maintained until the site is stabilized. Erosion controls will be inspected weekly and after a heavy precipitation event to ensure the erosion controls are operating properly.

4.3 ACCESS REQUIREMENTS

Five parcels comprise the area of the site proposed for remediation. Access agreements with each parcel owner are currently in place. However, these agreements will need to be updated to include the aspects of remedial construction on each parcel. In addition, proposed excavation and construction of northern biosparge expansion will include work within rights-of-way or easements of active subsurface utilities along Elder Road. The approximate locations of the existing utilities are shown on the drawings.

Approximately 12 acres of the site is surrounded by a perimeter chain-link fence. The fenced portion of the site includes the Tar Lake depression and existing biosparge groundwater treatment system (injection points and compressor building). Access to this portion of the site is through the north or west gates. The primary construction entrance will be the west gate. Site gates will be locked and periodically checked during non-work hours. The remainder of the site is not fenced.

Temporary construction trailers will be set up in the staging area before active site work begins and will include the temporary construction power, wiring, lighting, telephones, sanitary facilities, and potable water facilities.

During the work, the number of people expected to be on site will vary from about 5 to 15, with visits by suppliers (such as material deliveries, waste disposal, portable restroom, drinking water, FedEx), EPA, MDEQ, Antrim County, and Mancelona Township representatives. Site access will be maintained by keeping the gates closed and locked when field staff are absent from the site. The gates will be left unlocked, however (but in the closed position), when work is being performed in an area so emergency personnel have easy access to the area, should it be needed, and locked when field staff leave the area.

Access roads will be maintained to provide access for emergency vehicles. Parking facilities will be provided for personnel working on the project such that no parking will be allowed on city streets. Road closures, if necessary, will interfere as little as possible with public travel and occur only after proper written authorization is granted. At no time will access for emergency response equipment be prevented.

4.4 CONSTRUCTABILITY OF DESIGN

Constructability of the biosparge system expansion and excavation will be considered throughout the design process. Design drawings were prepared to entirely and clearly describe the design to the field personnel and are provided in Appendix B. Specifications will be prepared to effectively communicate engineering information, quality control, performance periods, and submittal requirements and will be provided at a later date. The drawings and specifications will be prepared to be explicit and to match each other.

5.0 RESULTS OF VALUE ENGINEERING SCREENING

A senior SulTRAC engineer not involved with the design conducted value engineering (VE) screening of the preliminary design for the OU2 – Northern Areas portion of the Tar Lake site. The purpose of a VE screen is to determine if the project includes any high-cost, non-industry-standard items that would benefit from a VE study. If there is a potential for significant cost savings, then the result of the VE screen would be a recommendation for a VE study.

A VE screen was performed on the June 10, 2016 preliminary design figures for the project and the preliminary design basis of design report. Certain portions of the design are specified on a preliminary basis at this time and are due to be evaluated further or refined during the final design.

The VE screen indicates that a VE study is not warranted for excavation and biosparge system expansion because the project uses straight forward excavation and air injection techniques already implemented at the site as specified in the ROD. However, potential cost saving components were identified during the VE screen. Shoring costs can be reduced by removing and replacing biosparge wells, as necessary. The design costs have been revised to reflect no shoring along excavation areas B2 and C, a savings of approximately [redacted]. Backfill in the Tar Lake depression area (excavation area B1) can be reduced to only a few feet above the water table (rather than to grade). The design costs have been revised to reflect a decrease in imported backfill of approximately 17,500 tons, a savings of approximately [redacted]. In addition, a local backfill source (adjacent MP3 property) may be utilized. This potential change requires additional evaluation and will be included, as appropriate.

Specific comments on minor cost issues were identified as follows:

- Permit costs can be deleted and included in engineering design costs.
- Given the large volume of soil planned to be excavated, contingency costs for soil excavation can be lowered to 10 percent.
- Given the large volume of soil planned to be excavated, contingency costs for engineering design and oversight for soil excavation can be lowered to 5 percent.

Given the complexity of the site and based on discussions with EPA and MDEQ, the final design was not modified to address the above comments.

6.0 REMEDIAL ACTION SOLICITATION PACKAGE SUBMITTALS

This section describes items to be included in the final remedial action solicitation package submittal. Design drawings and construction specifications will provide clear instructions to potential contractors so that they can prepare detailed bids, and, on award of a contract, complete the remedial action. Sections 6.1 and 6.2 list technical specifications and additional figures that the final remedial action solicitation package is anticipated to include.

6.1 LIST OF CONSTRUCTION SPECIFICATIONS

All construction specifications prepared for the project follow the Construction Specification Institute format. The following is a list of construction specifications to be provided in the final remedial action bid package:

DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

INTRODUCTORY INFORMATION

Section 00 11 16	Invitation to Bid
Section 00 21 13	Instructions to Bidders
Section 00 31 19	Subsurface Conditions
Section 00 41 00	Bid Form
Section 00 43 13	Bid Bond
Section 00 43 24	Offerer Representations and Certifications
Section 00 43 36	Proposed Subcontractors Form
Section 00 43 39	Minority and Small Disadvantaged Business Enterprise Utilization Certification
Section 00 43 43	Health and Safety Questionnaire
Section 00 45 16	Contractor's Compliance Statement and Certification
Section 00 45 19	Non-Collusion Affidavit
Section 00 45 33	Certification of Non-segregated Facilities

CONTRACTING REQUIREMENTS

Section 00 52 00	Agreement Form
Section 00 52 01	Notice of Award
Section 00 55 00	Notice to Proceed
Section 00 61 13.13	Performance Bond Form
Section 00 61 13.16	Payment Bond Form
Section 00 62 16	Certificate of Insurance Form
Section 00 62 99	Contractor's Notification of Subcontractors and Suppliers to be Utilized

Section 31 23 00 Excavation, Trenching, Dewatering, and Backfilling

DIVISION 32 EXTERIOR IMPROVEMENTS

Section 32 30 00 Site Restoration

DIVISION 33 UTILITIES

Section 33 10 00 Water Utilities
Section 33 23 00 Groundwater Extraction Wells, Monitoring Wells, and Piezometers
Section 33 23 01 Biosparge Wells

DIVISIONS 34 THROUGH 42 NOT USED

DIVISION 43 PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

Section 43 21 39 Biosparge System and Controls

6.2 LIST OF DESIGN DRAWINGS

Design drawings for this project were prepared using AutoCAD software. The drawings will be sealed and signed by a professional engineer. The following is a list of design drawings included in this design package as Appendix B.

G-1 Cover Sheet
C-1 Existing Conditions
C-2 Biosparge System Expansion Site Plan
C-3 Biosparge Well Details
C-4 Civil Details
C-5 Excavation Plan
C-6 Excavation Areas A & D Cross Sections
C-7 Excavation Area B1 Cross Sections
C-8 Excavation Area B2 Cross Sections
C-9 Excavation Area C Cross Sections
C-10 Excavation Areas E & J Cross Sections
C-11 Excavation Area F Cross Sections
C-12 Excavation Area G Cross Sections
C-13 Excavation Area H Cross Sections
C-14 Excavation Area I Cross Sections
E-1 Biosparge System – Electrical
E-2 Biosparge System – Electrical Plan View
E-3 Biosparge System – Electrical One-Line & Details
I-1 Piping and Instrumentation Diagram Symbols
I-2 Biosparge System Piping and Instrumentation Diagram
M-1 Biosparge System Plan View

7.0 PROJECTED REMEDIAL ACTION SCHEDULE AND CONTRACTING STRATEGY

This section discusses the RA schedule and contracting strategy for the site.

7.1 REMEDIAL ACTION SCHEDULE

The projected remedial action schedule assumes submittal of the 100 percent design in December 2018 and start of construction in April 2019. The schedule is based on typical review and bidding timeframes. The schedule in Appendix C summarizes the projected remedial action enhancement schedule for the site.

7.2 REMEDIAL ACTION CONTRACTING STRATEGY

Remedial construction at the site will proceed by application of standard equipment and construction procedures. All equipment and materials necessary for construction are readily available and require no highly-specialized expertise. It is likely that the turnkey biosparge system will be fabricated off-site by a remedial system fabrication company. The biosparge system installation will include mostly biosparge well installation and trenching and piping installation, by a remediation contractor. The soil excavation will be conducted by a remediation contractor experienced in deep remedial excavations. The remedial contractor may subcontract a geotechnical engineering company to design shoring or sloping for the deeper excavations. Biosparge system fabricators and remediation contractors capable of completing this work are available throughout the U.S.

8.0 CAPITAL REMEDIAL ACTION AND O&M COST ESTIMATES

The cost estimate includes capital and operations, monitoring, and maintenance (OM&M) costs. Each cost estimate is presented below.

8.1 CAPITAL REMEDIAL ACTION COSTS

The estimated capital cost for the remedial action is [redacted] This cost includes the total construction cost and applicable contingency costs. Groundwater monitoring and well installation costs are included in the OM&M costs. Appendix D includes a detailed breakdown of the capital costs.

Cost estimating processes require interpretation of construction approaches. Derivation of the design cost estimate proceeded in part through application of experience from previous EPA work assignments with similar scopes of work. If possible, actual price quotes for significant cost items were obtained from vendors and subcontractors.

Table 8-1 summarizes the capital costs estimated for the project.

TABLE 8-1. REMEDIAL ACTION COST SUMMARY

Number	Description	Subtotal
1	Source Area Soil Excavation	[redacted]
2	Biosparge System Expansion	[redacted]
Total Capital Cost		[redacted]

8.2 ANNUAL OM&M REMEDIAL ACTION COSTS

The estimated OM&M costs are based on expected routine biosparge system maintenance over 10 years and quarterly groundwater sampling during the first 4 years, semiannual groundwater monitoring for 3 years, and annual groundwater monitoring for 3 years. The costs also include a 1-year shakedown period. As requested, costs for performing OM&M on both the new system and the entire system are provided below.

TABLE 8-2. OM&M COST SUMMARY

Number	Description	Subtotal
1	EPA Performs OM&M on New System	[redacted]
2	EPA Performs All OM&M on Entire System	[redacted]

9.0 REFERENCES

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EPA 2004b. Preliminary Closeout Report for the Tar Lake Superfund Site, Mancelona, MI.

EPA. 2005. Direct final notice of partial deletion of the East Tailing Area of the Tar Lake Superfund Site from the National Priorities List. FR Doc 05-18834. September 21.

EPA. 2009a. Explanation of Significant Difference. Tar Lake Site. Mancelona, Michigan. September.

EPA. 2009b. Five-Year Review Report, Tar Lake Superfund Site. Mancelona, Antrim County, Michigan. June.

EPA. 2012. Direct final notice of partial deletion of the East Tailing Area of the Tar Lake Superfund Site from the National Priorities List. FR Doc 05-70057. January 9.

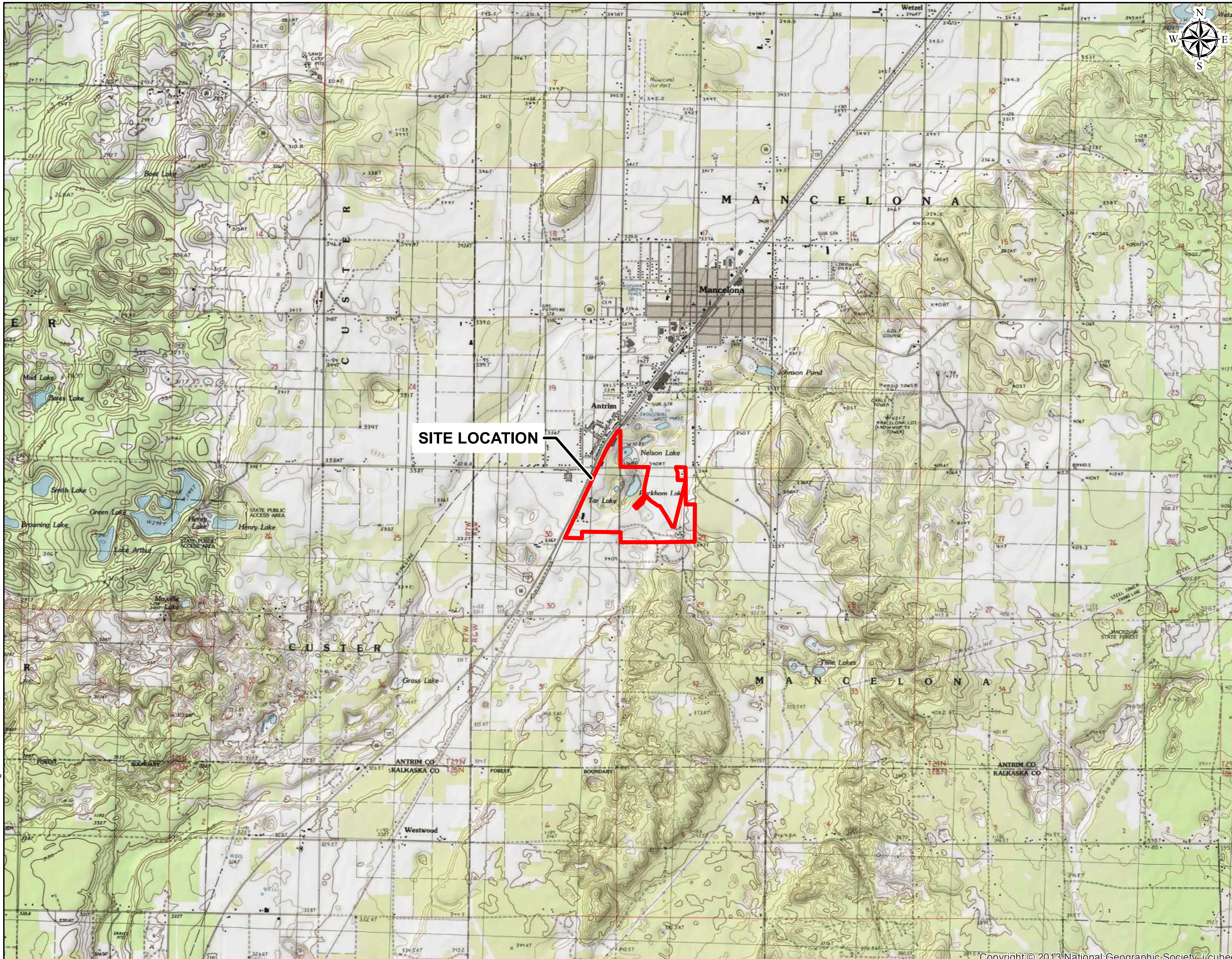
EPA. 2013. Explanation of Significant Difference. Tar Lake Site. Mancelona, Michigan. August.

EPA. 2014. Five-Year Review Report, Tar Lake Superfund Site. Mancelona, Antrim County, Michigan. June.

APPENDIX A

FIGURES

(5 Pages)



LEGEND

Site Boundary

0 2,000 4,000 Feet

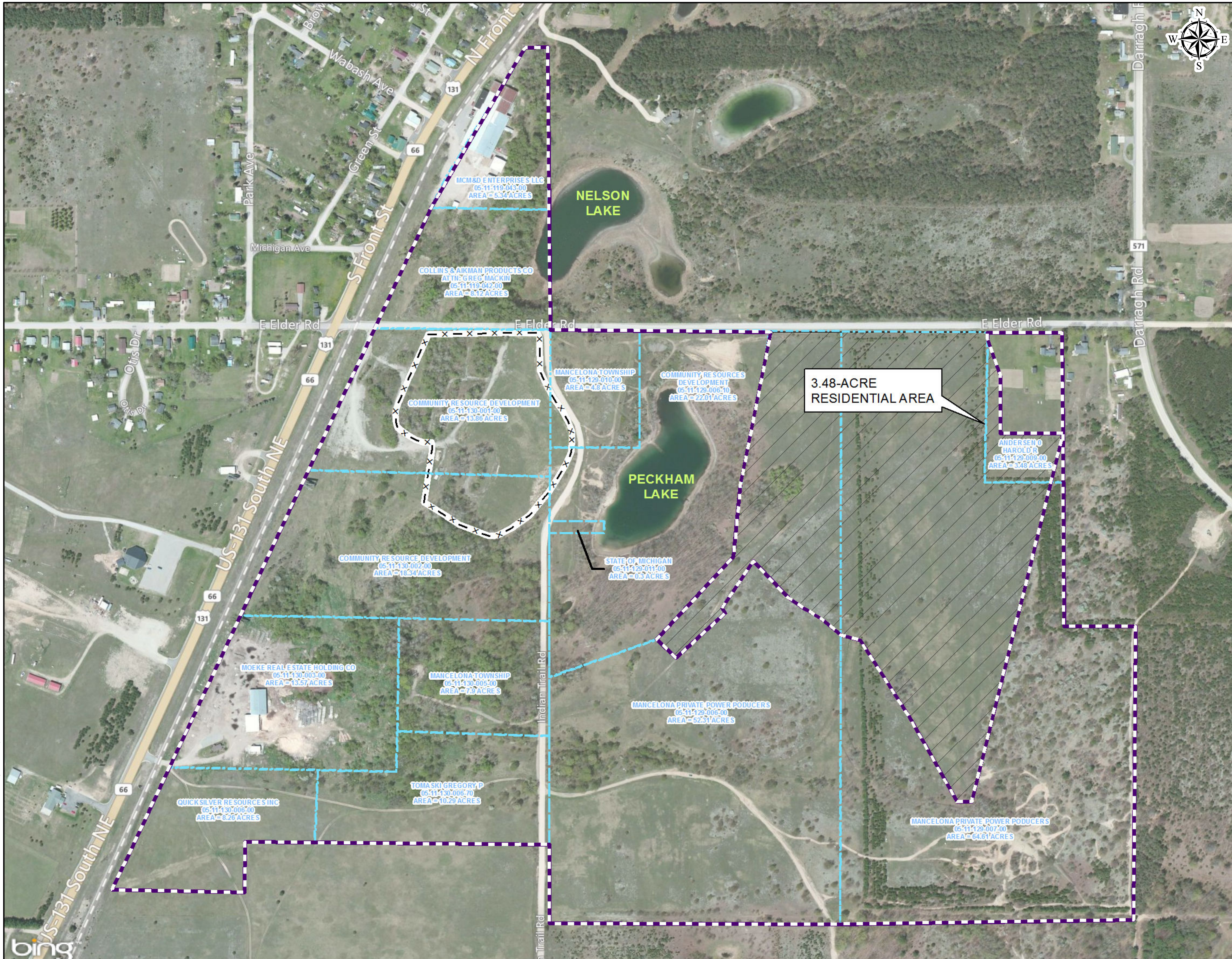
REFERENCE MAP

TAR LAKE SITE
ANTRIM COUNTY, MICHIGAN

FIGURE 1
SITE LOCATION MAP

ST SulTRAC

6/11/2013 G:\G1852\164 Tar Lake\mxd\2013-04\Fig1-SiteLocation.mxd m.banh



LEGEND

- Site Boundary
- Parcel Boundary
- East Tailings Area
- Fence

0 500 1,000 Feet

REFERENCE MAP

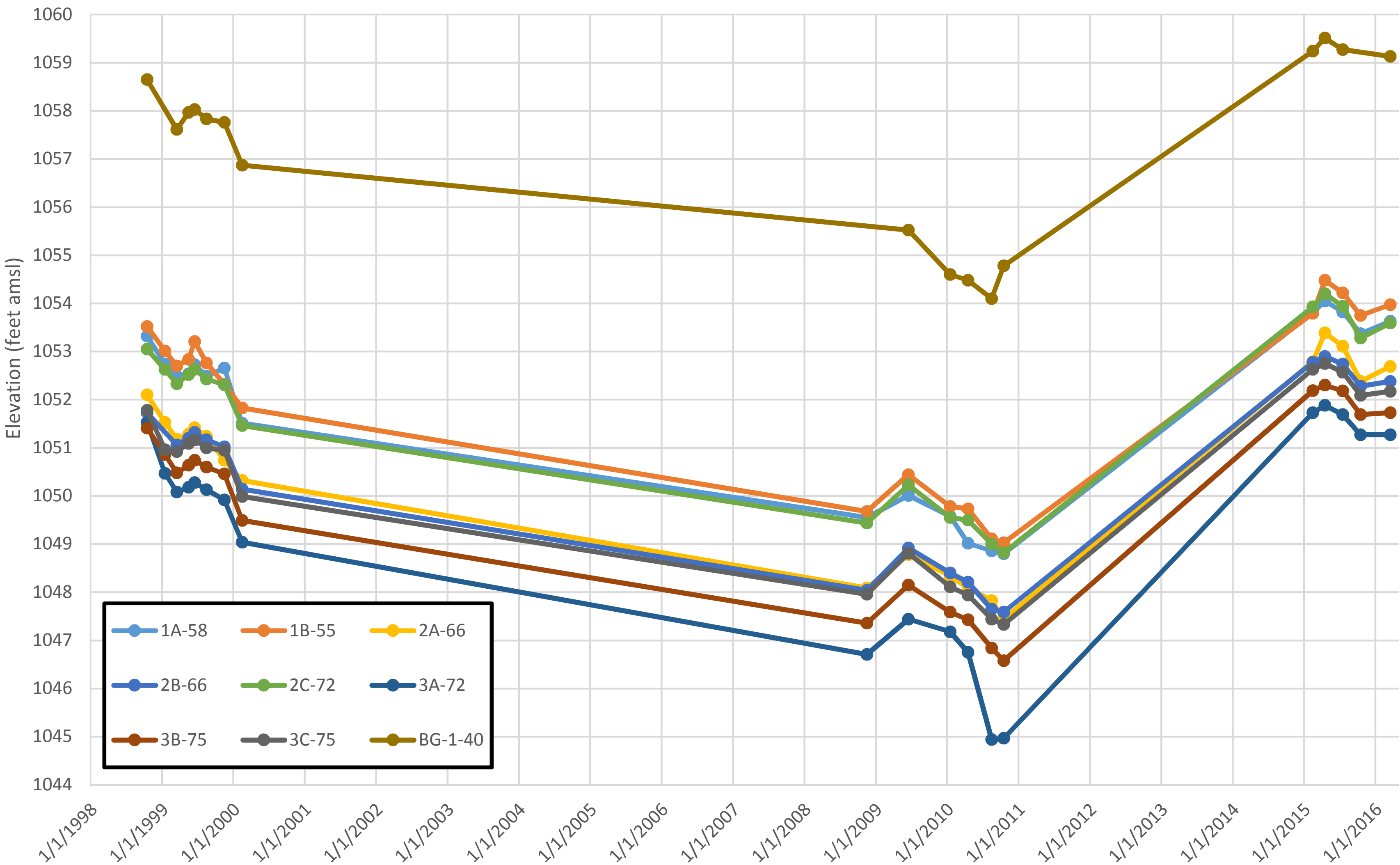
TAR LAKE SITE
ANTRIM COUNTY, MICHIGAN

FIGURE 2
SITE LAYOUT MAP

SulTRAC

4/10/2014 G:\G18521\64 Tar Lake\mxd\2014-04\Fig1-SiteLayout.mxd m.banh

Figure 3
Historical Groundwater Elevations
Tar Lake Superfund Site
Mancelona, Michigan



TAR LAKE SITE
ANTRIM COUNTY, MICHIGAN

FIGURE 4
PROPOSED BIOSPARGE WELL LAYOUT

5/4/2016 G:\G1852\194 Tar Lake RD\mxd\2016-05\Figx-PropBiospargeLayout.mxd m.banh

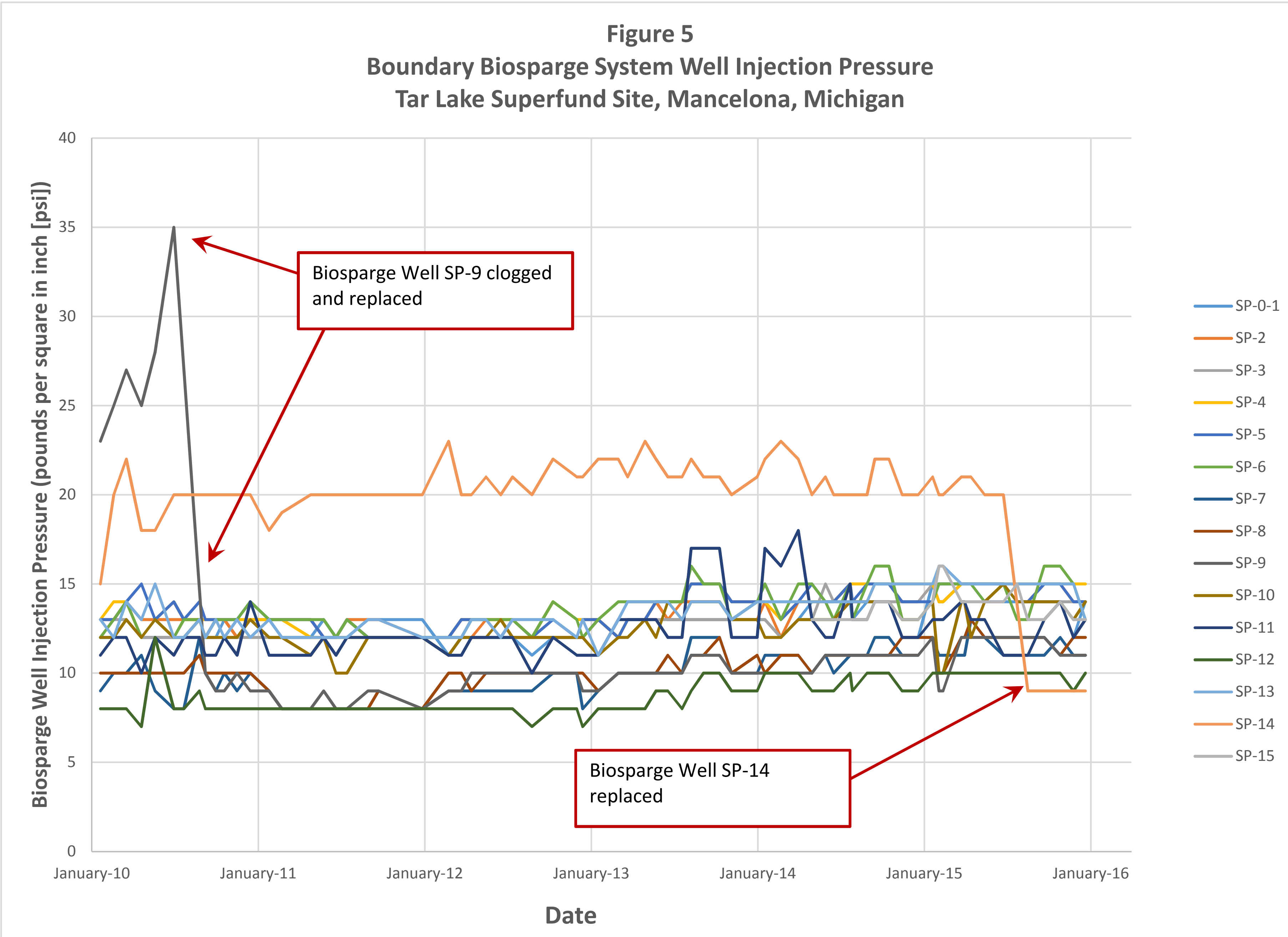


Figure 5
Boundary Biosparge System Well Injection Pressure
Tar Lake Superfund Site, Mancelona, Michigan
Biosparge Well Injection Pressure (pounds per square in inch [psi])
40
35
30
25
20
15
10
5
0
January-10
January-11
January-12
January-13
January-14
January-15
January-16
Date
Biosparge Well SP-9 clogged and replaced
Biosparge Well SP-14 replaced
SP-0-1
SP-2
SP-3
SP-4
SP-5
SP-6
SP-7
SP-8
SP-9
SP-10
SP-11
SP-12
SP-13
SP-14
SP-15

APPENDIX B

DESIGN DRAWINGS

PRELIMINARY DESIGN
BIOSPARGE SYSTEM EXPANSION AND CONTAMINATED SOIL EXCAVATION
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

AUGUST 2018

DRAWING INDEX

SHEET	DRAWING	DESCRIPTION	SHEET	DRAWING	DESCRIPTION
1	G-1	COVER SHEET	19	E-1	BIOSPARGE SYSTEM - ELECTRICAL
2	C-1	EXISTING CONDITIONS	20	E-2	BIOSPARGE SYSTEM - ELECTRICAL PLAN VIEW
3	C-2	BIOSPARGE SYSTEM EXPANSION SITE PLAN	21	E-3	BIOSPARGE SYSTEM - ONE LINE AND DETAILS
4	C-3	BIOSPARGE WELL DETAILS			
5	C-4	CIVIL DETAILS			
6	C-5	EXCAVATION PLAN			
7	C-6	EXCAVATION AREAS A & D CROSS SECTIONS			
8	C-7	EXCAVATION AREA B1 CROSS SECTIONS			
9	C-8	EXCAVATION AREA B2 CROSS SECTIONS			
10	C-9	EXCAVATION AREA C CROSS SECTIONS			
11	C-10	EXCAVATION AREAS E & J CROSS SECTIONS			
12	C-11	EXCAVATION AREA F CROSS SECTIONS			
13	C-12	EXCAVATION AREA G CROSS SECTIONS			
14	C-13	EXCAVATION AREA H CROSS SECTIONS			
15	C-14	EXCAVATION AREA I CROSS SECTIONS			
16	I-1	PIPING AND INSTRUMENTATION DIAGRAM SYMBOLS			
17	I-2	BIOSPARGE PIPING AND INSTRUMENTATION DIAGRAM			
18	M-1	BIOSPARGE SYSTEM - PLAN VIEW			

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED MB
DRAWN MB
CHECKED CN
DATE AUGUST 2018

ST SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

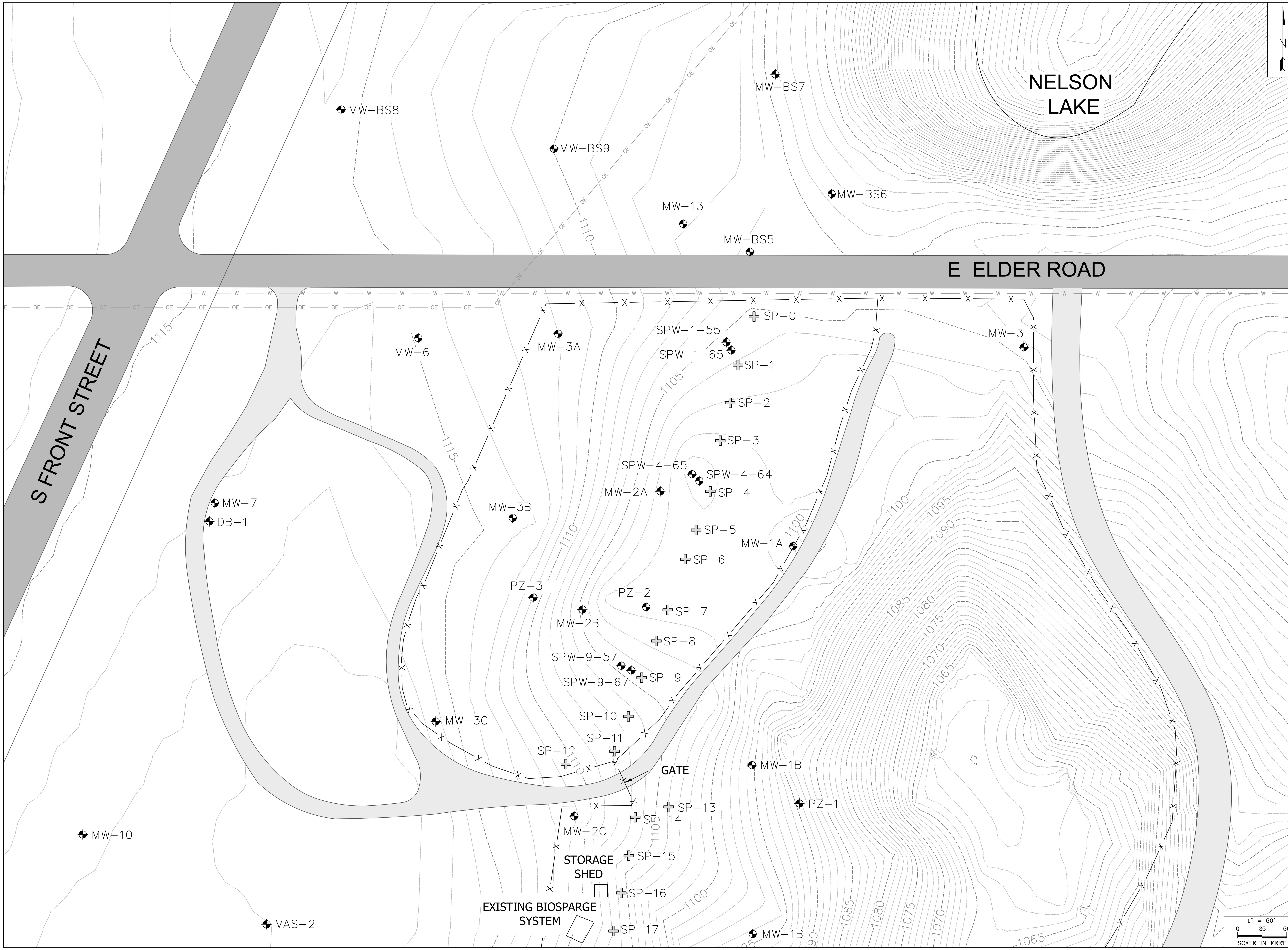
SCALES:
HORIZONTAL SCALE: AS SHOWN
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

COVER SHEET

WORK ASSIGNMENT NO. WA194
DRAWING NO. G-1
SHEET NO. 1 OF 21

8/14/2018



LEGEND

- EXISTING BIOSPARGE WELL
- EXISTING MONITORING WELL
- OE — OVERHEAD ELECTRIC (EXISTING)
- W — POTABLE WATER (EXISTING)
- X — EXISTING FENCE
- RAILROAD TRACKS
- EXISTING ASPHALT ROAD
- EXISTING GRAVEL ROAD
- 1110 — EXISTING TOPOGRAPHIC ELEVATION

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

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TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: AS SHOWN
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

EXISTING CONDITIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-1
SHEET NO. 2 OF 21

REVISIONS		
NO.	DATE	DESCRIPTION

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DRAWN MB
CHECKED DJB
DATE AUGUST 2018

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TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

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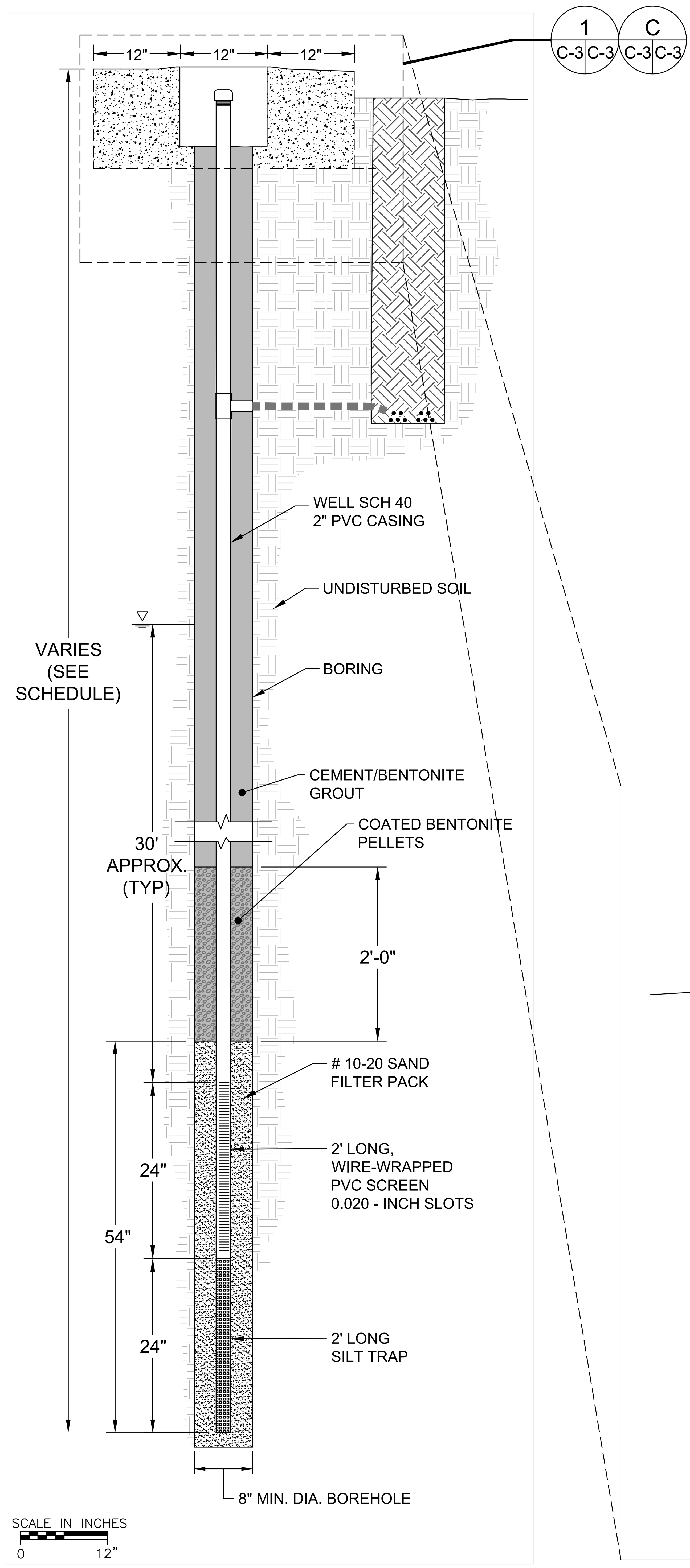
HORIZONTAL SCALE: AS SHOWN
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

BIOSPARGE SYSTEM EXPANSION SITE PLAN

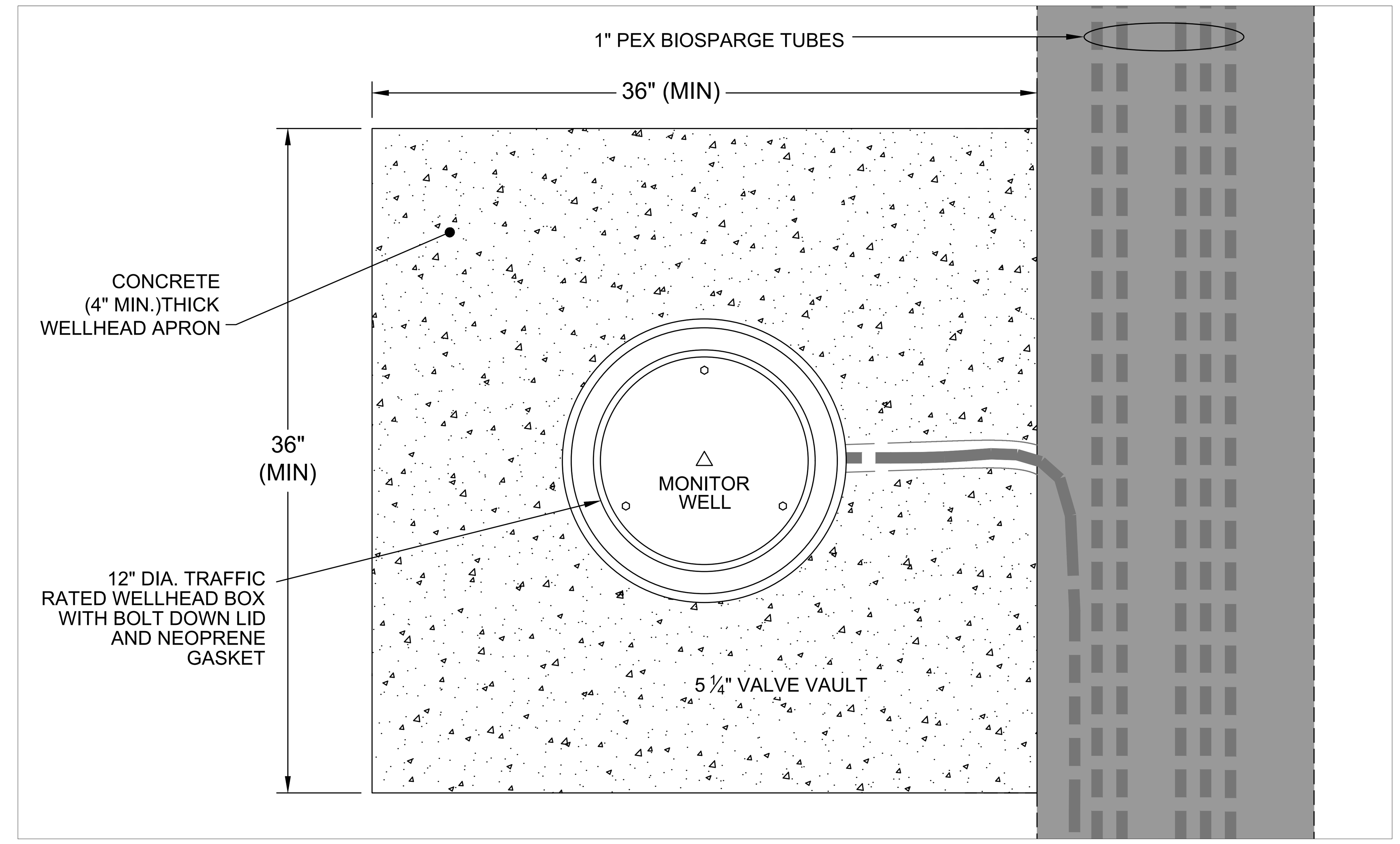
WORK ASSIGNMENT NO. WA194
DRAWING NO. C-2
SHEET NO. 3 OF 21

8/2/2018



A C-2 C-3 SECTION - BIOSPARGE INJECTION WELL

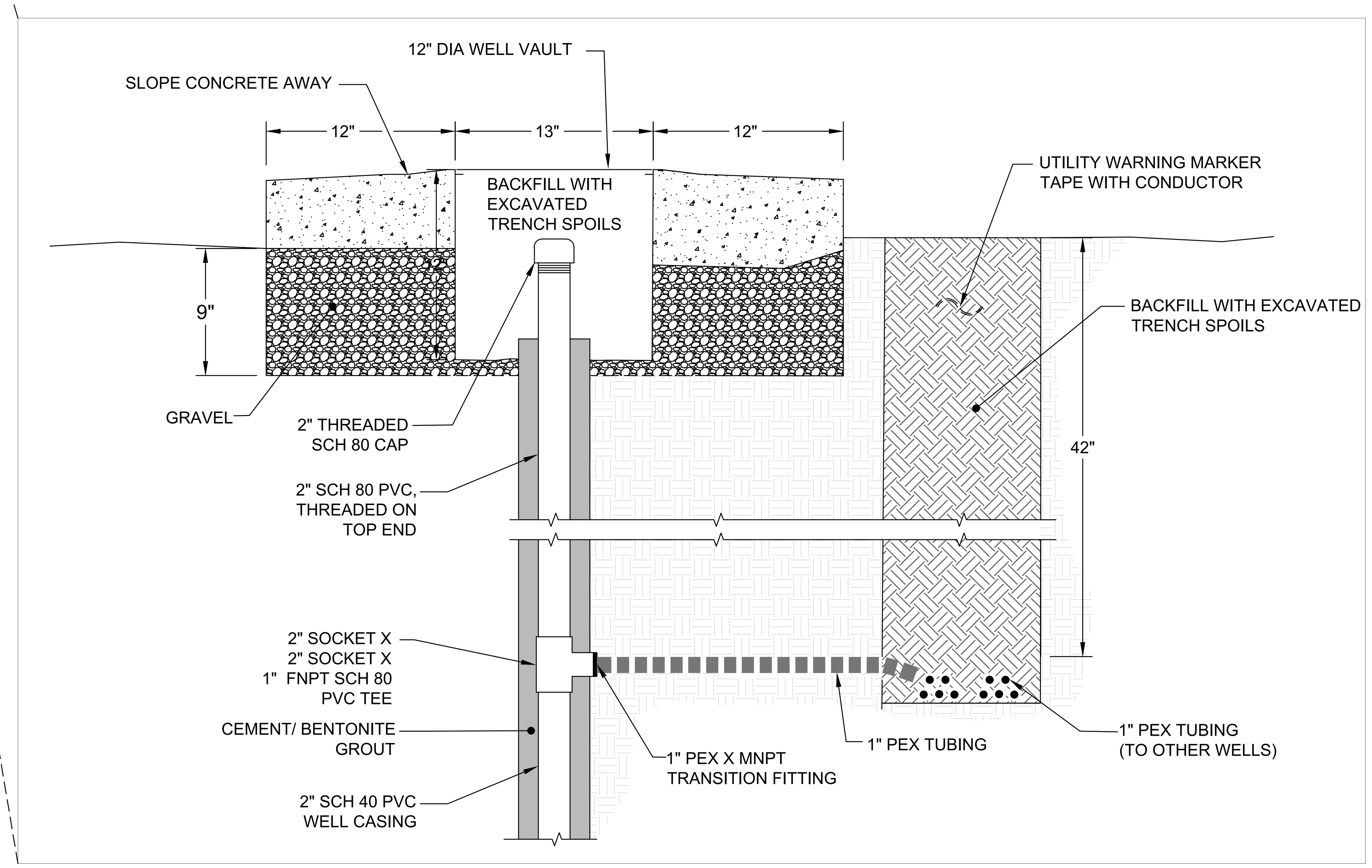
SCALE: 1" = 1'-0"



1 C-3 C-3 PLAN VIEW - LATERAL TRENCH AND WELL SPUR AFTER WELL INSTALLATION

SCALE: ½" = 1'-0"

SCALE IN INCHES 0 6"



C C-3 C-3 SECTION - BIOSPARGE WELLHEAD

SCALE: ½" = 1'-0"

SCALE IN INCHES 0 6"

Biosparge Well Schedule

Well ID	Easting	Northing	Existing Ground Elevation (AMSL)	Top of Screen Elevation (AMSL)	Bottom of Screen Elevation (AMSL)	Total Depth (feet)
AS-101	19501957.46	573556.46	1107.00	1022.00	1017.00	90.00
AS-102	19501981.51	573602.03	1106.50	1022.00	1017.00	89.50
AS-103	19502011.56	573633.73	1106.50	1022.00	1017.00	89.50
AS-104	19502041.83	573664.39	1105.75	1022.00	1017.00	88.75
AS-105	19502030.77	573560.69	1105.50	1022.00	1017.00	88.50
AS-106	19502053.71	573601.90	1105.50	1022.00	1017.00	88.50
AS-107	19502107.78	573602.03	1105.50	1022.00	1017.00	88.50
AS-108	19502052.26	573473.19	1103.25	1022.00	1017.00	86.25
AS-109	19502094.42	573496.15	1103.00	1022.00	1017.00	86.00
AS-110	19502133.35	573511.01	1104.00	1022.00	1017.00	87.00
AS-111	19502048.67	573345.84	1102.00	1023.00	1018.00	84.00
AS-112	19502088.41	573361.67	1102.00	1023.00	1018.00	84.00
AS-113	19502129.65	573375.11	1102.00	1023.00	1018.00	84.00
AS-114	19502175.67	573387.36	1102.00	1024.00	1019.00	83.00
AS-115	19502075.26	573222.70	1100.00	1024.00	1019.00	81.00
AS-116	19502121.58	573241.62	1095.00	1024.00	1019.00	76.00
AS-117	19502165.51	573258.04	1089.00	1025.00	1021.00	68.00
AS-118	19502206.45	573275.07	1084.00	1025.00	1021.00	63.00
AS-119	19502172.74	573135.88	1071.00	1025.00	1021.00	50.00
AS-120	19502215.77	573156.79	1063.00	1025.00	1021.00	42.00
AS-121	19502257.91	573174.71	1063.00	1025.00	1021.00	42.00
AS-122	19502211.29	573057.04	1062.00	1025.00	1021.00	41.00
AS-123	19502254.92	573071.97	1060.50	1026.00	1022.00	38.50
AS-124	19502299.45	573086.91	1064.25	1026.00	1022.00	42.25
AS-125	19502347.26	573104.53	1071.00	1026.00	1022.00	49.00
AS-126	19502255.22	572994.63	1062.00	1026.00	1022.00	40.00
AS-127	19502301.24	573005.97	1061.25	1026.00	1022.00	39.25
AS-128	19502341.88	573033.15	1062.00	1026.00	1022.00	40.00

08/14/2018

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

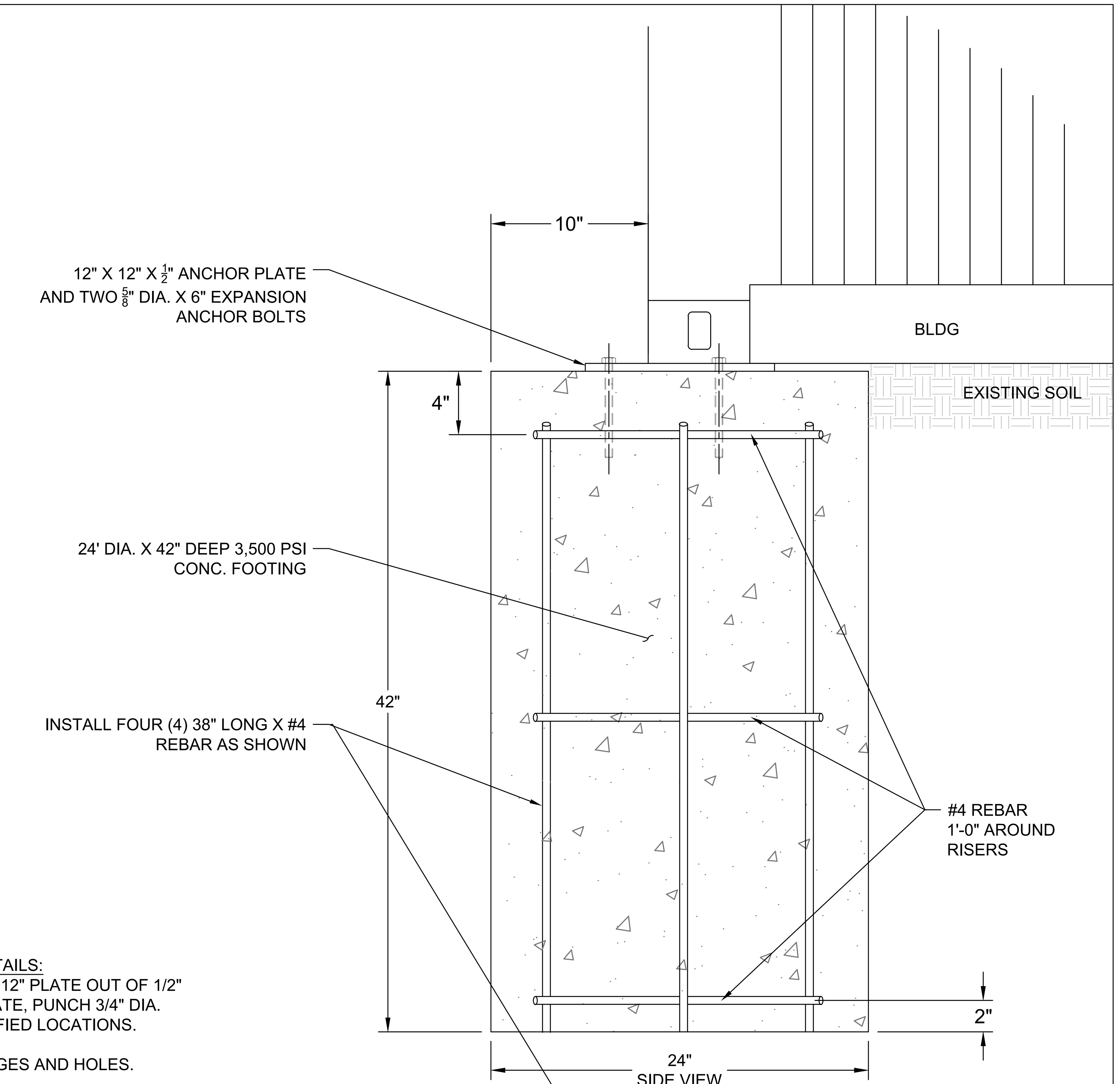
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE WELL DETAILS

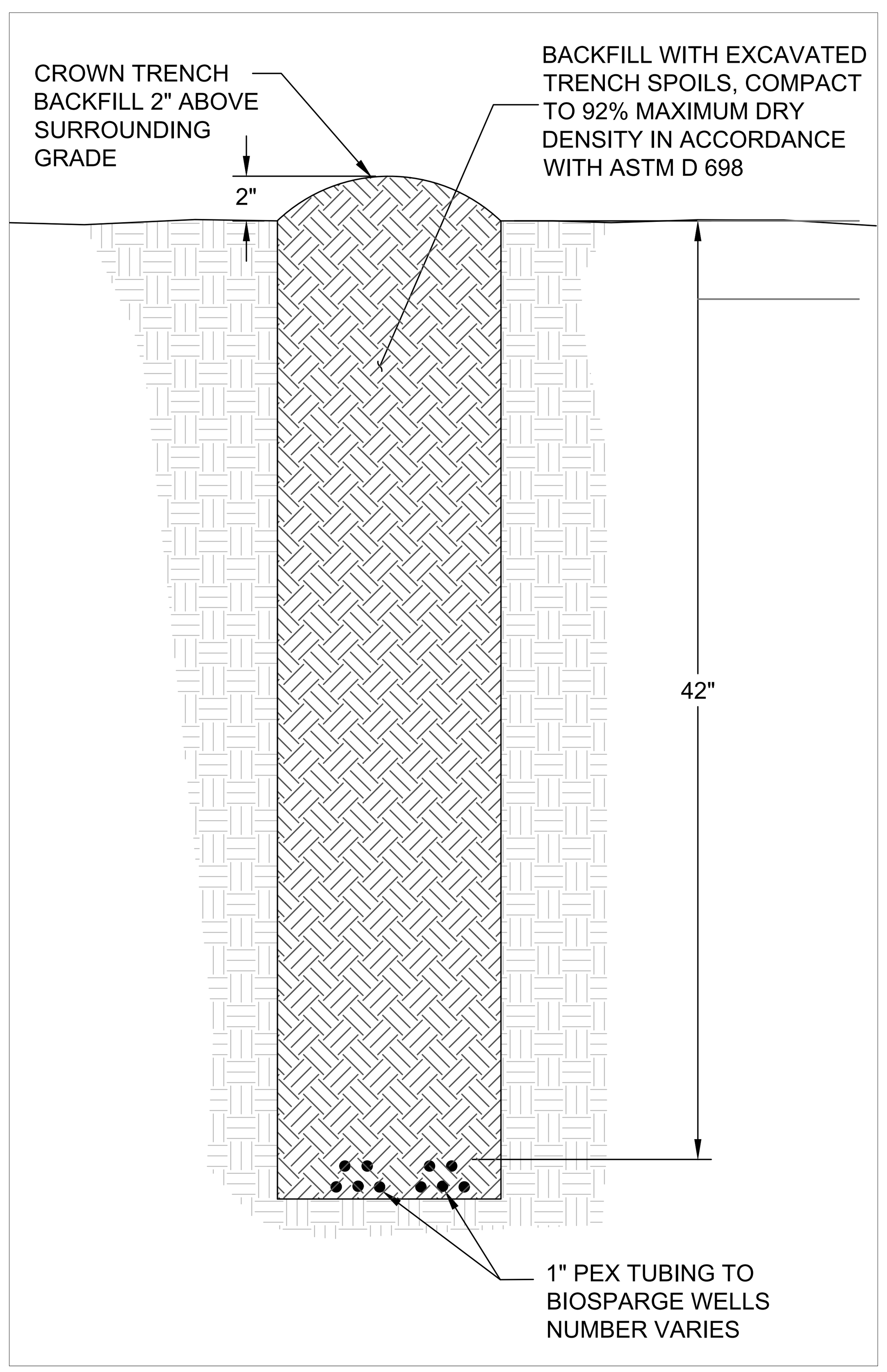
WORK ASSIGNMENT NO. WA194
DRAWING NO. C-3
SHEET NO. 4 OF 21

NOTES

1. EQUIPMENT ENCLOSURE SHALL BE SUPPORTED ON AND ANCHORED TO SIX (6) 24" DIA. X 42" DEEP CONCRETE FOOTINGS.
2. CONCRETE FOOTING TO CONSTRUCTED USING 3,500 PSI CONCRETE WITH #4 REINFORCEMENT BARS INSTALLED AS SHOWN ON DETAIL.
3. CONTRACTOR RESPONSIBLE FOR SETTING FORMS SO THAT TOPS OF ALL FOUR FOOTERS ARE AT A FIXED ELEVATION (+/-) $\frac{1}{2}$" TO ENSURE LEVEL MOUNTING SURFACE FOR ENCLOSURE. IN ADDITION, FOOTER ELEVATIONS TO BE SET TO ACCOUNT FOR INSTALLATION OF NEW ASPHALT PAVEMENT SUCH THAT NEW PAVEMENT WILL BE FLUSH OR BELOW THE TOPS OF FOOTERS.
4. ENCLOSURE TO BE ANCHORED TO CONCRETE FOOTERS USING 12" X 12" X $\frac{1}{2}$" STEEL ANCHOR PLATE SHOWN IN DETAIL. ANCHOR PLATES WILL BE SUPPLIED AND WELDED TO ENCLOSURE BY EQUIPMENT SUBCONTRACTOR AT LOCATIONS SHOWN IN DETAIL PRIOR TO SHIPPING.
5. ENCLOSURE TO BE ATTACHED TO CONCRETE FOOTINGS BY SITE CONTRACTOR USING $\frac{5}{8}$" X 6" LONG EXPANSION ANCHOR WITH MIN. 4" EMBEDMENT (USE RED HEAD ZINC PLATED CARBON STEEL CONCRETE ANCHOR PART #WS-5860 OR APPROVED EQUAL). EQUIPMENT SUBCONTRACTOR WILL PROVIDE SPECIFIED ANCHOR BOLTS FOR GENERAL CONTRACTOR TO INSTALL AFTER ENCLOSURE IS PLACED ON FOOTERS.

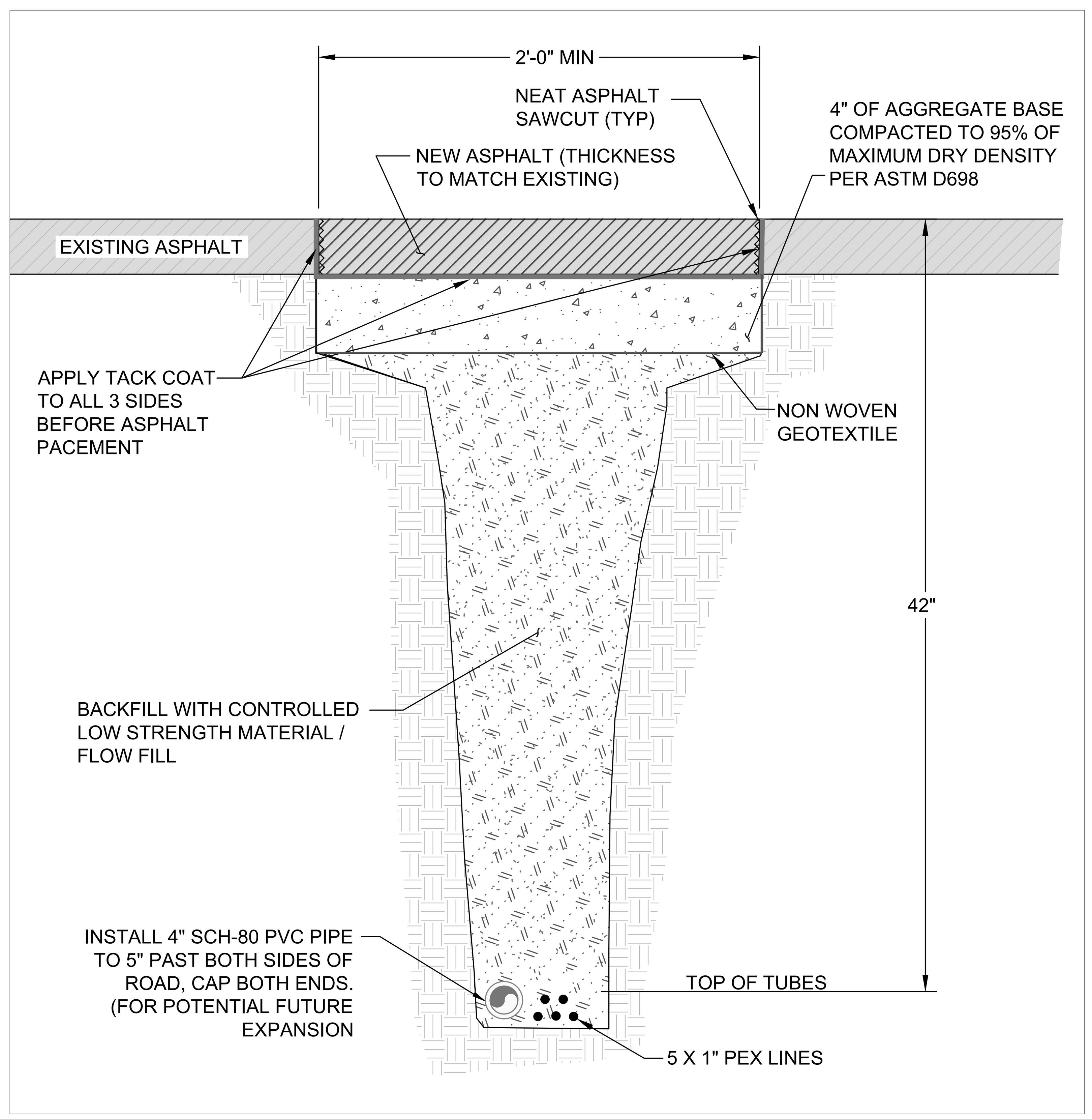
DESIGN CRITERIA
ROOF SNOWLOAD: 60 PSF
BASIC WIND SPEED: 100 MPH (3 sec gust)
SITE EXPOSURE CATEGORY: C





D C-2 C-4 TYPCAL BIOSPARGE TUBING TRENCH

NOT TO SCALE

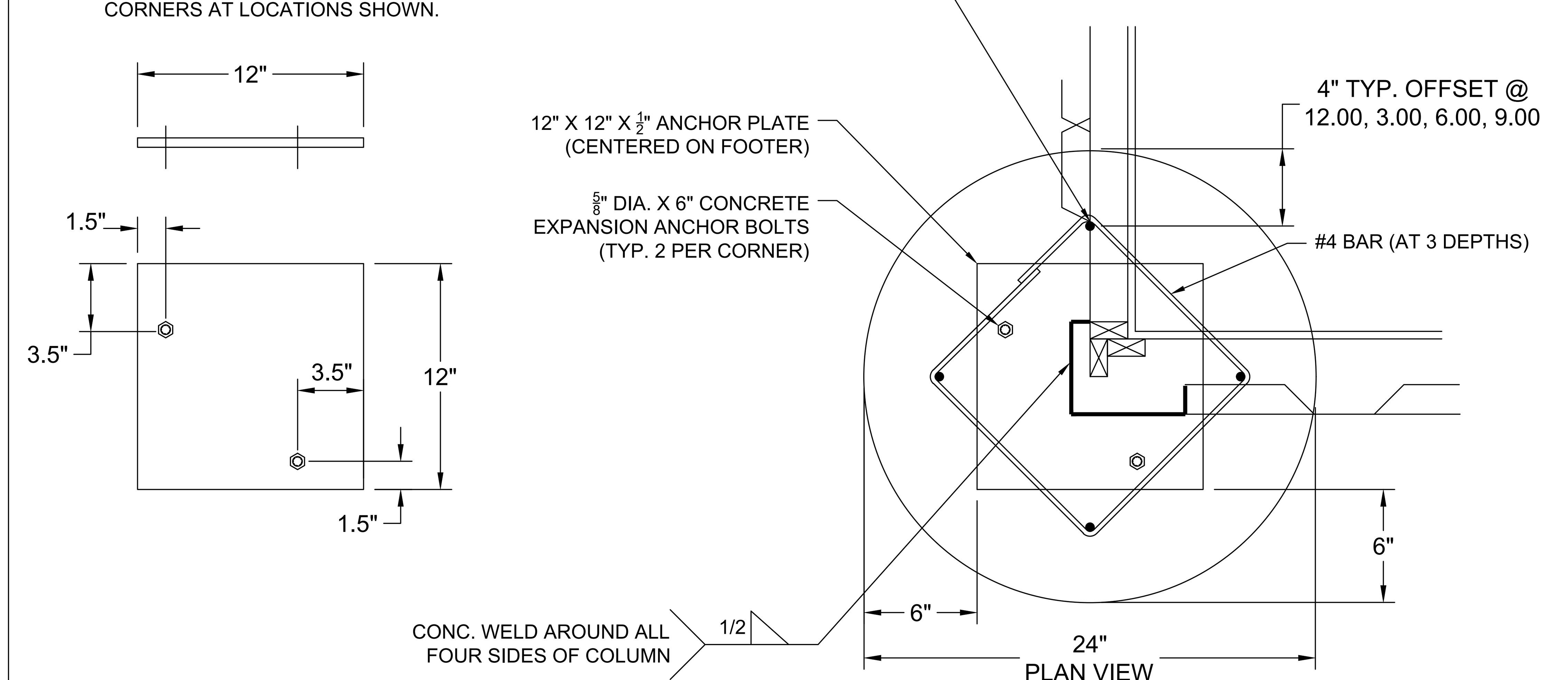


E C-2 C-4 TRENCH IN ROAD SECTION

NOT TO SCALE

ANCHOR PLATE DETAILS:

1. FABRICATE 12" X 12" PLATE OUT OF 1/2" THICK STEEL PLATE, PUNCH 3/4" DIA. HOLES AT SPECIFIED LOCATIONS.
2. DEBURR CUT EDGES AND HOLES.
3. WELD PLATE TO BOTTOM OF ENCLOSED CORNERS AT LOCATIONS SHOWN.



F M-1 C-4 FOOTER & ANCHOR PLATE DETAILS

SCALE: $\frac{1}{2}$" = 1'-0"

SCALE IN INCHES 0 6"

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

SulTRAC

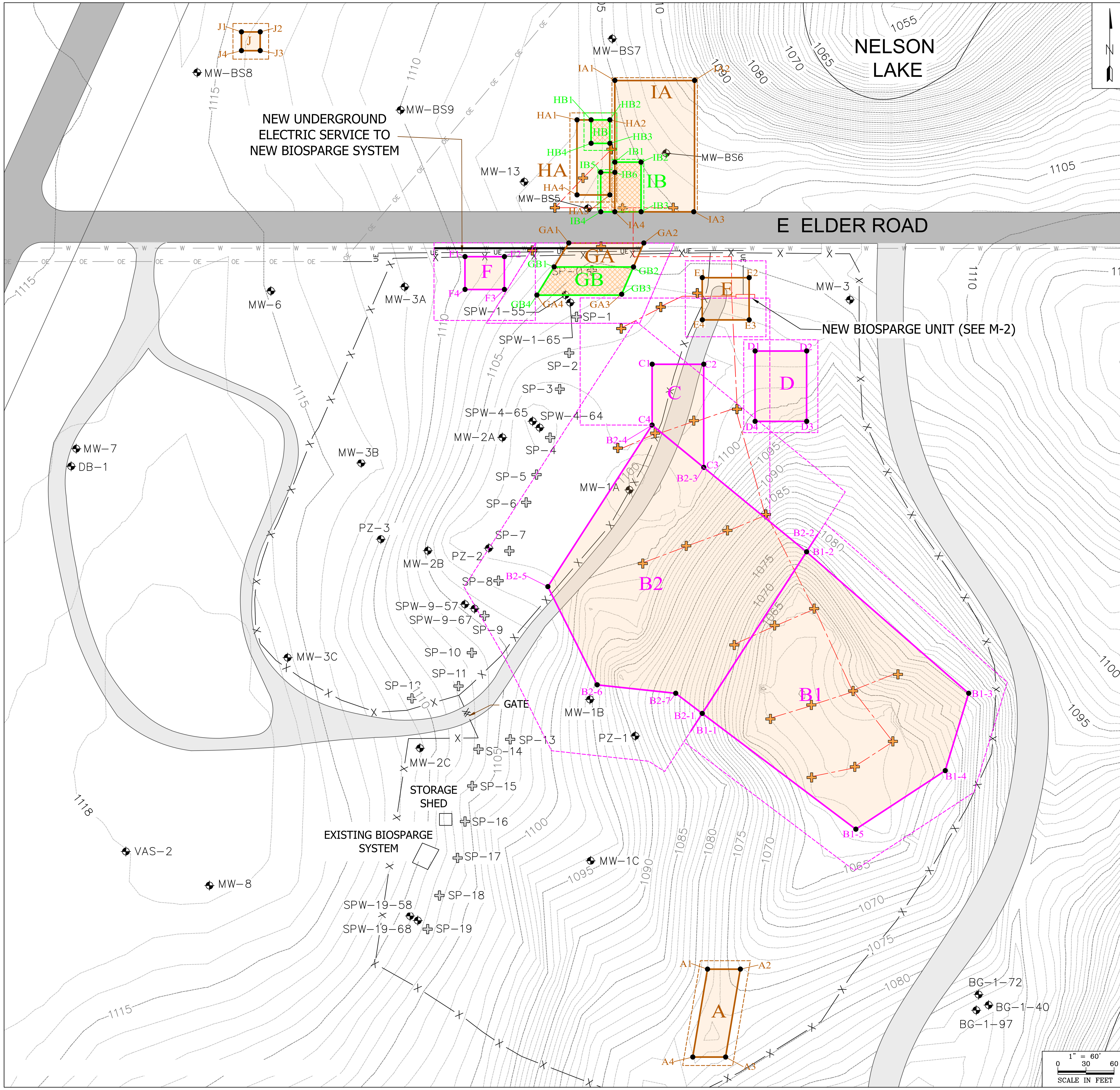
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
CIVIL DETAILS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-4
SHEET NO. 5 OF 21

8/17/2018



Excavation Table			
Excavation Area	Control Point	Easting	Northing
A	A-1	19502144.42	572790.1425
A	A-2	19502179.42	572790.1425
A	A-3	19502163.64	572696.4619
A	A-4	19502128.64	572696.4619
B1	B1-1	19502138.79	573062.7728
B1	B1-2	19502249.95	573235.0228
B1	B1-3	19502422.78	573084.1975
B1	B1-4	19502397.77	573001.704
B1	B1-5	19502302.5	572939.3817
B2	B2-1	19502138.79	573062.7728
B2	B2-2	19502249.95	573235.0228
B2	B2-3	19502140.33	573325.0108
B2	B2-4	19502085.33	573370.1638
B2	B2-5	19501974.16	573197.9246
B2	B2-6	19502026.81	573093.1968
B2	B2-7	19502110.5	573084.1975
C	C-1	19502085.33	573435.0108
C	C-2	19502140.33	573435.0108
C	C-3	19502140.33	573325.0108
C	C-4	19502085.33	573370.1638
D	D-1	19502195.06	573449.1065
D	D-2	19502250.06	573449.1065
D	D-3	19502250.06	573374.1065
D	D-4	19502195.06	573374.1065
E	E-1	19502138.75	573527.3601
E	E-2	19502188.75	573527.3601
E	E-3	19502188.75	573482.3601
E	E-4	19502138.75	573482.3601
F	F-1	19501885.88	573549.7185
F	F-2	19501927.88	573549.7185
F	F-3	19501927.88	573514.7185
F	F-4	19501885.88	573514.7185

Excavation Table			
Excavation Area	Control Point	Easting	Northing
GA	GA1	19501996.43	573564.2115
GA	GA2	19502076.43	573564.2115
GA	GA3	19502052.47	573508.7868
GA	GA4	19501962.47	573508.7868
GB	GB1	19501980.85	573538.7868
GB	GB2	19502065.44	573538.7868
GB	GB3	19502052.47	573508.7868
GB	GB4	19501962.47	573508.7868
HA	HA1	19502005.3	573695.4967
HA	HA2	19502040.3	573695.4967
HA	HA3	19502040.3	573615.4967
HA	HA4	19502005.3	573615.4967
HB	HB1	19502020.3	573695.4967
HB	HB2	19502040.3	573695.4967
HB	HB3	19502040.3	573670.4967
HB	HB4	19502020.3	573670.4967
IA	IA1	19502045.54	573737.5065
IA	IA2	19502130.54	573737.5065
IA	IA3	19502130.54	573597.5065
IA	IA4	19502045.54	573597.5065
IB	IB1	19502045.59	573650.5065
IB	IB2	19502073.59	573650.5065
IB	IB3	19502073.59	573597.5065
IB	IB4	19502030.59	573597.5065
IB	IB5	19502030.59	573639.5065
IB	IB6	19502045.54	573639.5065
J	J-1	19501647.54	573789.3415
J	J-2	19501667.54	573789.3415
J	J-3	19501667.54	573769.3415
J	J-4	19501647.54	573769.3415

NOTE: DASHED LINE REPRESENTS THE APPROXIMATE EXTENT OF EXCAVATION TOP TO INCLUDE SLOPE

LEGEND

- EXISTING BIOSPARGE WELL
- EXISTING MONITORING WELL
- NEW BIOSPARGE WELL
- NEW BIOSPARGE PIPING (1" PEX)
- UE — NEW UNDERGROUND ELECTRIC
- OE — OVERHEAD ELECTRIC (EXISTING)
- W — POTABLE WATER (EXISTING)
- X — EXISTING FENCE
- EXCAVATION BOUNDARY REQUIRING SHORING
- RAILROAD TRACKS
- EXISTING ASPHALT ROAD
- EXISTING GRAVEL ROAD
- 1110 — EXISTING TOPOGRAPHIC ELEVATION
- ORGANIC ONLY EXCAVATION AREA (B1, B2, C, D, and F)
- ORGANIC PORTION EXCAVATION AREA (AREAS GB, HB, AND IB)
- INORGANIC ONLY EXCAVATION AREA (AREAS A, E, GA, HA, IA AND J)

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: AS SHOWN
VERTICAL SCALE: NA

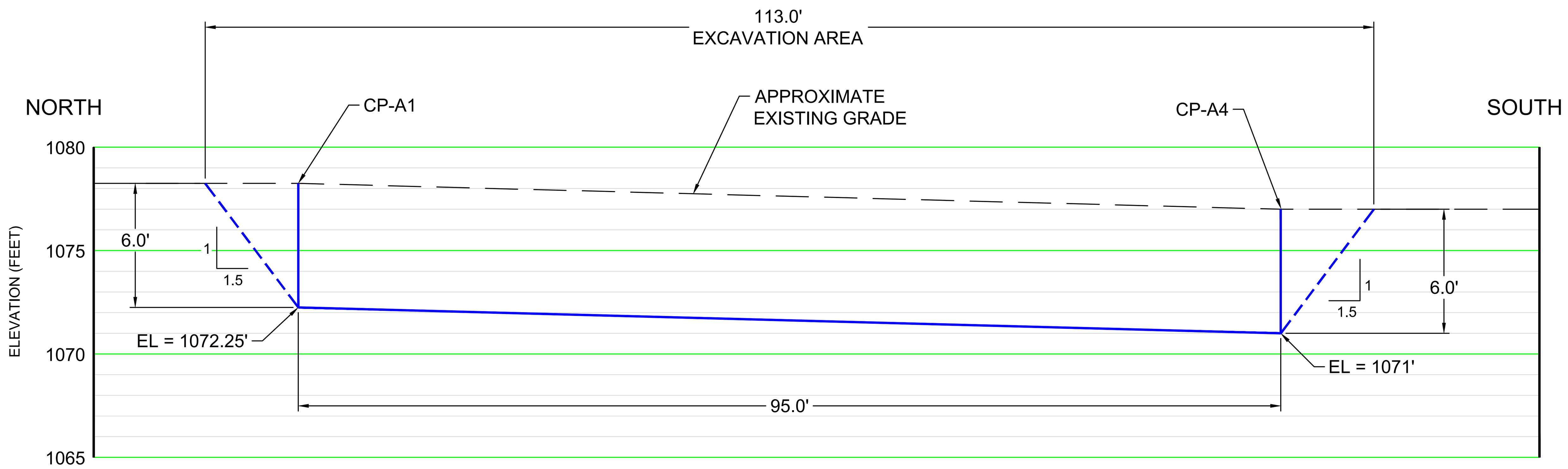
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

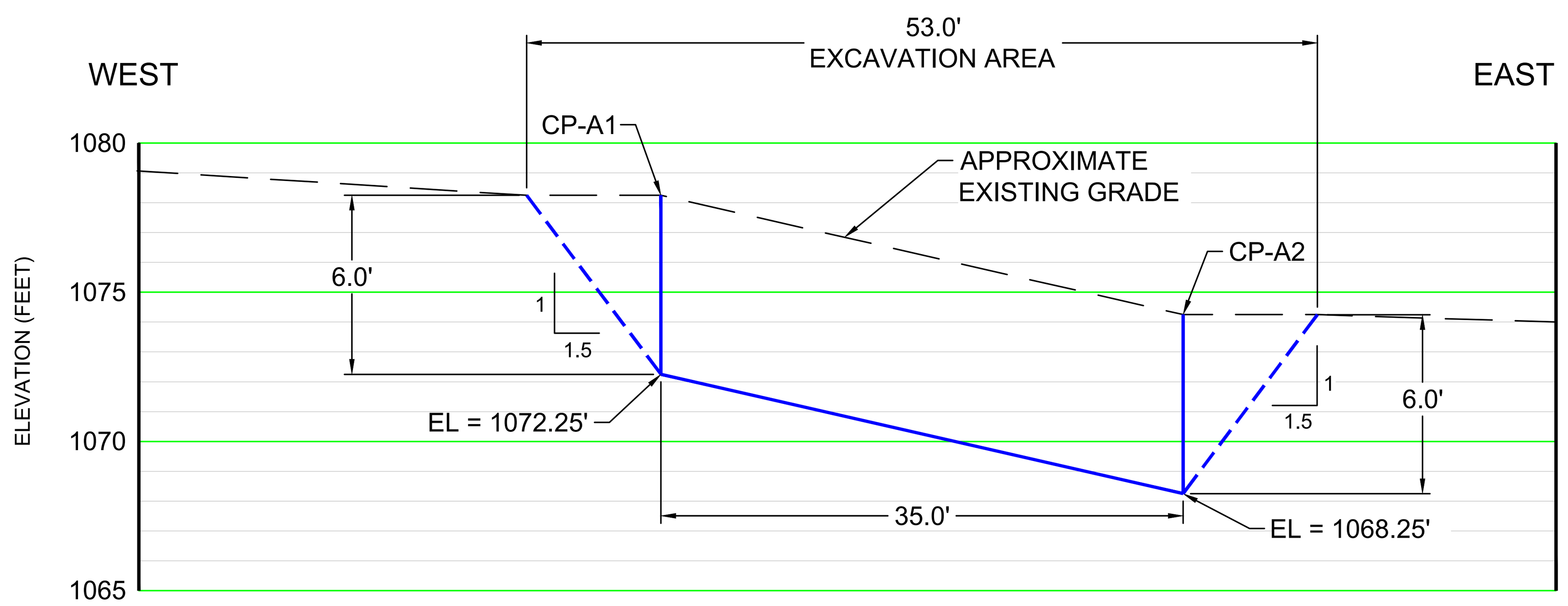
EXCAVATION PLAN

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-5
SHEET NO. 6 OF 21

8/14/2018
G:\G1852\194 Tar Lake RD\dwg\2018-08\C-5 Excavation Plan-111618.dwg

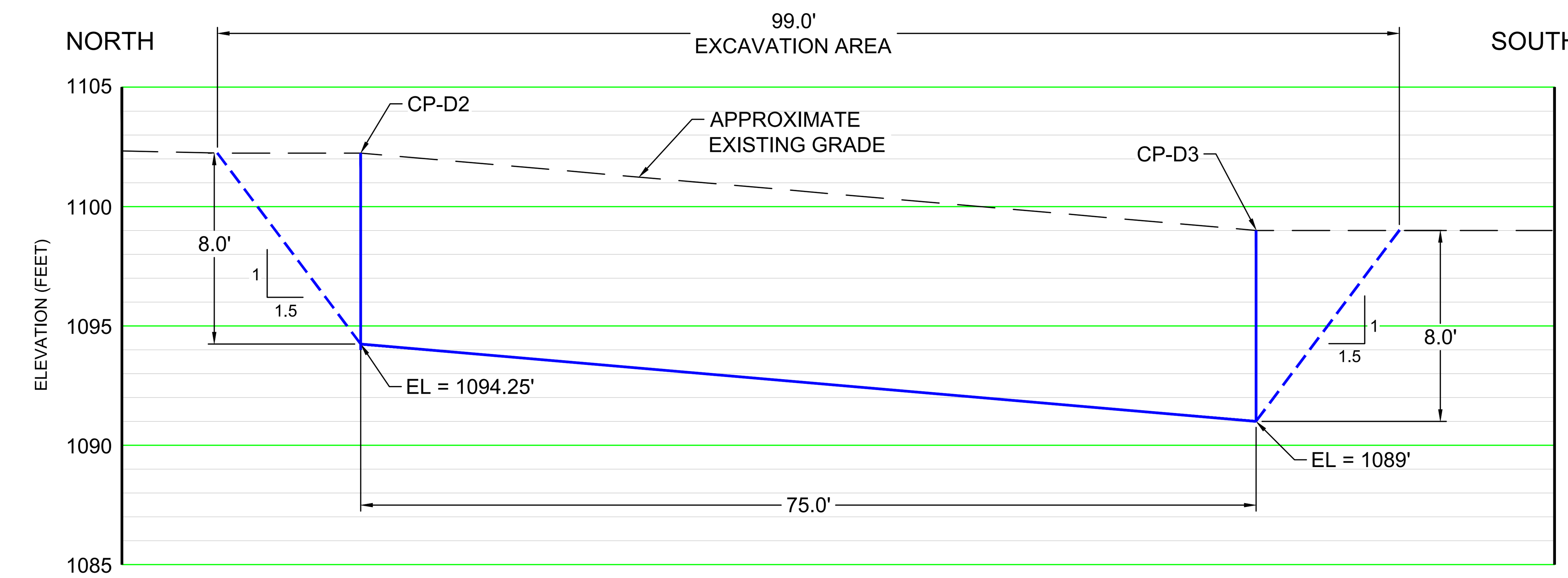
EXCAVATION AREA A CROSS SECTIONS

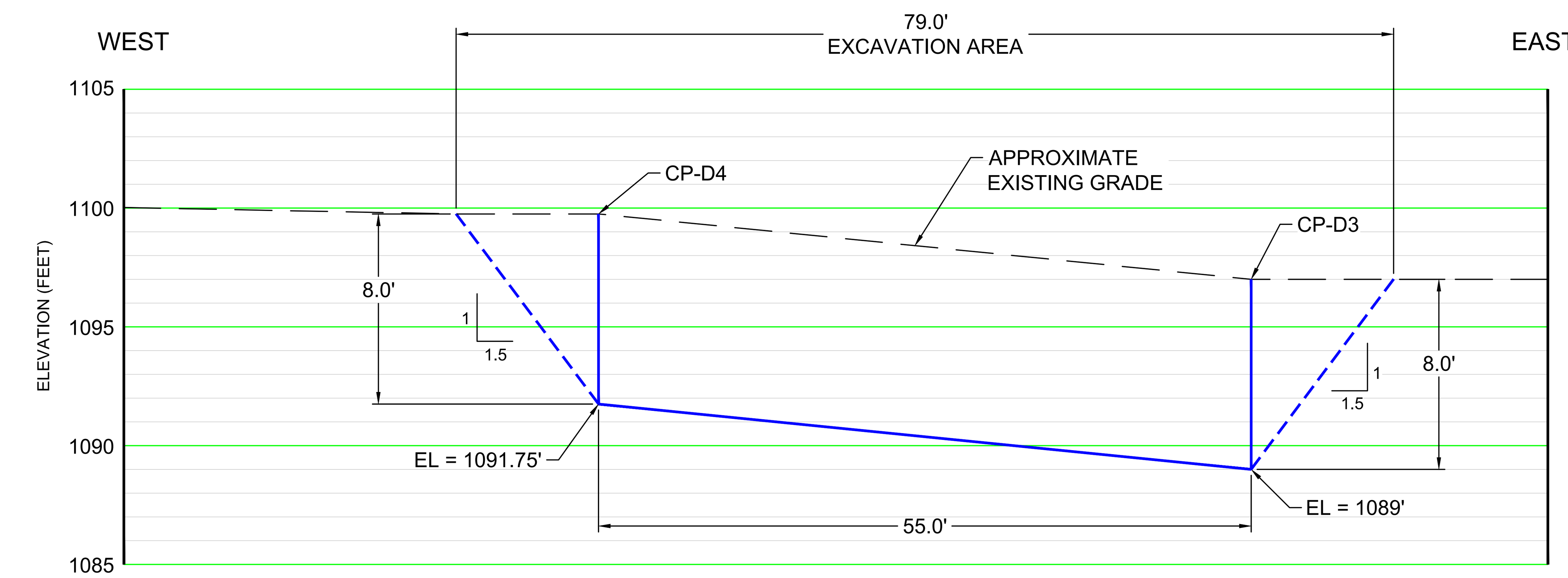




NOTE:
GROUNDWATER ELEVATION IS ABOUT 1057 FEET

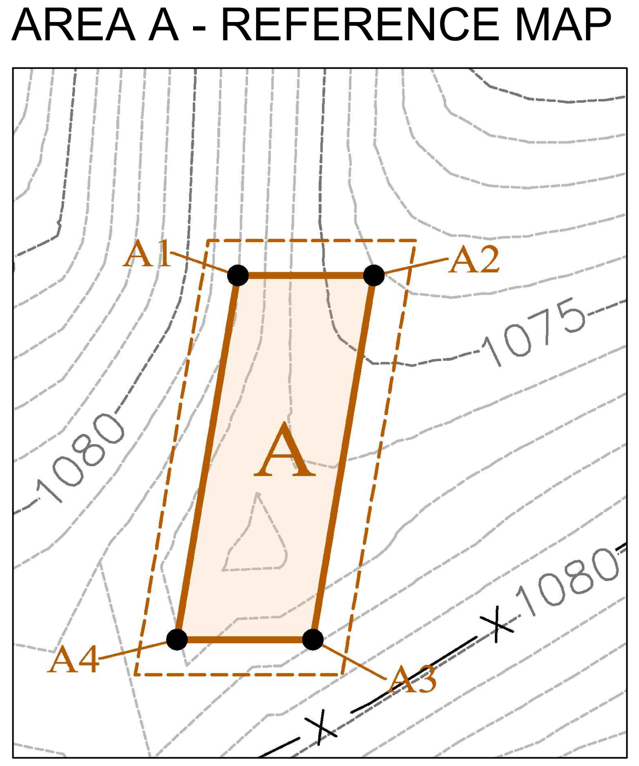
EXCAVATION AREA D CROSS SECTIONS



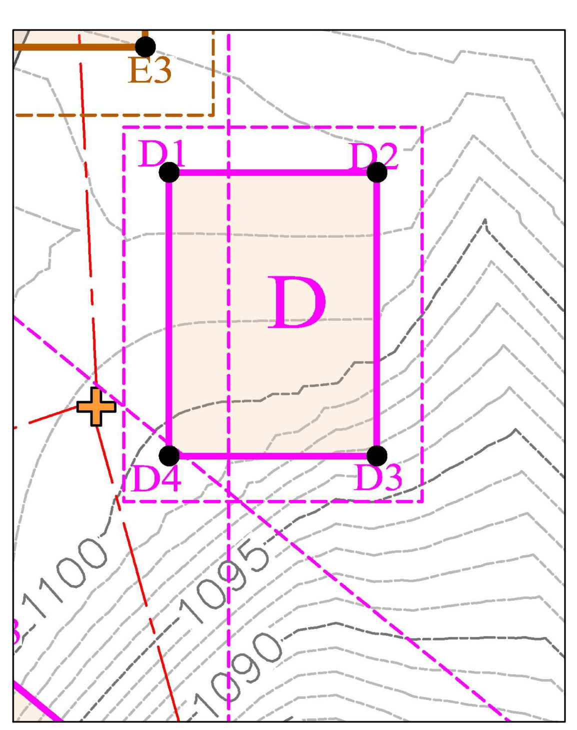


NOTE:
GROUNDWATER ELEVATION IS ABOUT 1057 FEET

AREA A - REFERENCE MAP



AREA D - REFERENCE MAP



NOTE:
1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
A	A-1	19502144.42	572790.1425	1078.25	1072.25	6	1,007	0.00
A	A-2	19502179.42	572790.1425	1074.25	1068.25	6		
A	A-3	19502163.64	572696.4619	1077.75	1071.75	6		
A	A-4	19502128.64	572696.4619	1077	1071	6		
D	D-1	19502195.06	573449.1065	1102.25	1094.25	8	0.00	1,729
D	D-2	19502250.06	573449.1065	1102.25	1094.25	8		
D	D-3	19502250.06	573374.1065	1097	1089	8		
D	D-4	19502195.06	573374.1065	1099.75	1091.75	8		

HORIZONTAL SCALE: 1" = 10'-0"
0 10 20
SCALE IN FEET

VERTICAL SCALE: 1" = 5'-0"
0 5 10
SCALE IN FEET

VERTICAL EXAGERRATION: 2x

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

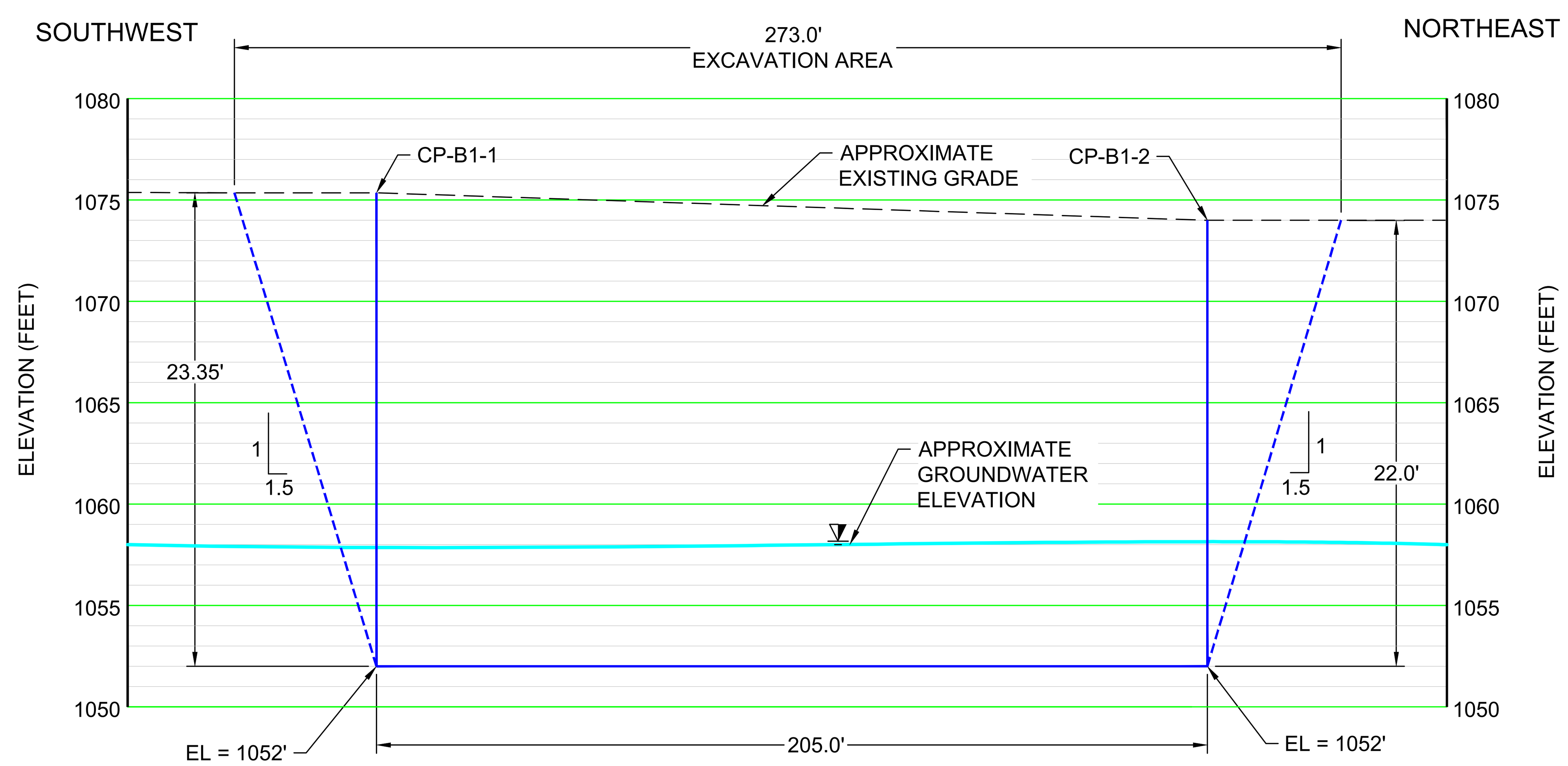
SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

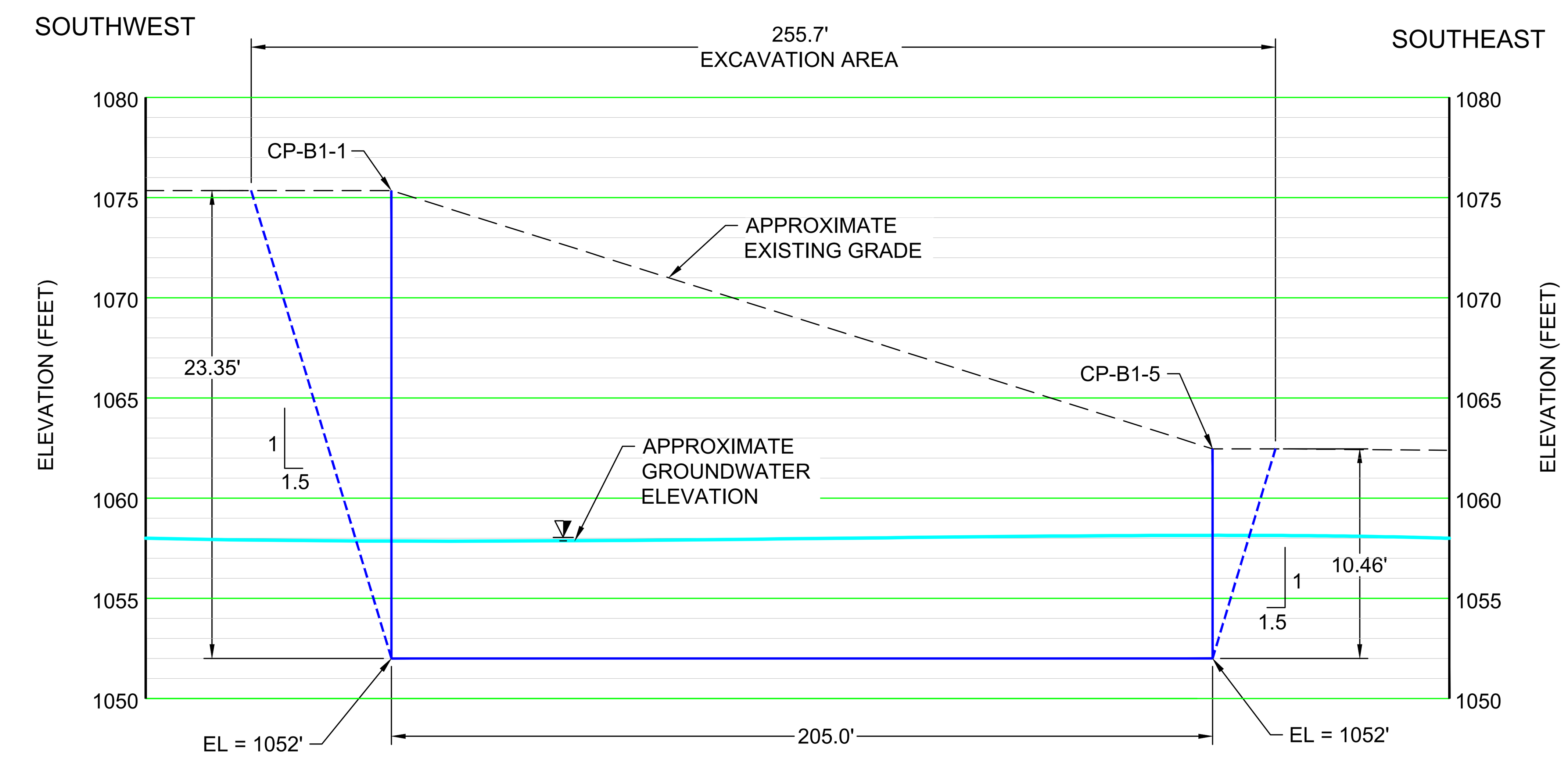
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREAS A & D CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-6
SHEET NO. 7 OF 21

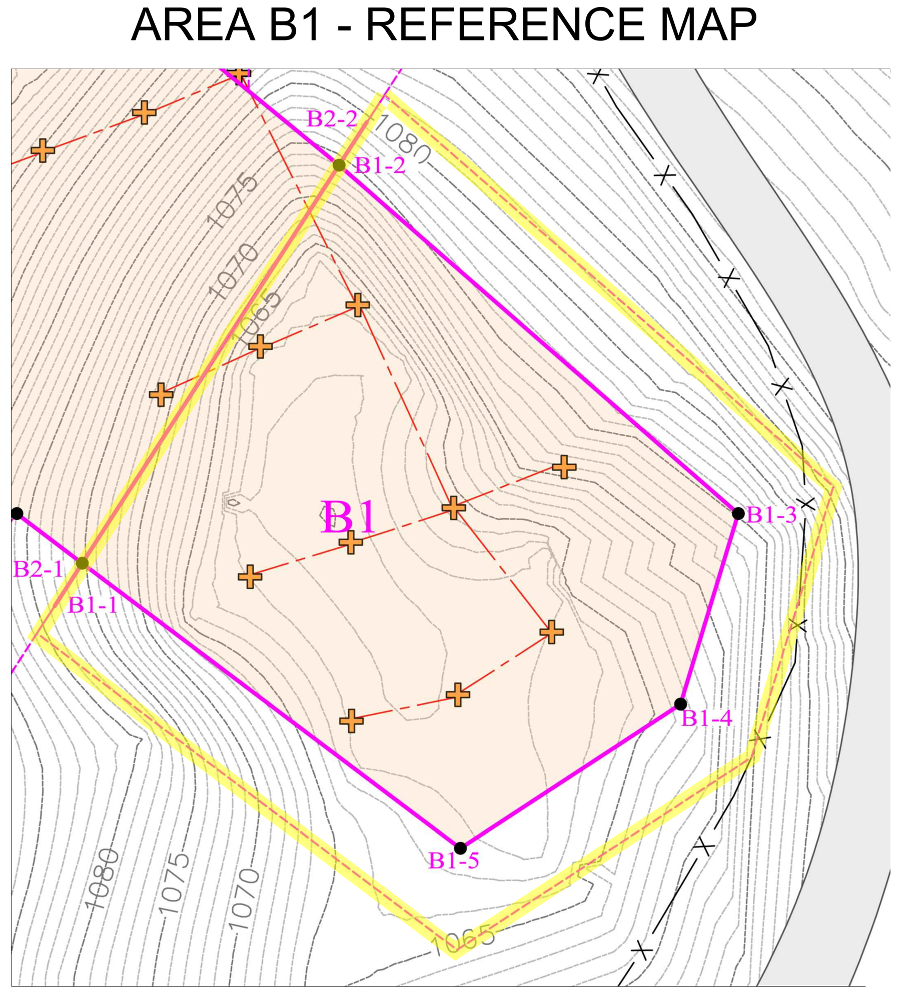
8/6/2018
G:\G\1852\194 Tar Lake RD\dwg\2018-08\ExcavationArea-XSections.dwg

EXCAVATION AREA B1 CROSS SECTIONS





AREA B1 - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO 3 FEET BELOW EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
B1	B1-1	19502138.79	573062.7728	1075.35	1052	23.35	0.00	34,889
B1	B1-2	19502249.95	573235.0228	1074	1052	22		
B1	B1-3	19502422.78	573084.1975	1075.26	1052	23.26		
B1	B1-4	19502397.77	573001.704	1066.5	1052	14.5		
B1	B1-5	19502302.5	572939.3817	1062.46	1052	10.46		

HORIZONTAL SCALE: 1" = 30'-0"

VERTICAL SCALE: 1" = 6'-0"

VERTICAL EXAGERRATION: 5x

0 30 60 SCALE IN FEET

0 6 12 SCALE IN FEET

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

SulTRAC

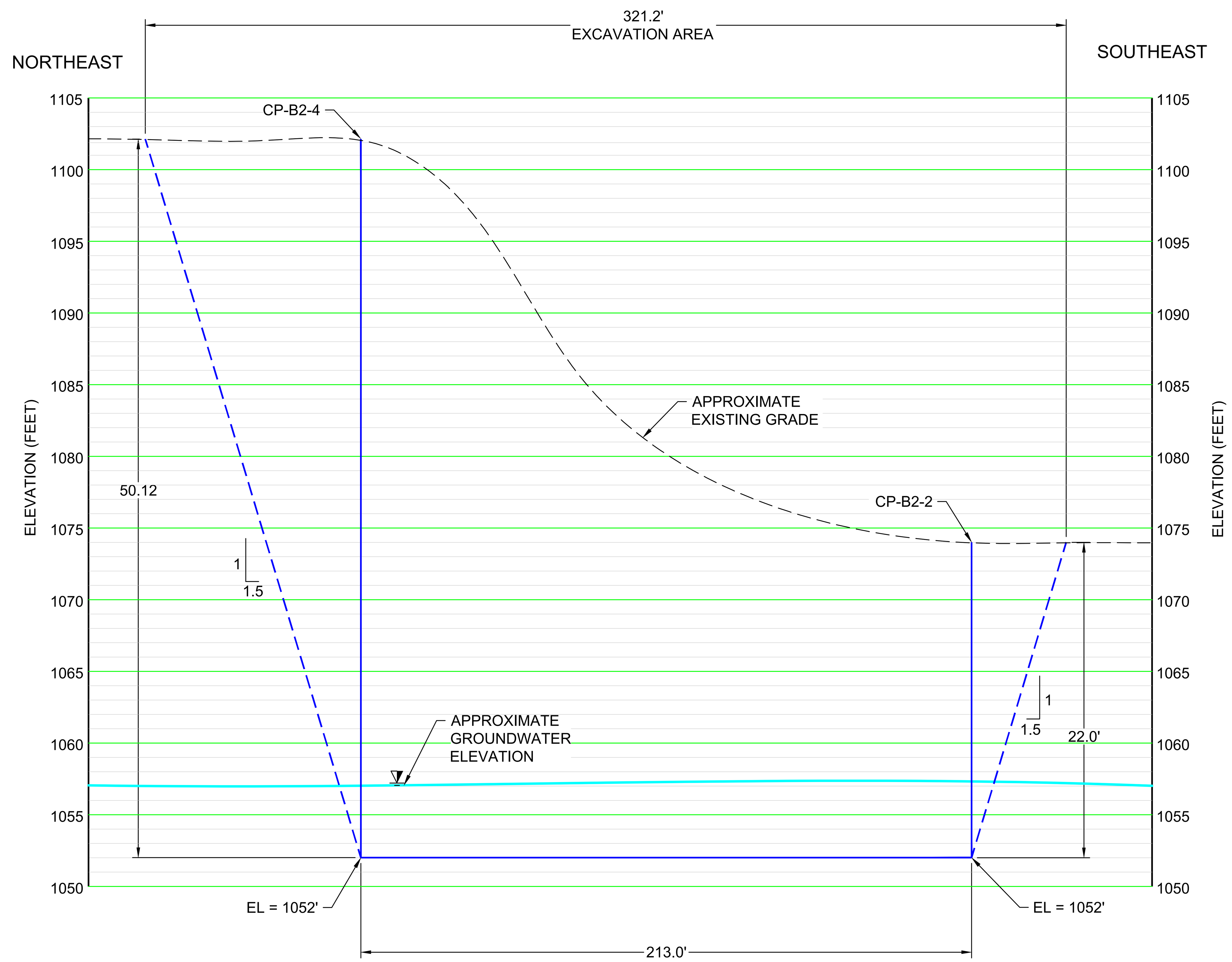
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

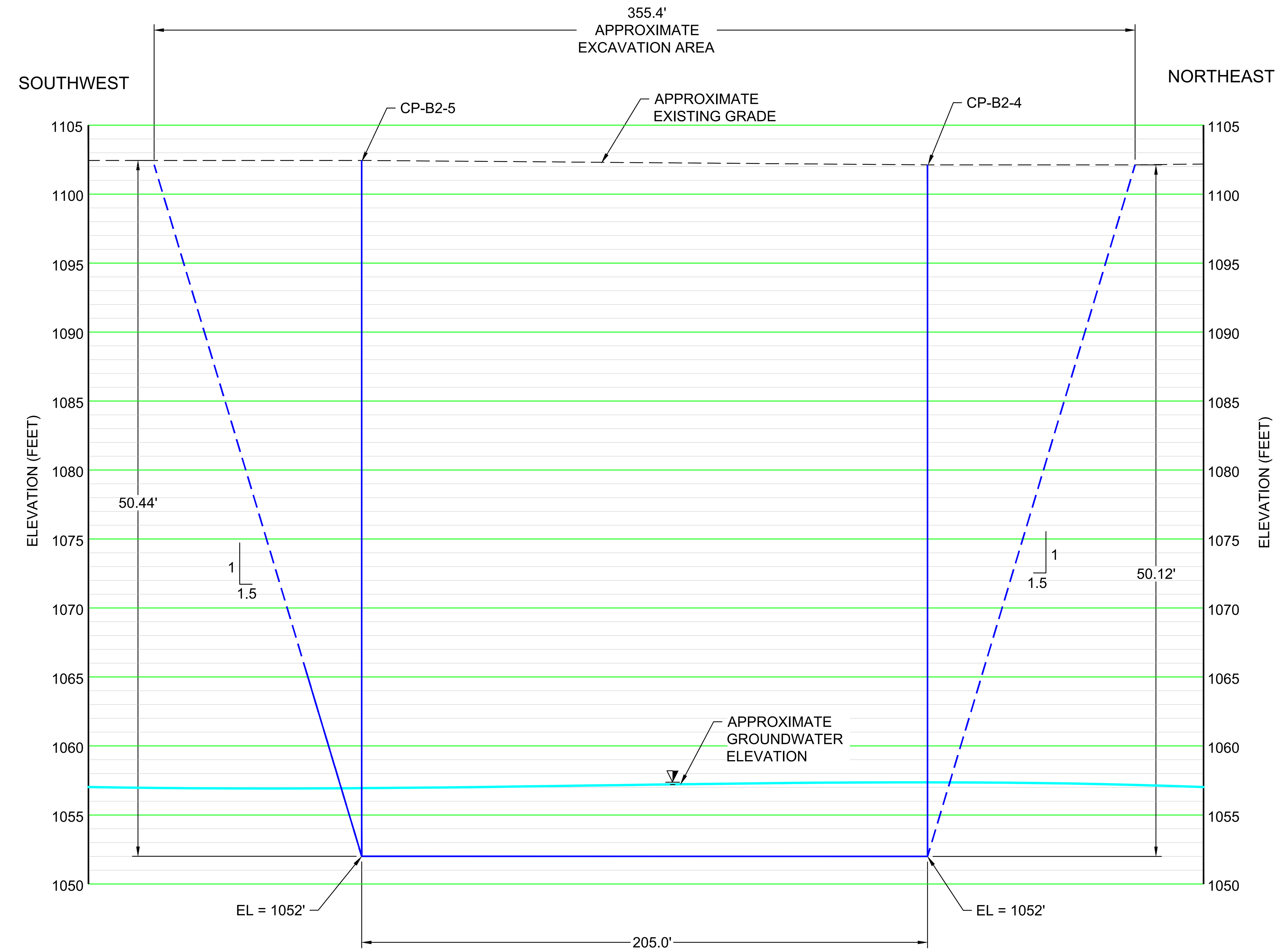
SCALES:
HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 6'

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREA B1 CROSS SECTIONS

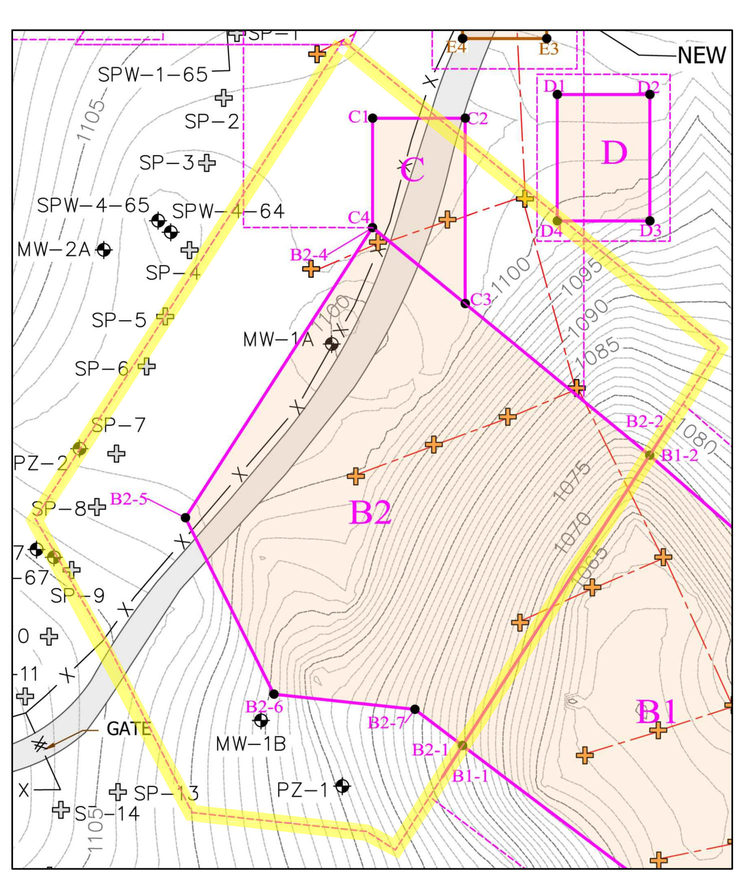
WORK ASSIGNMENT NO. WA194
DRAWING NO. C-7
SHEET NO. 8 OF 21

EXCAVATION AREA B2 CROSS SECTIONS





AREA B2 - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO 3 FEET BELOW EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
B2	B2-1	19502138.79	573062.7728	1075.35	1052	23.35	0.00	73,461
B2	B2-2	19502249.95	573235.0228	1074	1052	22		
B2	B2-3	19502140.33	573325.0108	1101.2	1052	49.2		
B2	B2-4	19502085.33	573370.1638	1102.12	1052	50.12		
B2	B2-5	19501974.16	573197.9246	1102.44	1052	50.44		
B2	B2-6	19502026.81	573093.1968	1094.53	1052	42.53		
B2	B2-7	19502110.5	573084.1975	1080.98	1052	28.98		

HORIZONTAL SCALE: 1" = 30'-0"

VERTICAL SCALE: 1" = 6'-0"

VERTICAL EXAGERRATION: 5x

0 30 60 SCALE IN FEET

0 6 12 SCALE IN FEET

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED CN

DRAWN MB

CHECKED CN

DATE AUGUST 2018

SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 6'

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

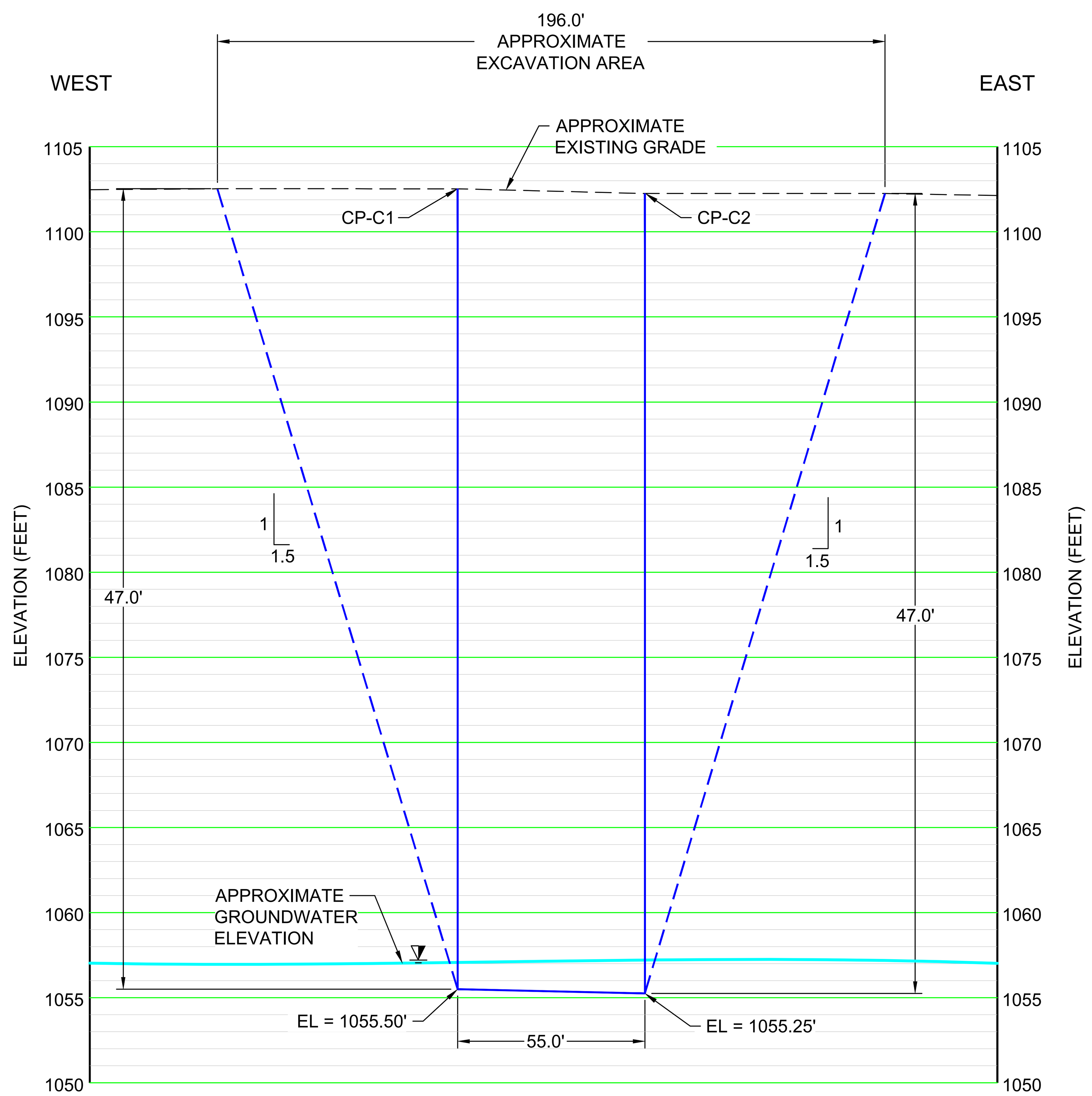
EXCAVATION AREA B2 CROSS SECTIONS

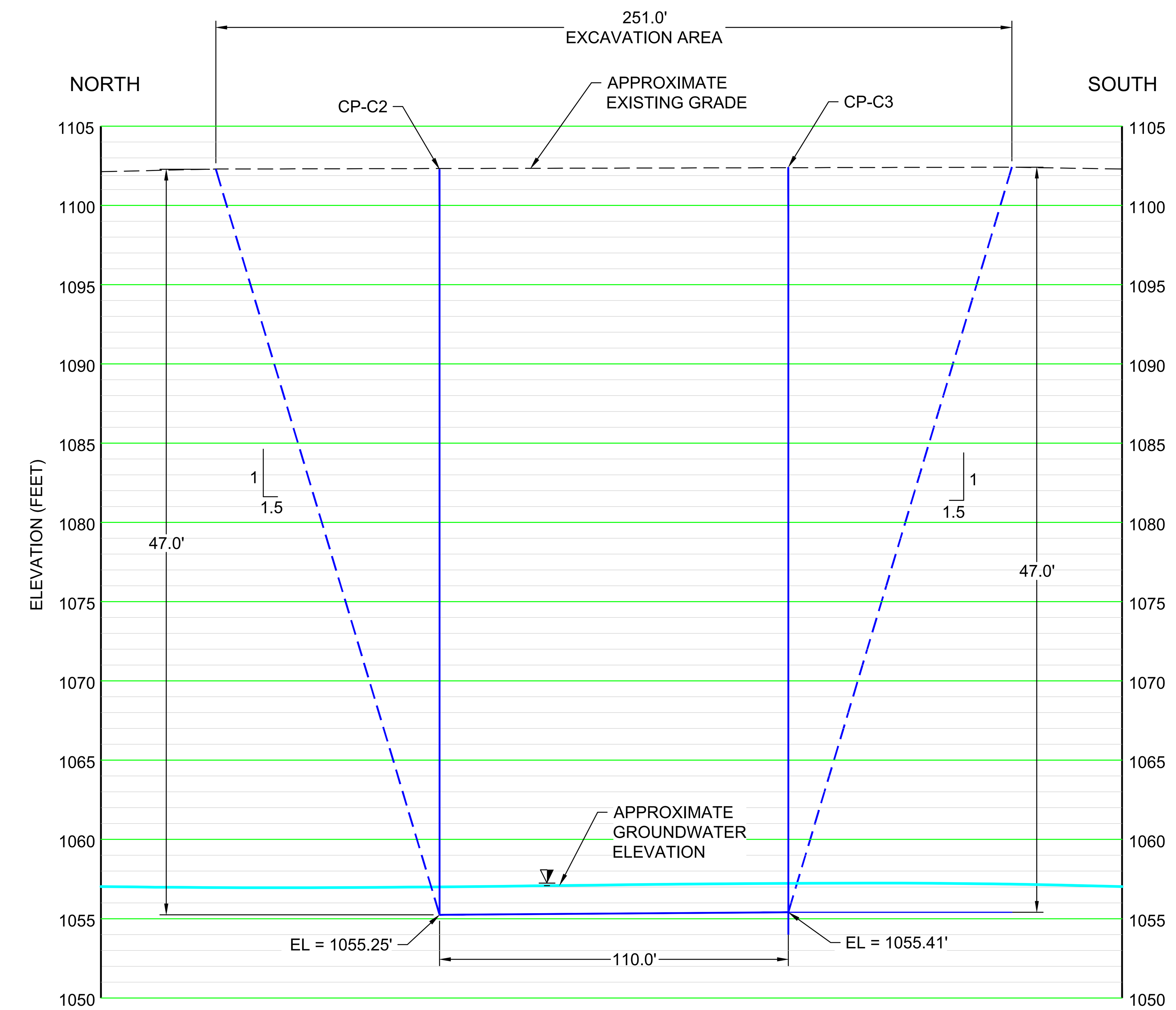
WORK ASSIGNMENT NO. WA194

DRAWING NO. C-8

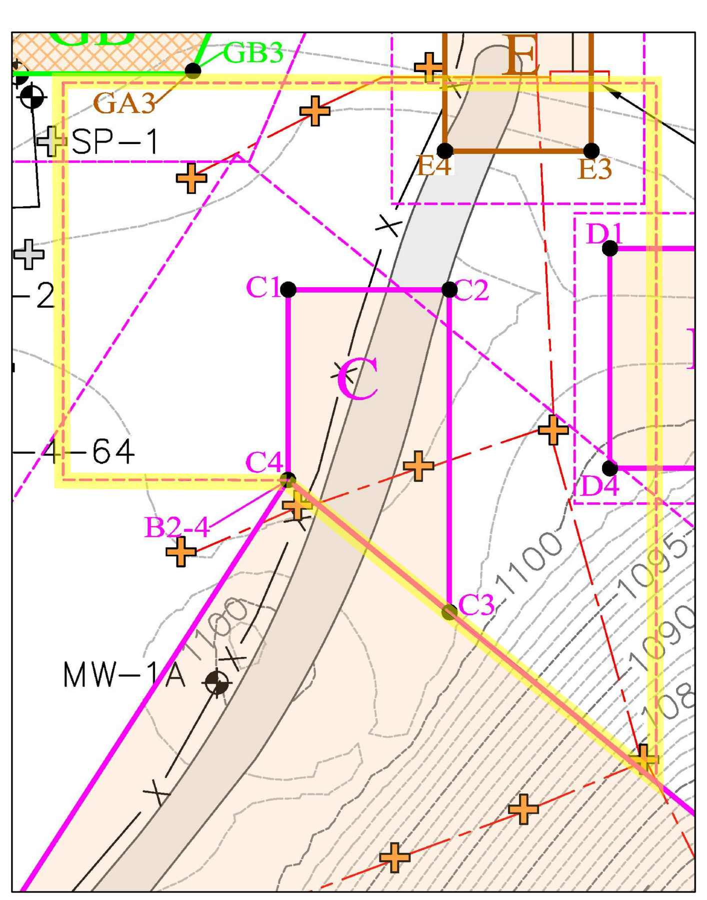
SHEET NO. 9 OF 21

EXCAVATION AREA C CROSS SECTIONS





AREA C - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
C	C-1	19502085.33	573435.0108	1102.5	1055.5	47	0.00	34,624
C	C-2	19502140.33	573435.0108	1102.25	1055.25	47		
C	C-3	19502140.33	573325.0108	1102.41	1055.41	47		
C	C-4	19502085.33	573370.1638	1104.18	1057.18	47		

HORIZONTAL SCALE: 1" = 30'-0"
VERTICAL SCALE: 1" = 6'-0"
VERTICAL EXAGERRATION: 5x

0 30 60 SCALE IN FEET
0 6 12 SCALE IN FEET

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

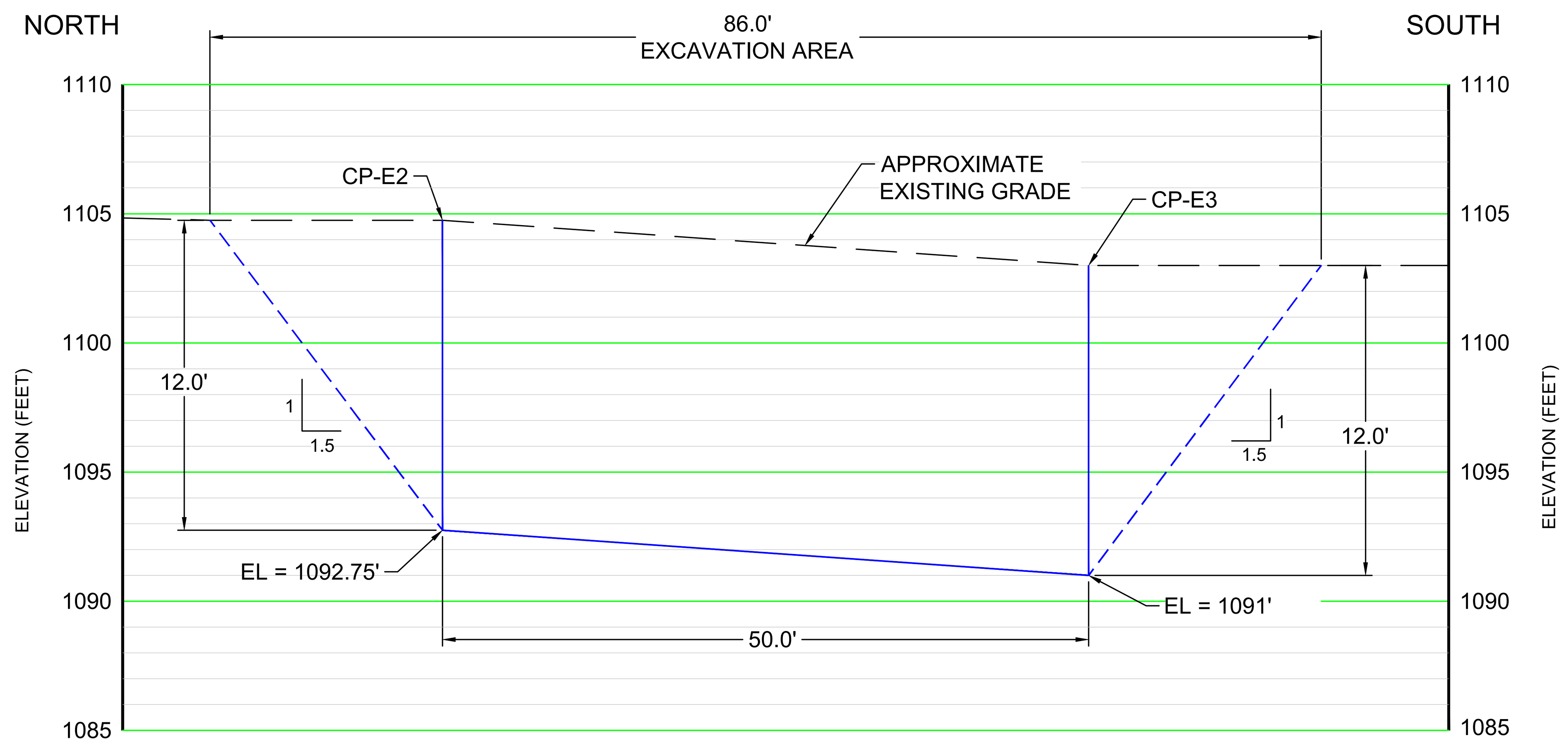
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

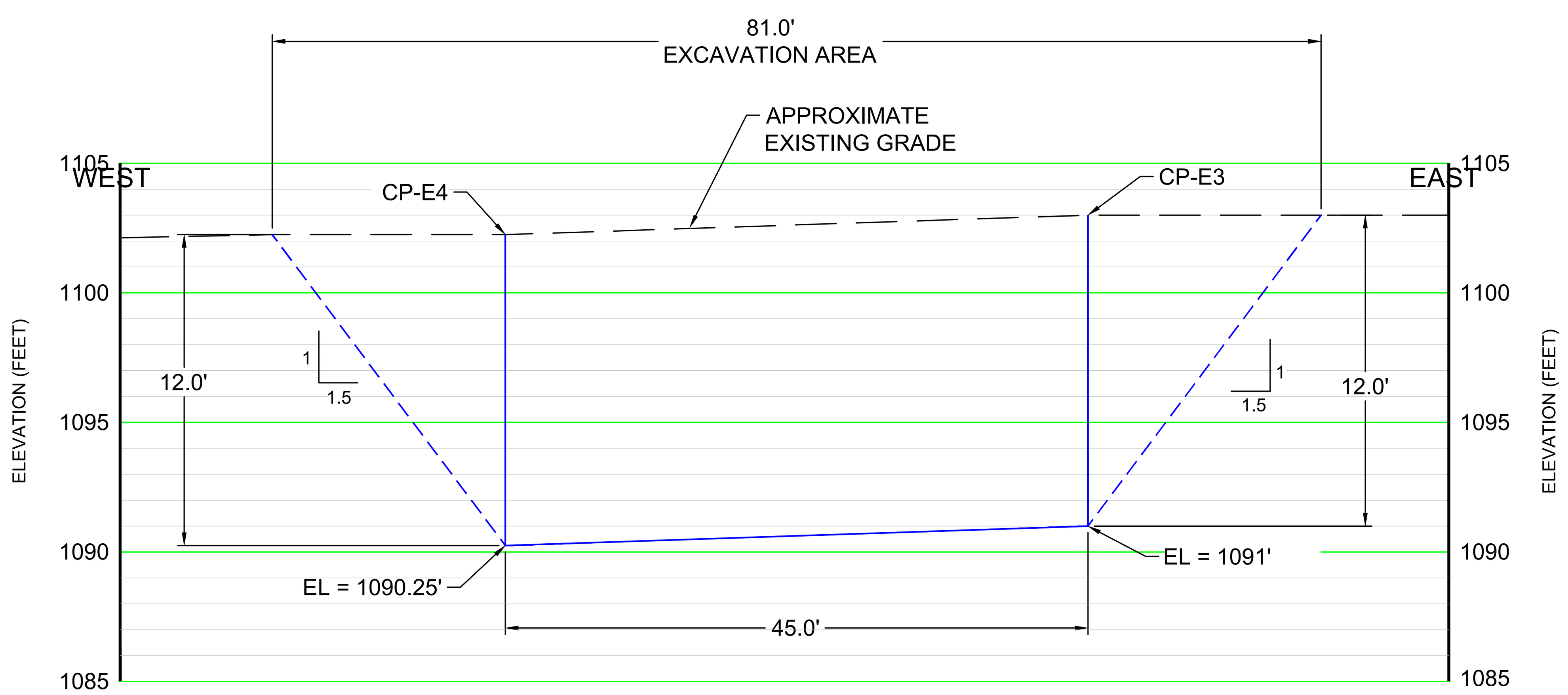
SCALES:
HORIZONTAL SCALE: 1" = 30'
VERTICAL SCALE: 1" = 6'

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREA C CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-9
SHEET NO. 10 OF 21

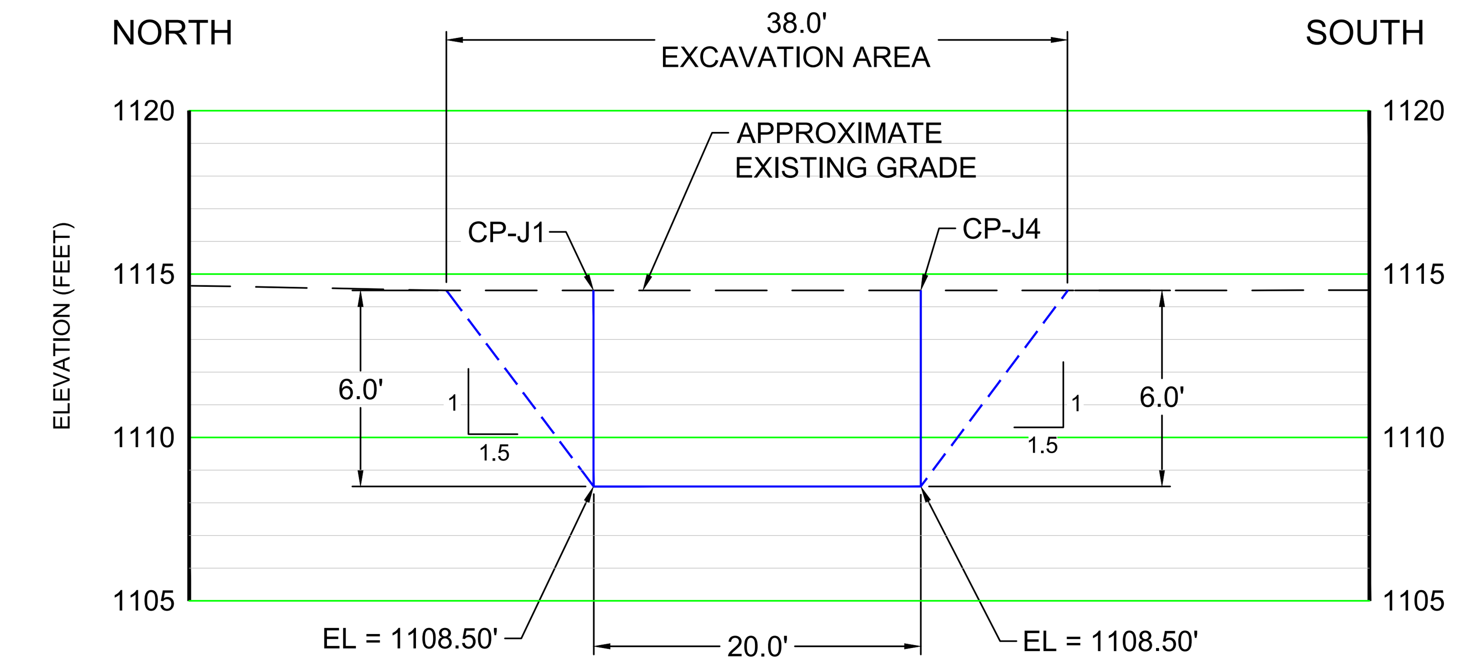
EXCAVATION AREA E - CROSS SECTIONS

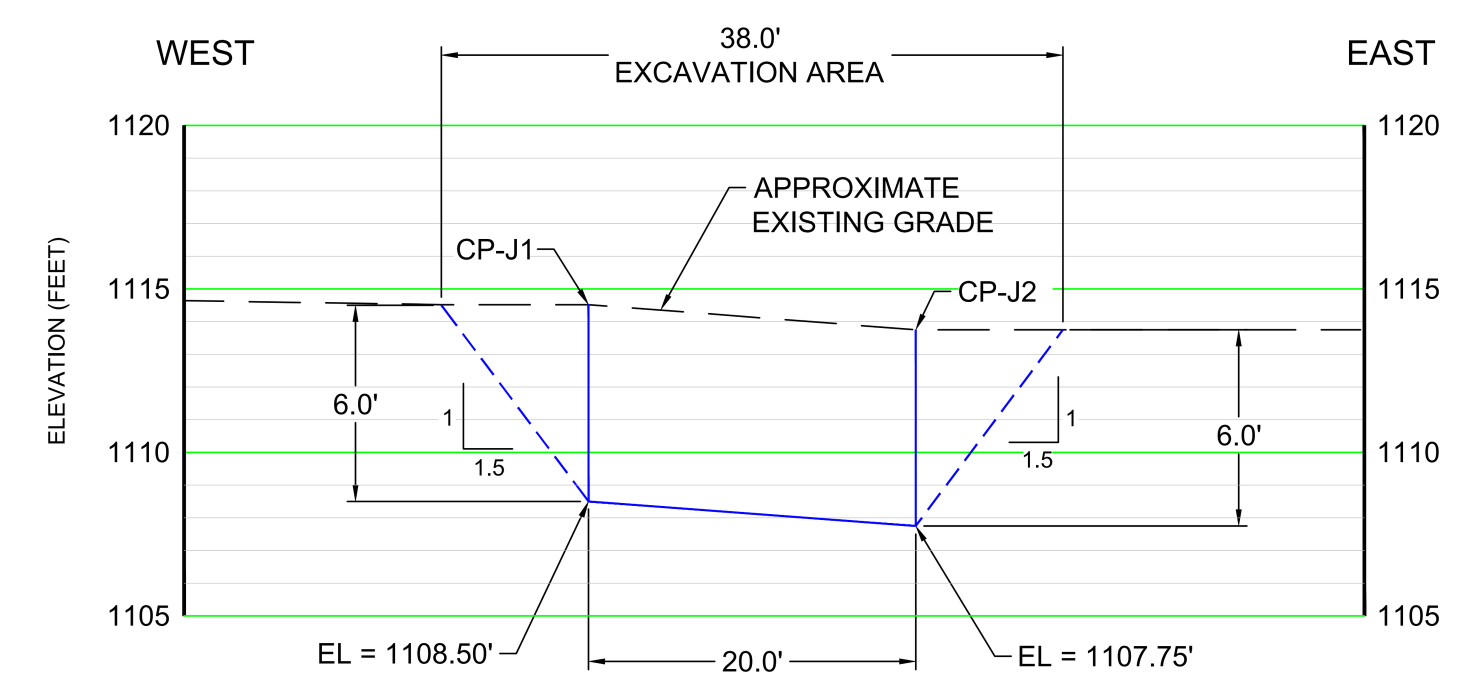




NOTE:
GROUNDWATER ELEVATION IS ABOUT 1057 FEET

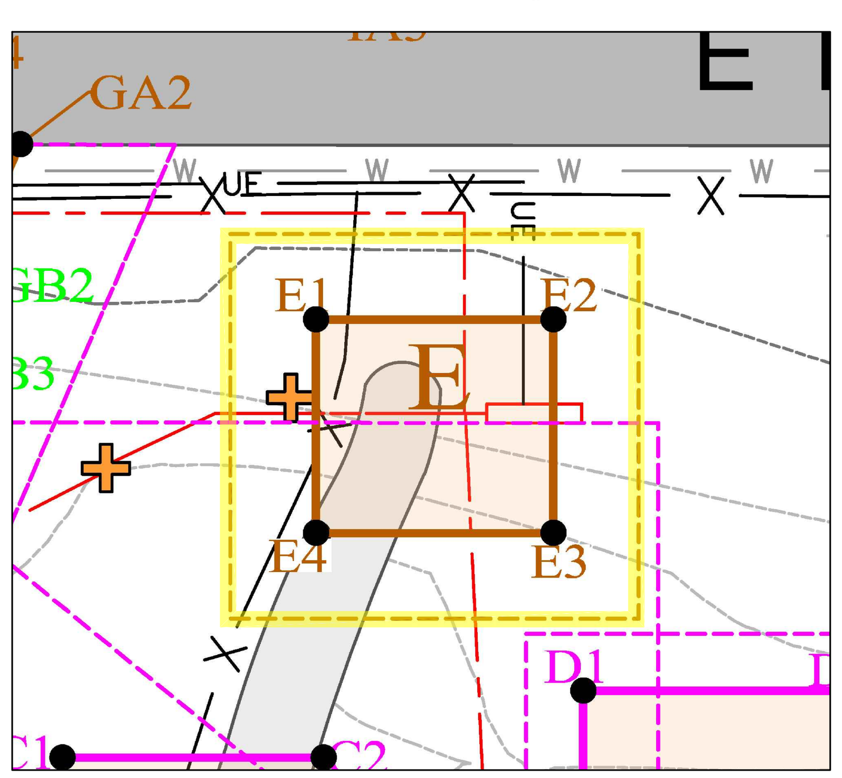
EXCAVATION AREA J - CROSS SECTIONS



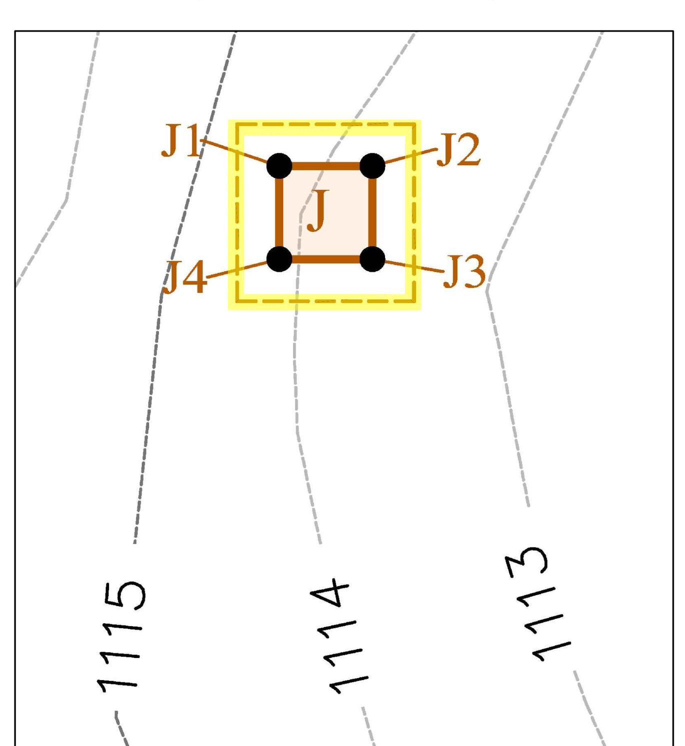


NOTE:
GROUNDWATER ELEVATION IS ABOUT 1057 FEET

AREA E - REFERENCE MAP



AREA J - REFERENCE MAP



NOTE:
1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
E	E-1	19502138.75	573527.3601	1104.75	1092.75	12	1,911	0.00
E	E-2	19502188.75	573527.3601	1104.75	1092.75	12		
E	E-3	19502188.75	573482.3601	1103	1091	12		
E	E-4	19502138.75	573482.3601	1102.25	1090.25	12		
J	J-1	19501647.54	573789.3415	1114.5	1108.5	6	188	0.00
J	J-2	19501667.54	573789.3415	1113.75	1107.75	6		
J	J-3	19501667.54	573769.3415	1113.75	1107.75	6		
J	J-4	19501647.54	573769.3415	1114.5	1108.5	6		

HORIZONTAL SCALE: 1" = 10'-0"
VERTICAL SCALE: 1" = 5'-0"
VERTICAL EXAGERRATION: 2x

0 10 20 SCALE IN FEET
0 5 10 SCALE IN FEET

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

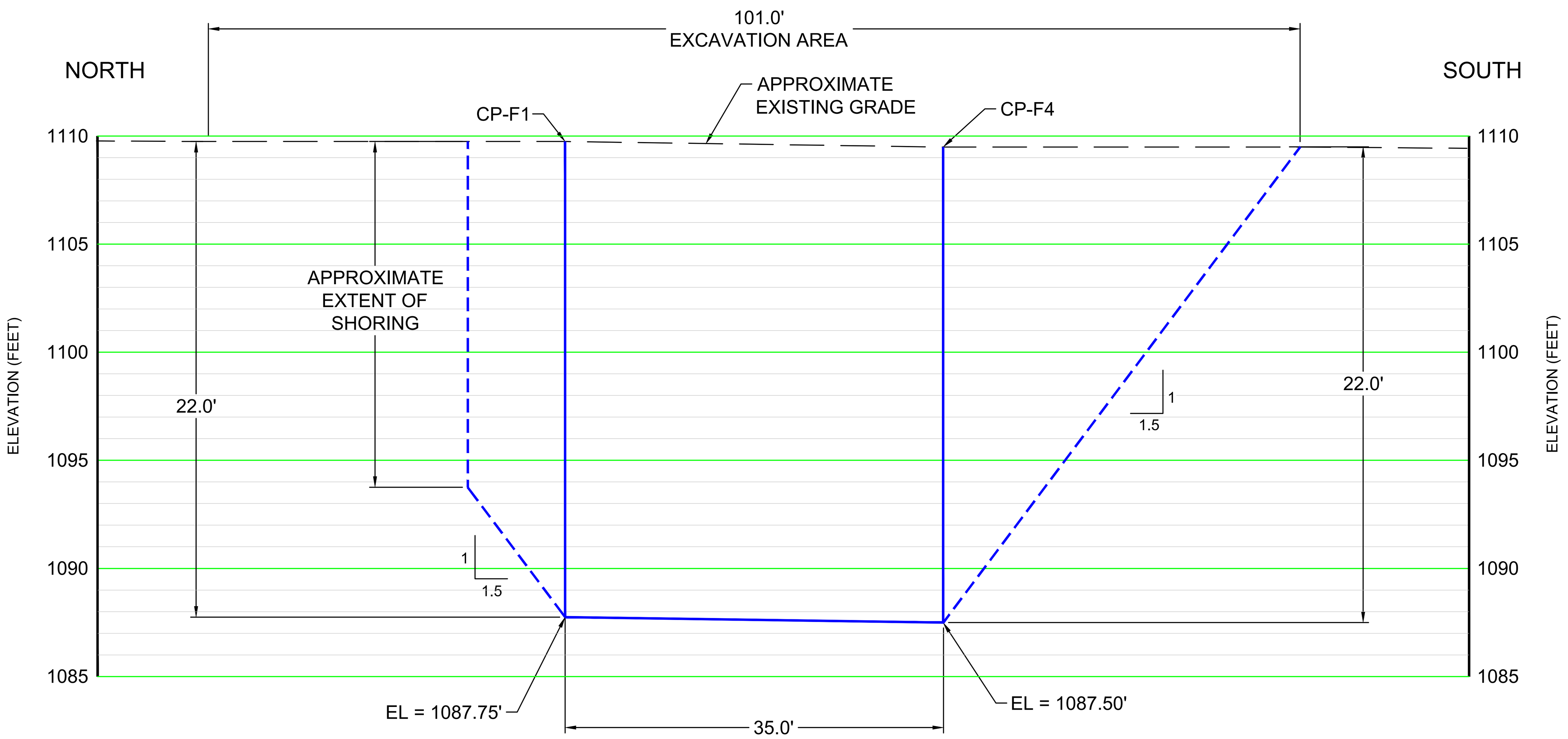
SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

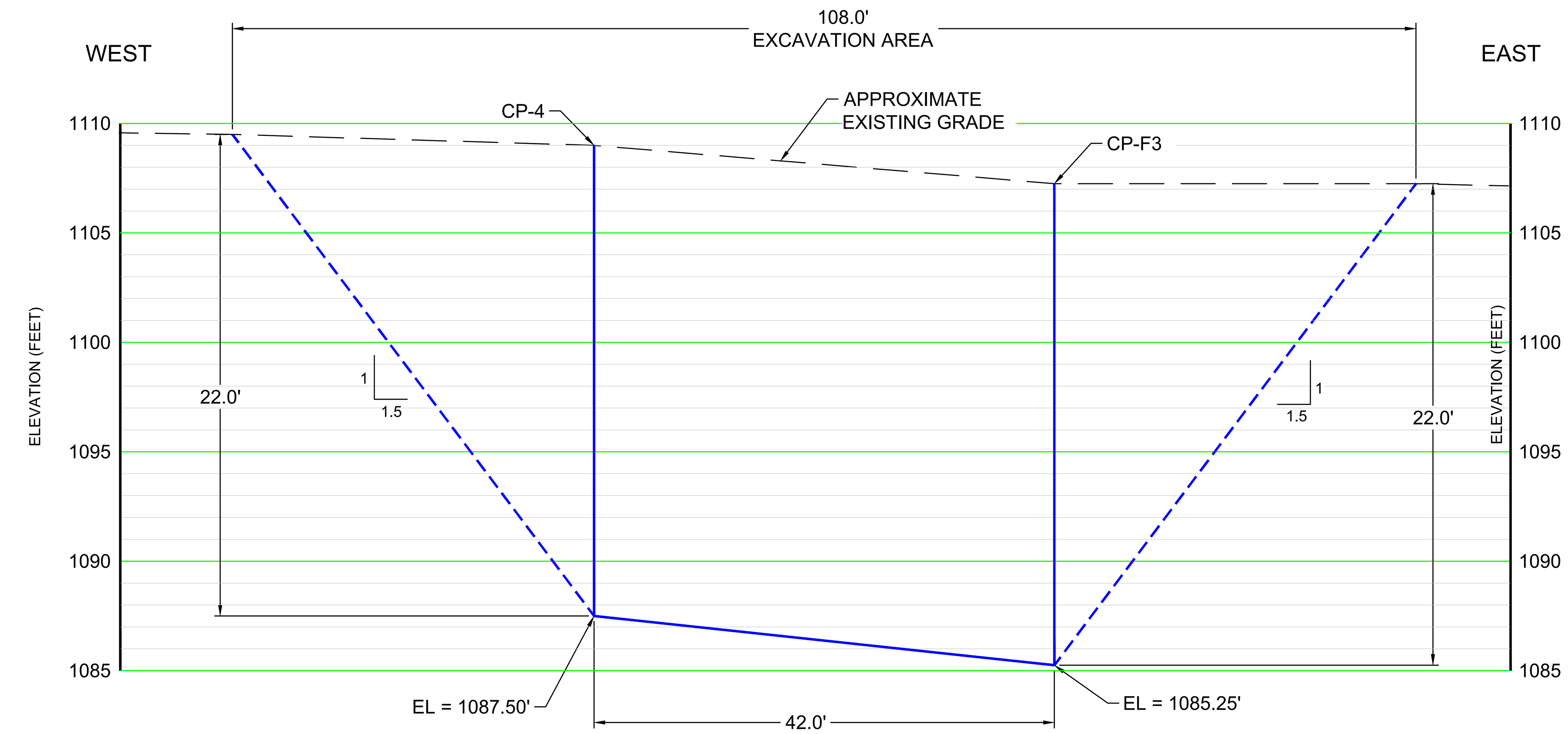
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREAS E & J CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-10
SHEET NO. 11 OF 21

8/14/2018

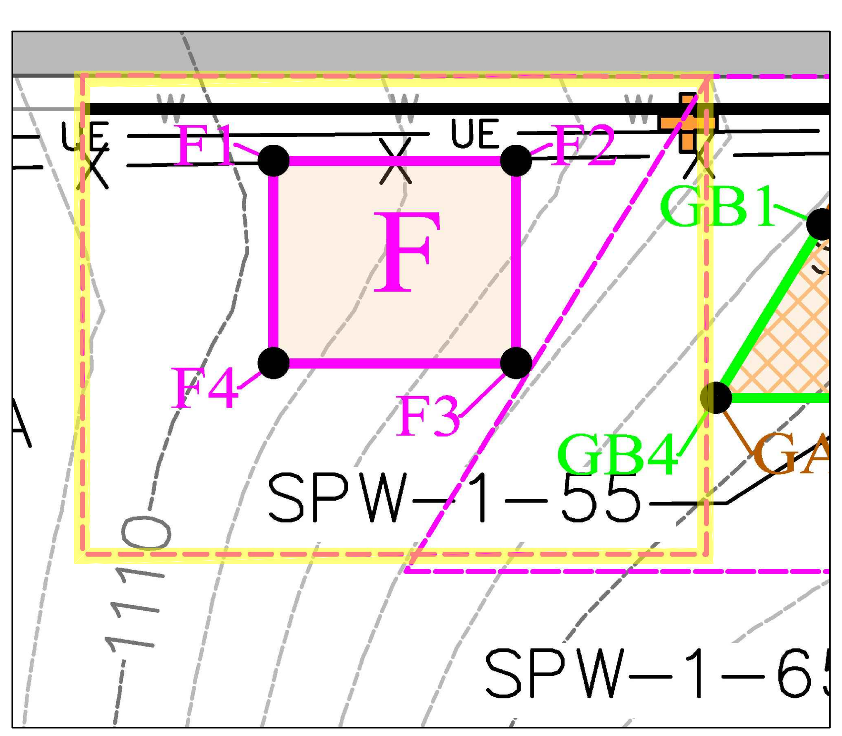
EXCAVATION AREA F - CROSS SECTIONS





NOTE:
GROUNDWATER ELEVATION IS ABOUT 1057 FEET

AREA F - REFERENCE MAP



NOTE:
1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
F	F-1	19501885.88	573549.7185	1109.75	1087.75	22	0.00	4,197
F	F-2	19501927.88	573549.7185	1108.5	1086.5	22		
F	F-3	19501927.88	573514.7185	1107.25	1085.25	22		
F	F-4	19501885.88	573514.7185	1109.5	1087.5	22		

HORIZONTAL SCALE: 1" = 10'-0"
VERTICAL SCALE: 1" = 5'-0"
VERTICAL EXAGERRATION: 2x

0 10 20 SCALE IN FEET
0 5 10 SCALE IN FEET

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

ST SulTRAC

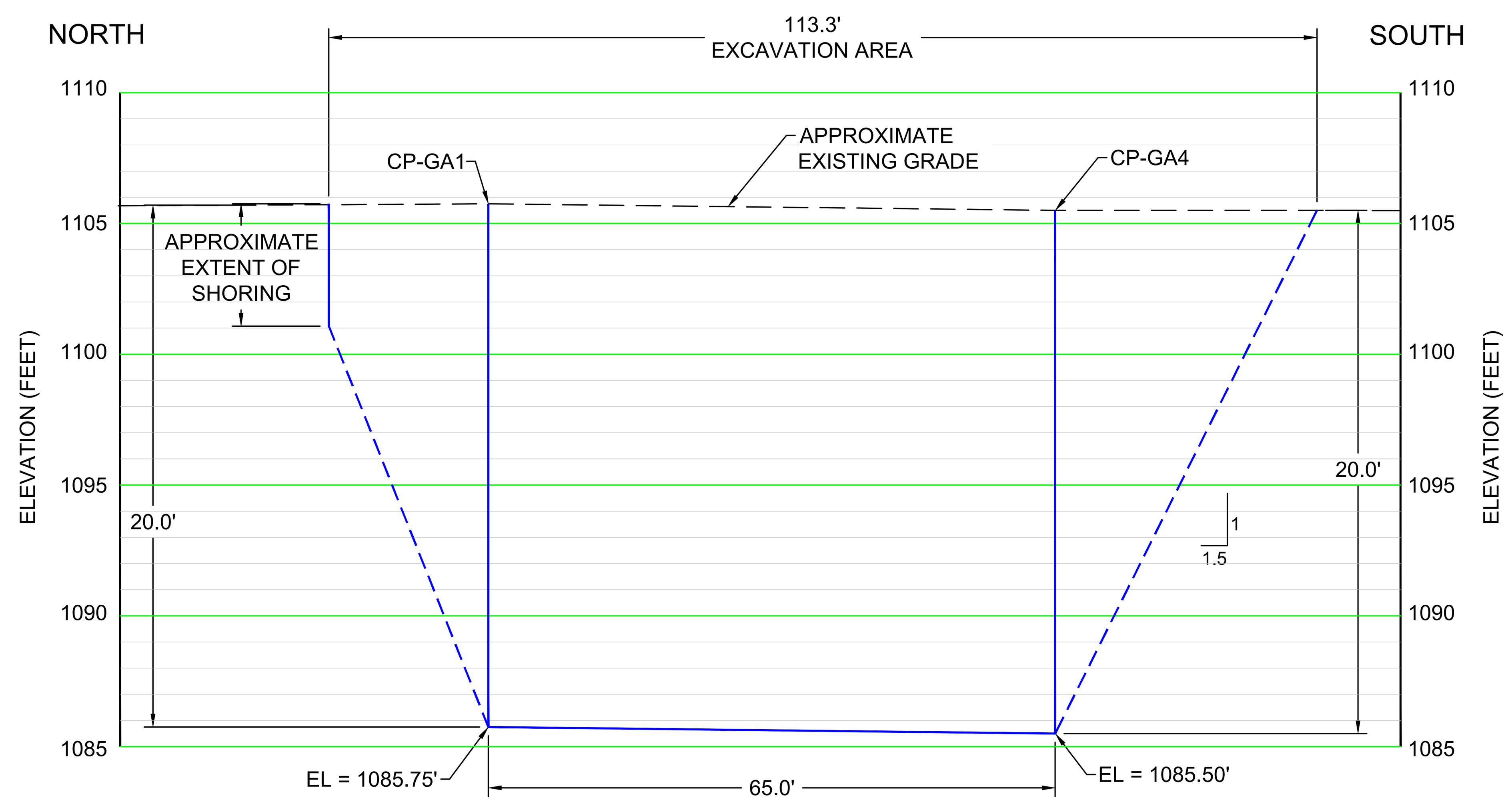
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

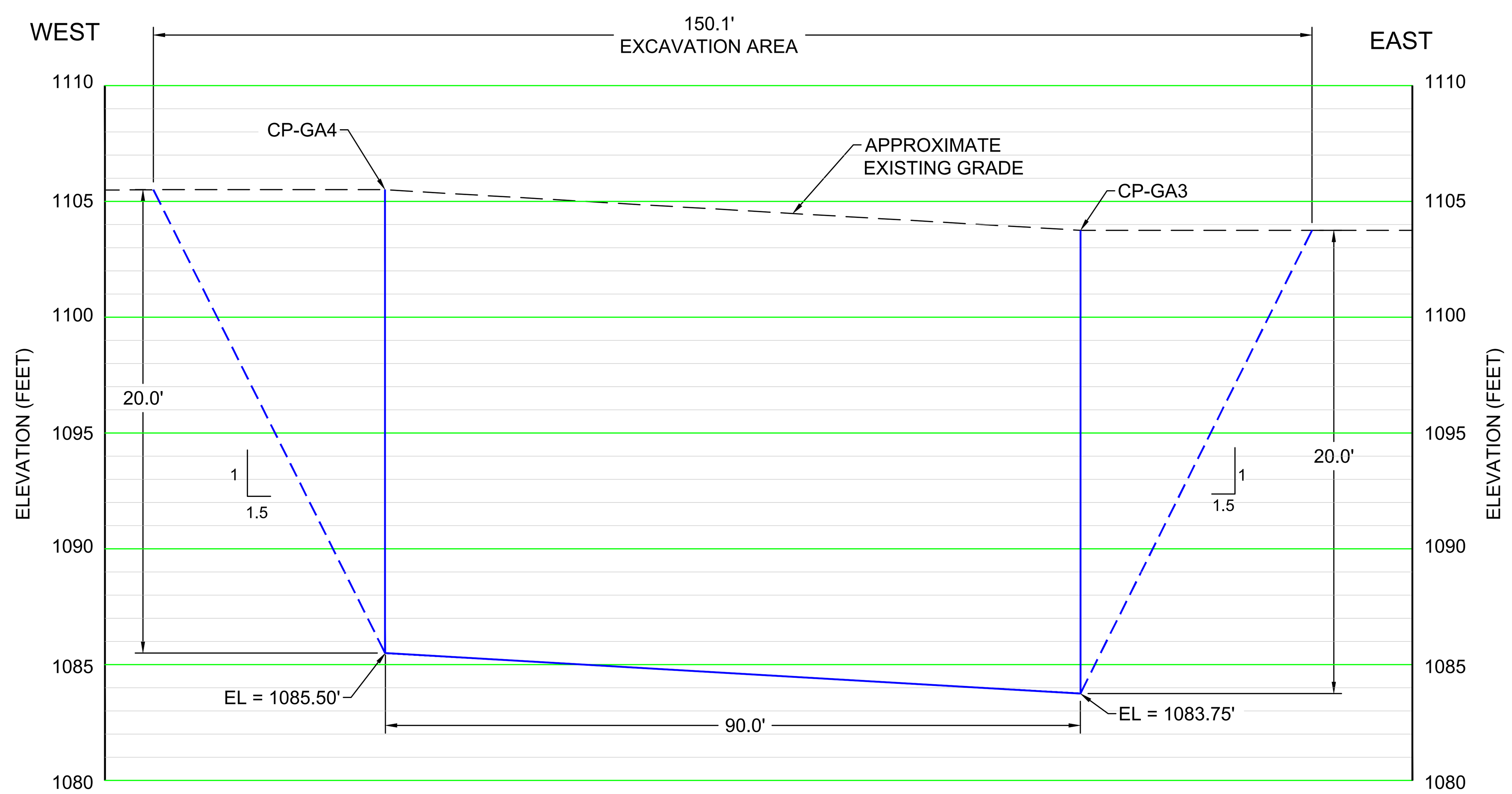
SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREA F CROSS SECTIONS

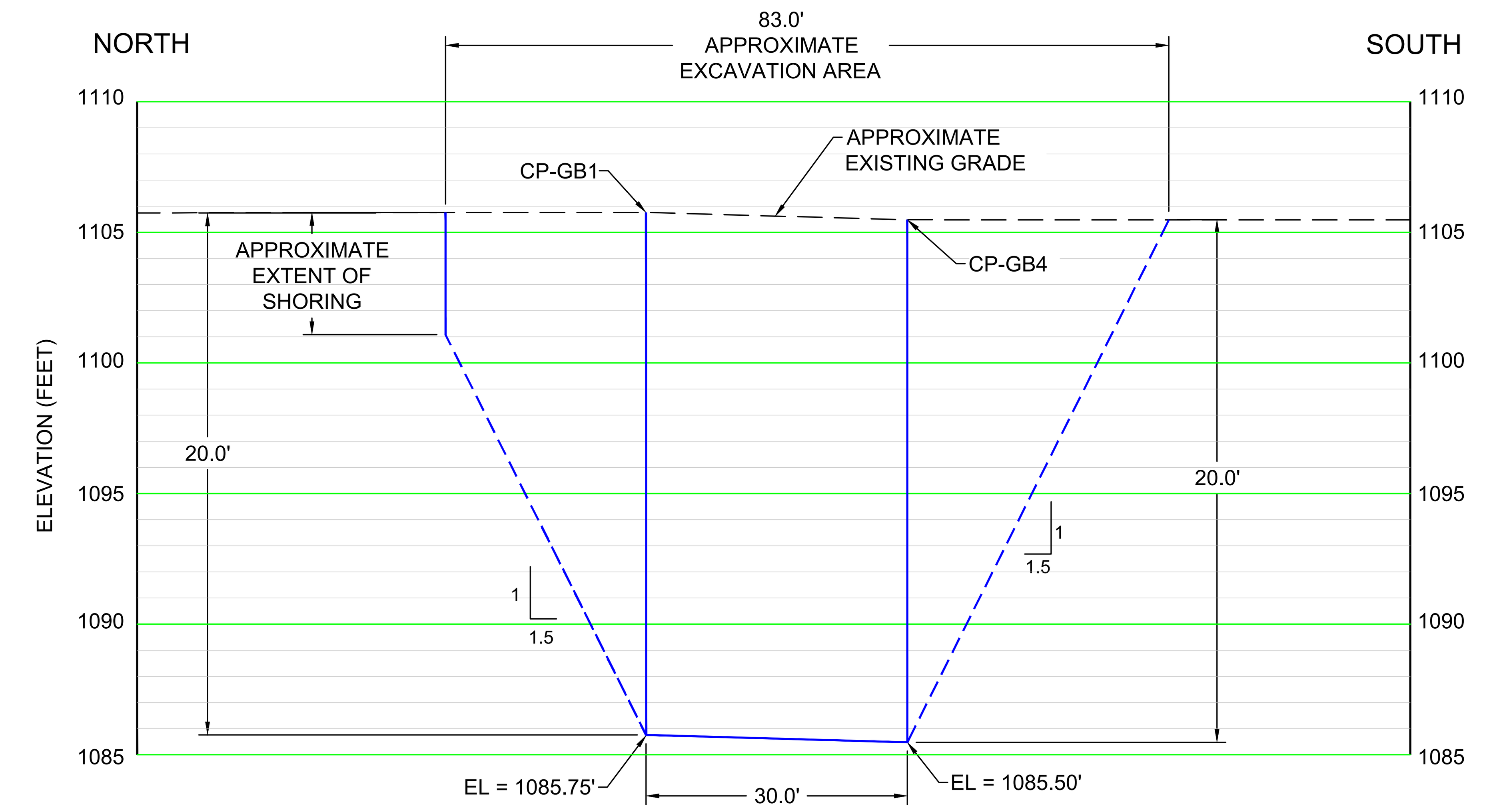
WORK ASSIGNMENT NO. WA194
DRAWING NO. C-11
SHEET NO. 12 OF 21

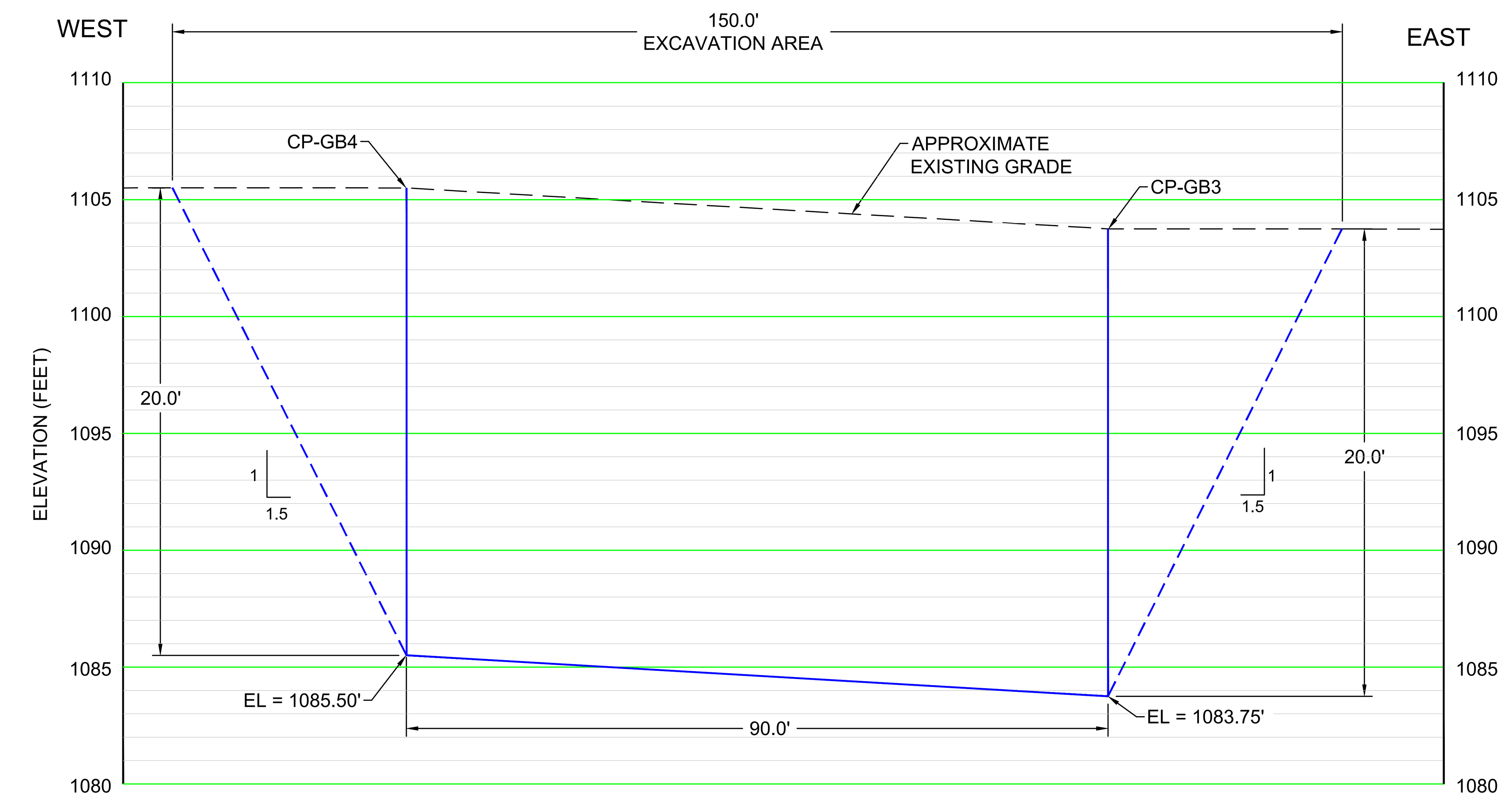
EXCAVATION AREA GA (INORGANIC) - CROSS SECTIONS



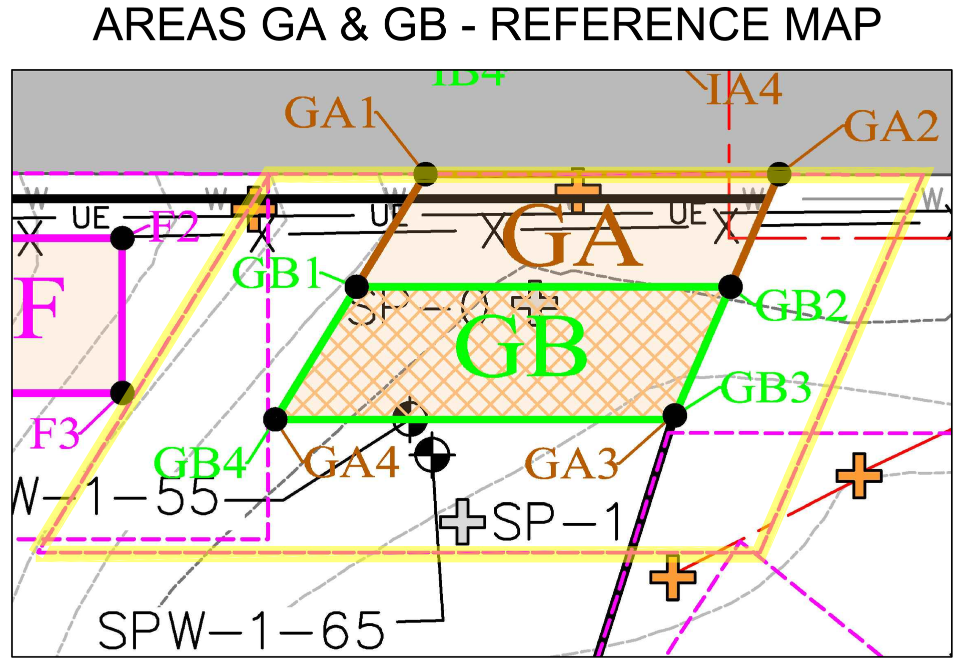


EXCAVATION AREA GB (ORGANIC) - CROSS SECTIONS





AREAS GA & GB - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
GA	GA1	19501996.43	573564.2115	1105.75	1085.75	20	6,247	0.00
GA	GA2	19502076.43	573564.2115	1105	1085	20		
GA	GA3	19502052.47	573508.7868	1103.75	1083.75	20		
GA	GA4	19501962.47	573508.7868	1105.5	1085.5	20		
GB	GB1	19501980.85	573538.7868	1105.75	1085.75	20	0	5,332
GB	GB2	19502065.44	573538.7868	1105	1085	20		
GB	GB3	19502052.47	573508.7868	1103.75	1083.75	20		
GB	GB4	19501962.47	573508.7868	1105.5	1085.5	20		

NOTE: GROUNDWATER ELEVATION IS ABOUT 1057 FEET

HORIZONTAL SCALE: 1" = 15'-0" (0 15 30 SCALE IN FEET)

VERTICAL SCALE: 1" = 5'-0" (0 5 10 SCALE IN FEET)

VERTICAL EXAGERRATION: 3x

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: 1" = 15'
VERTICAL SCALE: 1" = 5'

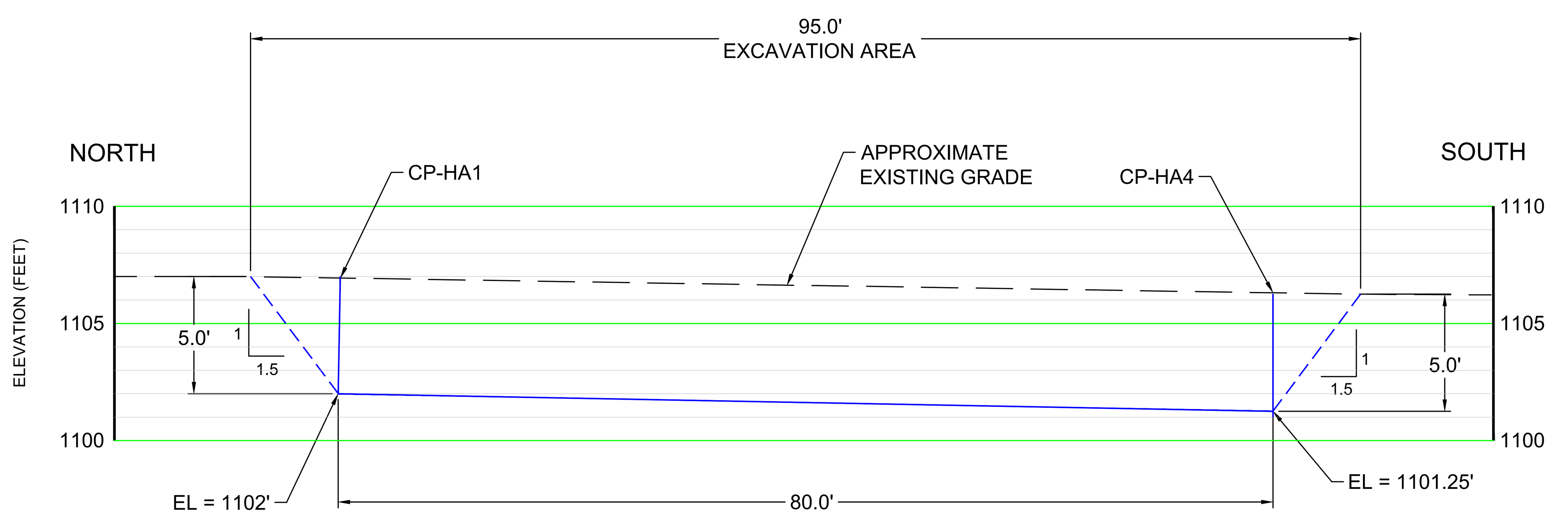
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

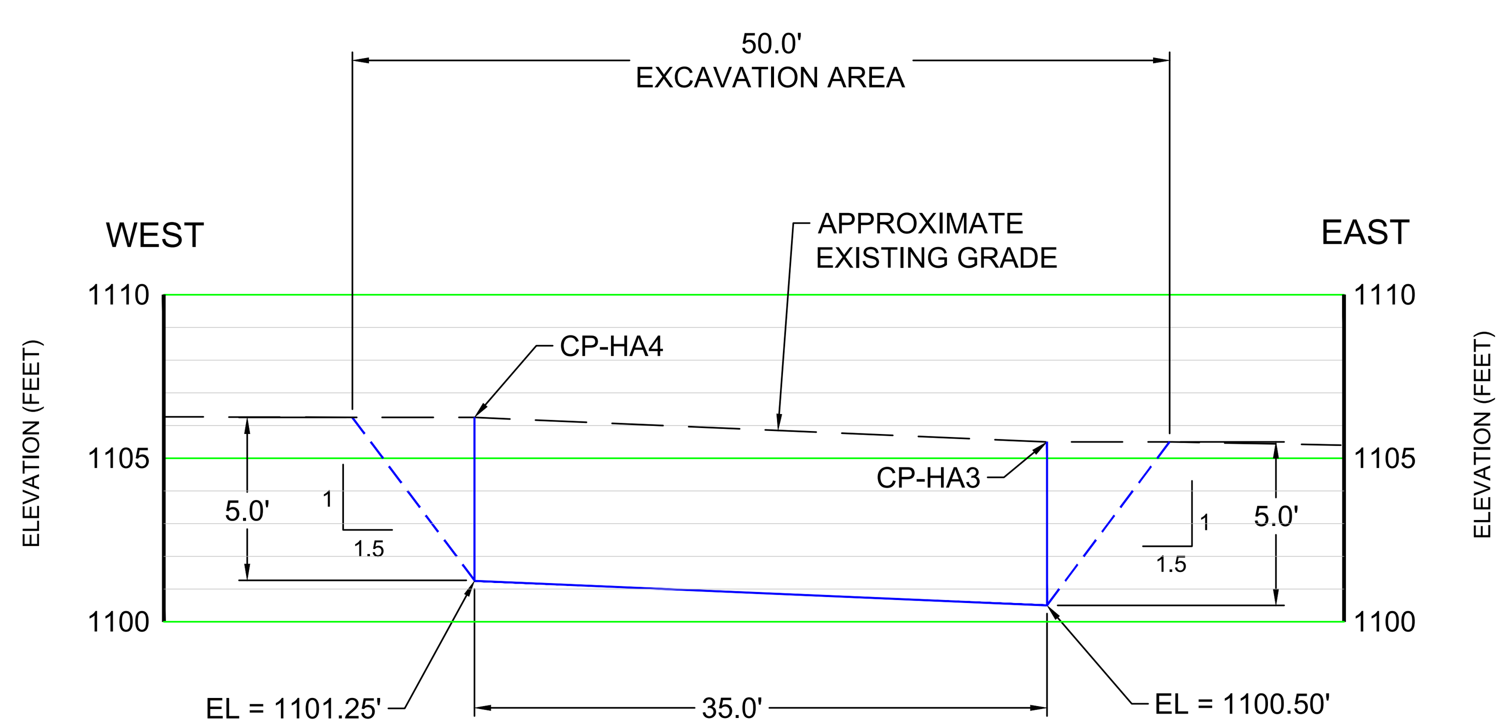
EXCAVATION AREA G CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-12
SHEET NO. 13 OF 21

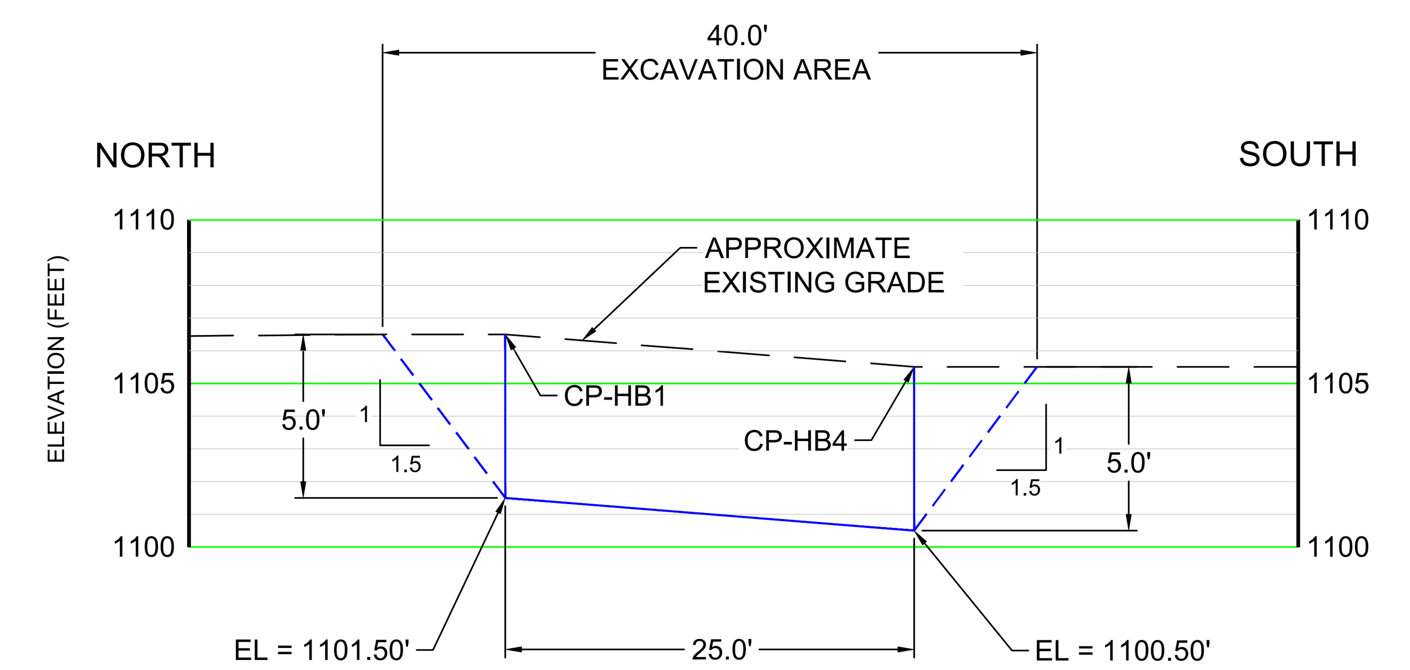
8/14/2018

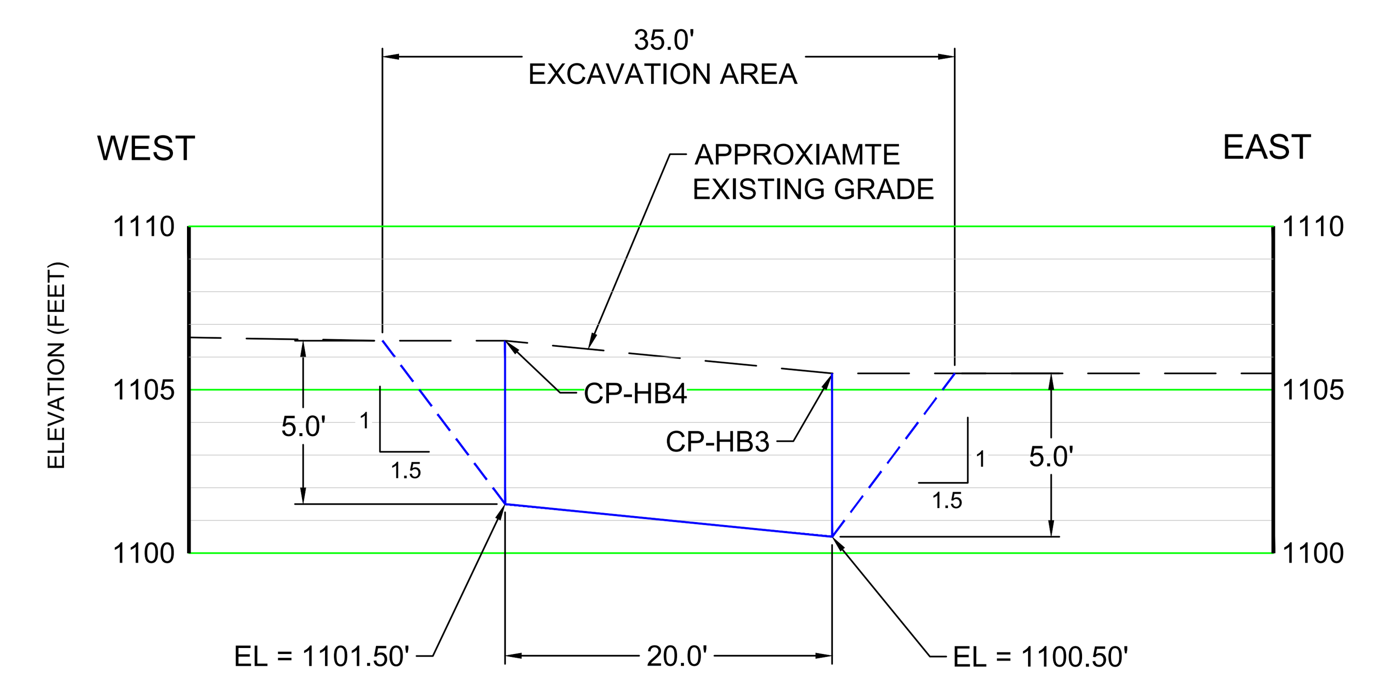
EXCAVATION AREA HA (INORGANIC) - CROSS SECTIONS



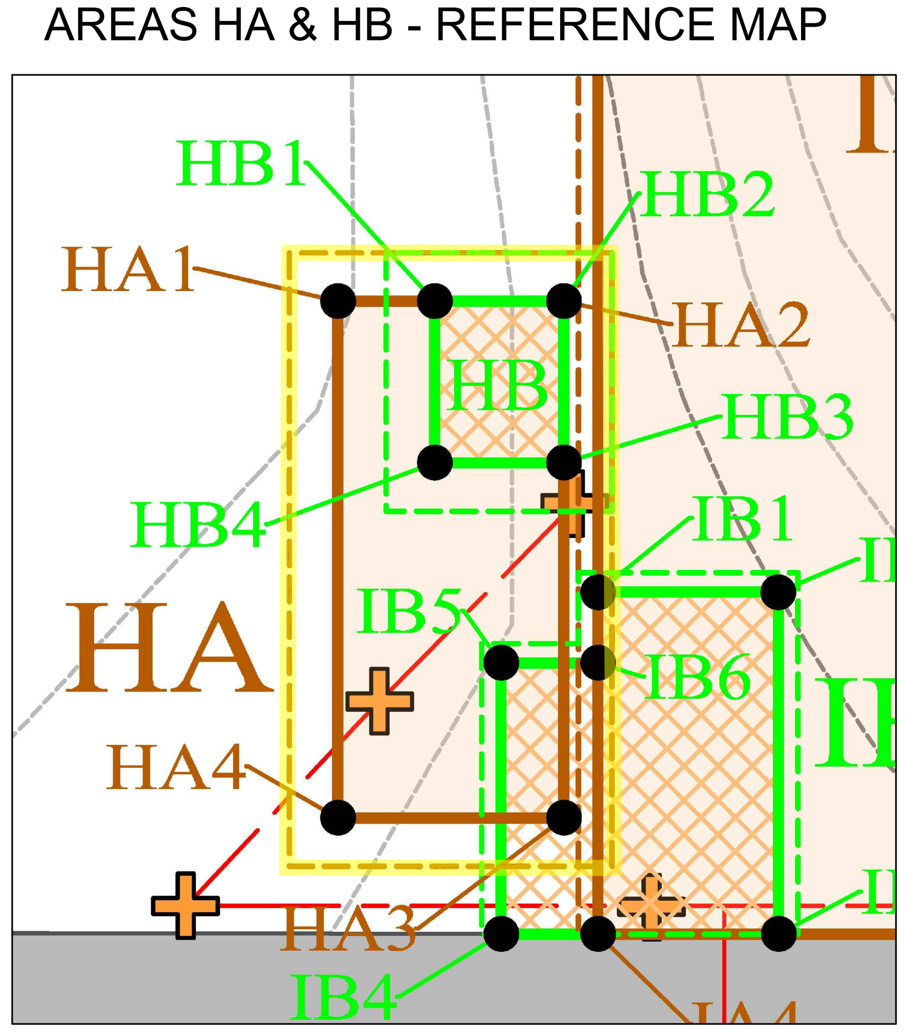


EXCAVATION AREA HB (ORGANIC) - CROSS SECTIONS





AREAS HA & HB - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
HA	HA1	19502005.3	573695.4967	1107	1102	5	682	0.00
HA	HA2	19502040.3	573695.4967	1105.5	1100.5	5		
HA	HA3	19502040.3	573615.4967	1105.5	1100.5	5		
HA	HA4	19502005.3	573615.4967	1106.25	1101.25	5		
HB	HB1	19502020.3	573695.4967	1106.5	1101.5	5	0.00	166
HB	HB2	19502040.3	573695.4967	1105.5	1100.5	5		
HB	HB3	19502040.3	573670.4967	1106.5	1101.5	5		
HB	HB4	19502020.3	573670.4967	1105.5	1100.5	5		

NOTE: GROUNDWATER ELEVATION IS ABOUT 1057 FEET

HORIZONTAL SCALE: 1" = 10'-0" (0 10 20 SCALE IN FEET)

VERTICAL SCALE: 1" = 5'-0" (0 5 10 SCALE IN FEET)

VERTICAL EXAGERRATION: 2x

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

ST SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

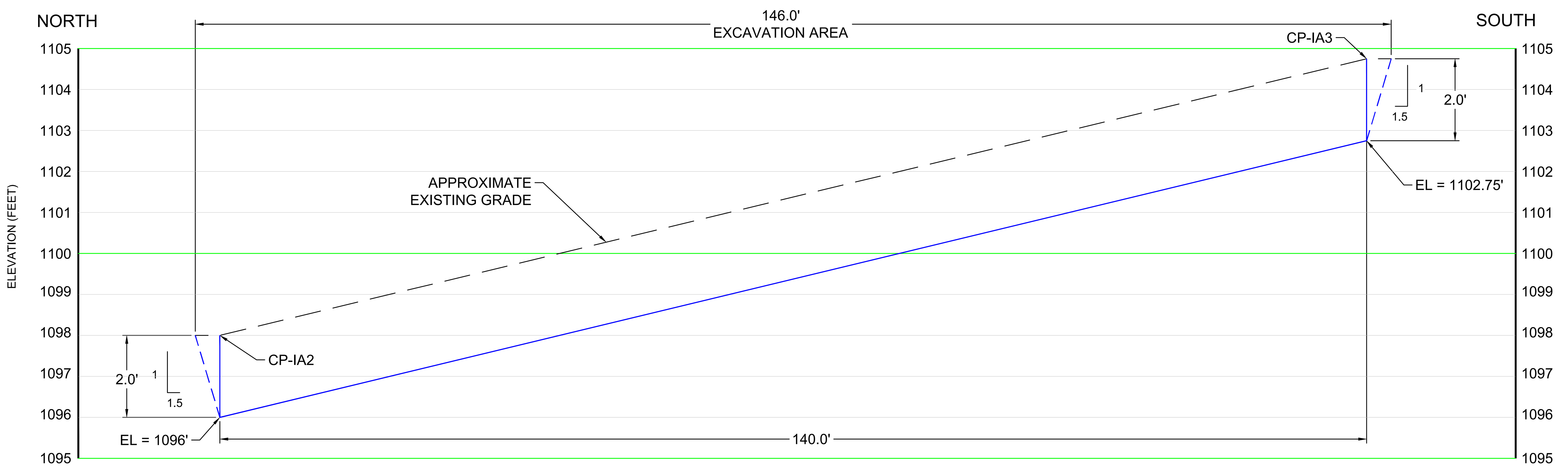
SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 5'

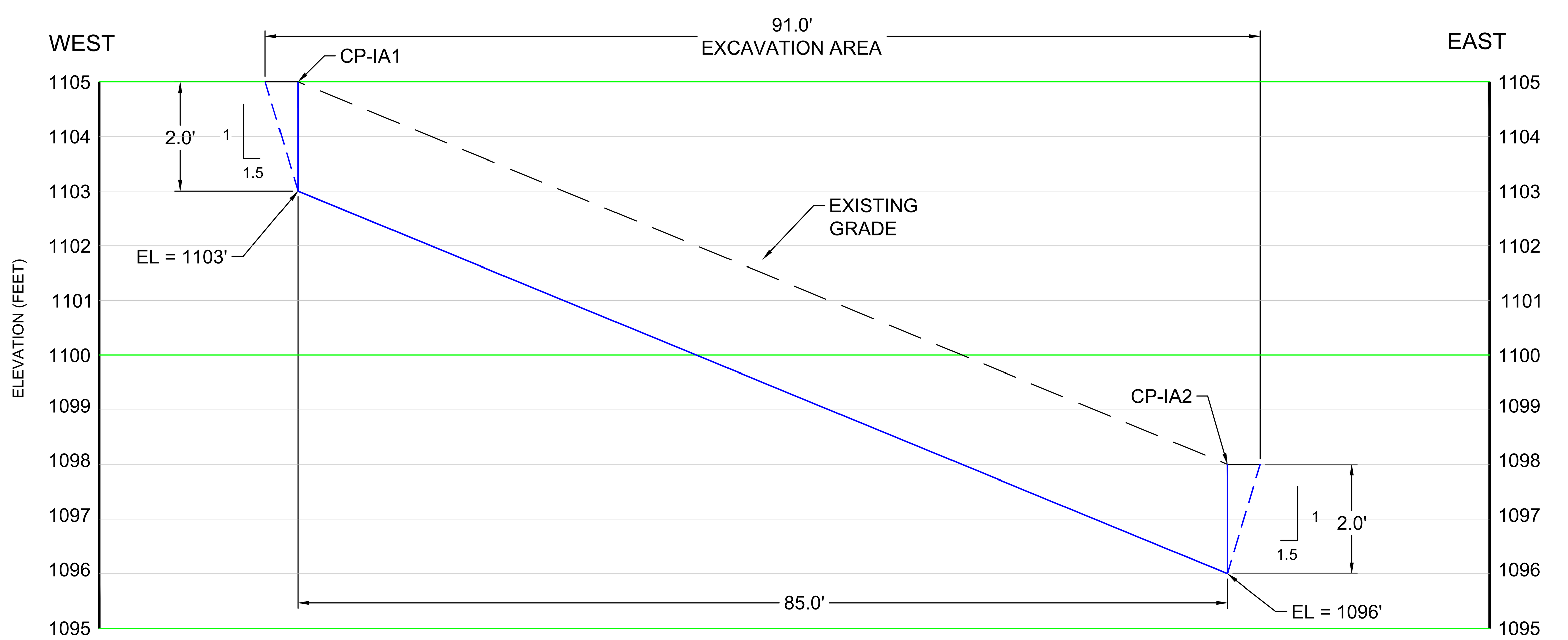
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREA H CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-13
SHEET NO. 14 OF 21

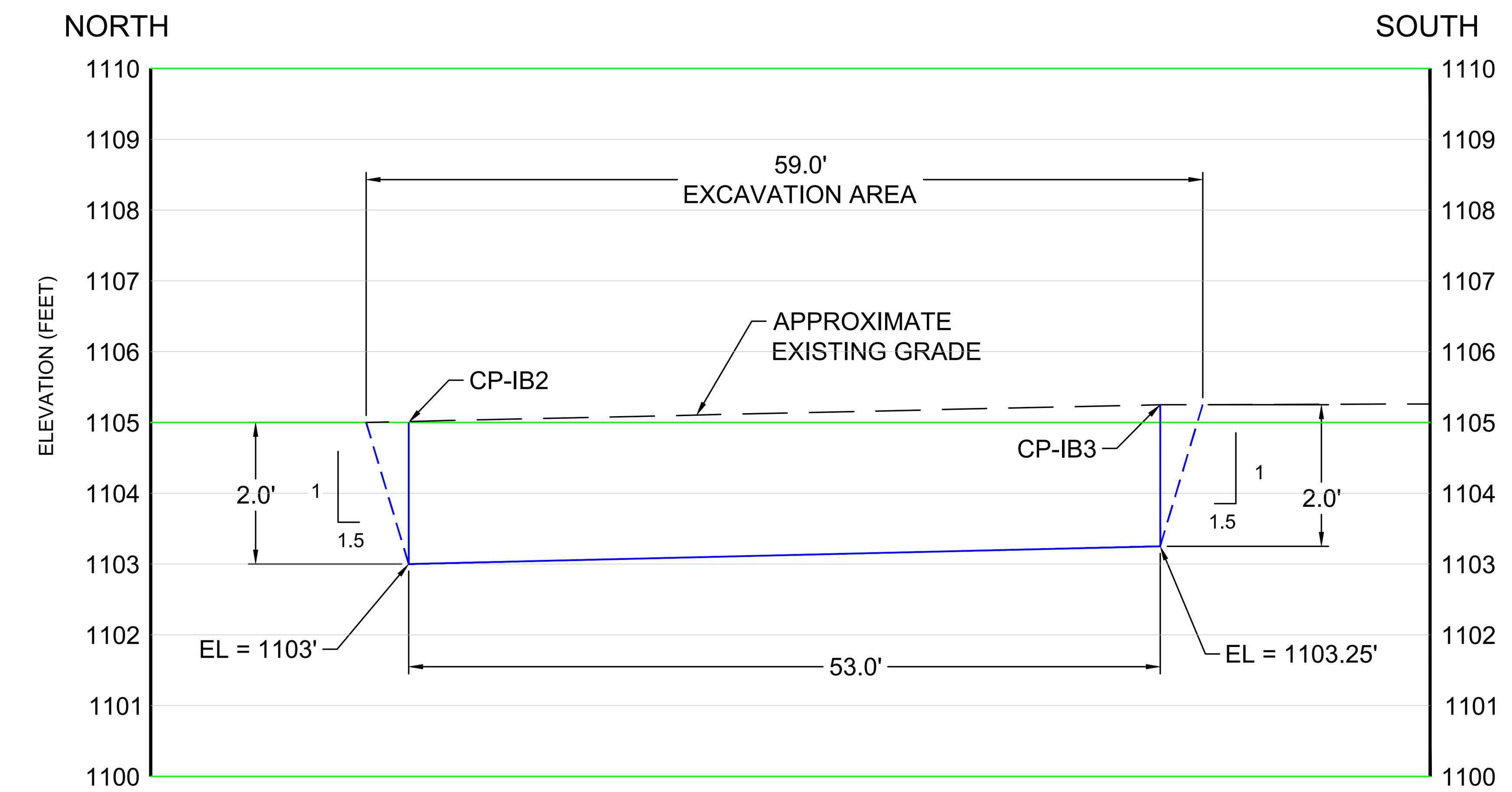
8/14/2018
G:\GL1852\194 Tar Lake RD\dwg\2018-08\ExcavationArea-XSections.dwg

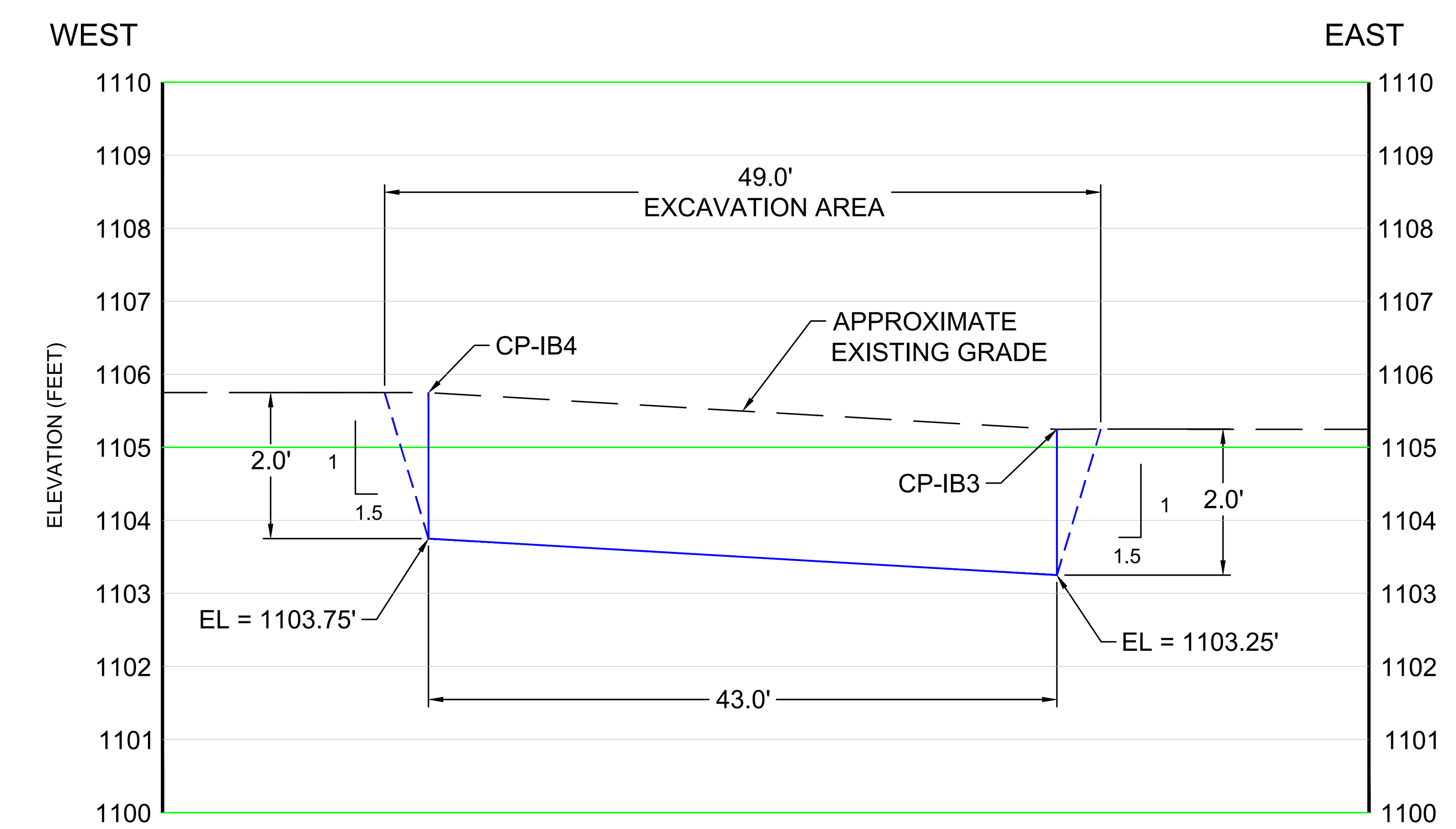
EXCAVATION AREA IA (INORGANIC) - CROSS SECTIONS



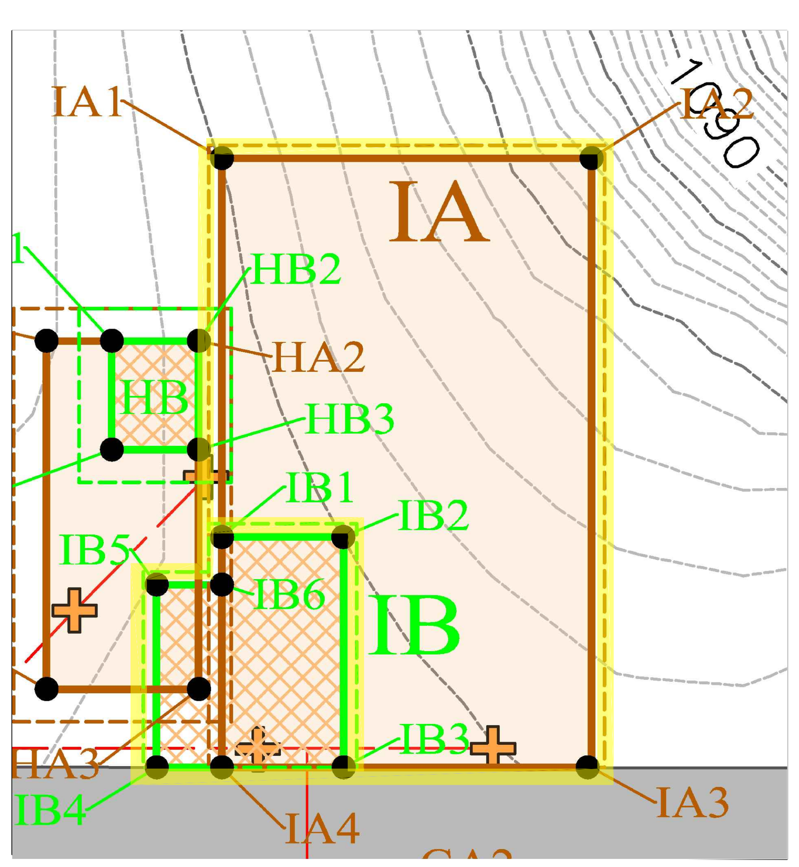


EXCAVATION AREA IB (ORGANIC) - CROSS SECTIONS





AREAS IA & IB - REFERENCE MAP



NOTE:

1. BACKFILL EXCAVATION TO EXISTING GRADE WITH STRUCTURAL FILL COMPACTED TO 90% MAX. DRY DENSITY IN ACCORDANCE WITH ASTM D698.

Excavation Table

Excavation Area	Control Point	Easting	Northing	Existing Ground Elevation (ASML)	Bottom of Excavation Depth (ASML)	Depth of Excavation (ft bgs)	Inorganic Volume (cu. Yd.)	Organic Volume (cu. Yd.)
IA	IA1	19502045.54	573737.5065	1105	1103	2	932	0.00
IA	IA2	19502130.54	573737.5065	1098	1096	2		
IA	IA3	19502130.54	573597.5065	1104.75	1102.75	2		
IA	IA4	19502045.54	573597.5065	1105.25	1103.25	2		
IB	IB1	19502045.59	573650.5065	1105.75	1103.75	2	0.00	91
IB	IB2	19502073.59	573650.5065	1105	1103	2		
IB	IB3	19502073.59	573597.5065	1105.25	1103.25	2		
IB	IB4	19502030.59	573597.5065	1105.75	1103.75	2		
IB	IB5	19502030.59	573639.5065	1106	1104	2		
IB	IB6	19502045.54	573639.5065	1106	1104	2		

NOTE: GROUNDWATER ELEVATION IS ABOUT 1057 FEET

HORIZONTAL SCALE: 1" = 10'-0" (0 10 20 SCALE IN FEET)

VERTICAL SCALE: 1" = 2'-0" (0 2 4 SCALE IN FEET)

VERTICAL EXAGERRATION: 5x

REVISIONS

NO.	DATE	DESCRIPTION

DESIGNED CN
DRAWN MB
CHECKED CN
DATE AUGUST 2018

SulTRAC

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

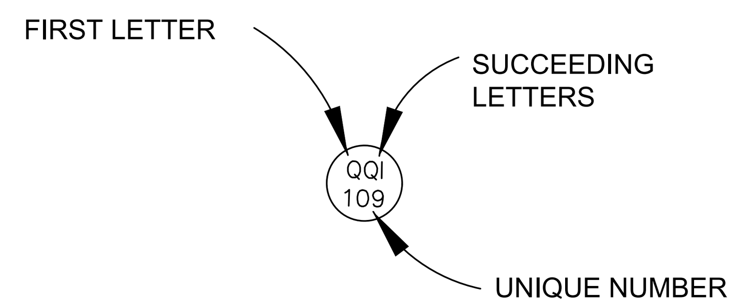
SCALES:
HORIZONTAL SCALE: 1" = 10'
VERTICAL SCALE: 1" = 2'

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
EXCAVATION AREA I CROSS SECTIONS

WORK ASSIGNMENT NO. WA194
DRAWING NO. C-14
SHEET NO. 15 OF 21

8/14/2018

INSTRUMENTATION SYMBOL NOMENCLATURE KEY



	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME				
C	CONDUCTIVITY			CONTROL	
D	DENSITY OR SP. GRAV.	DIFFERENTIAL			
E	VOLTAGE (EMF)		PRIMARY ELEMENT		
F	FLOW	RATIO			
G			GLASS OR GAUGE		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOTOR				MIDDLE
N					
O					
P	PRESSURE OR VACUUM				
Q	QUANTITY OR EVENT	TOTALIZE			
R	RADIOACTIVITY		RECORD OR PRINT		
S	SPEED			SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION		
V				VALVE	
W	WEIGHT OR FORCE				
X	UNCLASSIFIED		UNCLASSIFIED		
Y				RELAY OR COMPUTE	
Z	POSITION				

GENERAL INSTRUMENT SYMBOLS & DEFINITIONS

- MAIN PROCESS
- SECONDARY PROCESS LINE
- ELECTRICAL SIGNAL
- INSTRUMENT LINE
- INSTRUMENT (FIELD MOUNTED)
- INSTRUMENT (PANEL MOUNTED)
- INDICATING LIGHT (PANEL MOUNTED) PRIMARY LOCATION
- INSTRUMENT (HMI ACCESSIBLE)
- I — INTERLOCK
- HOA — HAND-OFF-AUTO SELECTOR SWITCH
- N.C. — NORMALLY CLOSED

EQUIPMENT SYMBOLS

- ROTARY CLAW COMPRESSOR
- FILTER
- AIR RECEIVER
- AIR/AIR HEAT EXCHANGER
- STRAINER

VALVE AND APPURTENANCE SYMBOLS

- BALL VALVE (BV)
- GATE VALVE (GV)
- CHECK VALVE (CV)
- GLOBE VALVE
- BUTTERFLY VALVE
- VENTURI FLOW ELEMENT
- VARIABLE AREA FLOW METER
- PRESSURE SAFETY VALVE (PSV)
- PRESSURE REGULATING VALVE (PRV)
- VACUUM RELIEF VALVE (VRV)
- UNION
- FLANGE
- S — SOLENOID VALVE
- REDUCER
- FEMALE CAMLOCK FITTING AND PLUG
- MALE CAMLOCK FITTING AND CAP
- DAMPER
- ST — SCH 40 STEEL
- PVC — POLYVINYL CHLORIDE
- DEX — CROSS-LINKED POLYETHYLENE
- HDPE — HIGH-DENSITY POLYETHYLENE

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE SYSTEM EXPANSION
PIPING AND INSTRUMENTATION DIAGRAM SYMBOLS

WORK ASSIGNMENT NO. WA194
DRAWING NO. I-1
SHEET NO. 16 OF 21

8/20/2018

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE SYSTEM EXPANSION
PIPING AND INSTRUMENTATION DIAGRAM

WORK ASSIGNMENT NO. WA194
DRAWING NO. I-2
SHEET NO. 17 OF 21

SCALE IN INCHES
0 12"

BIOSPARGE SYSTEM - PLAN VIEW

1" = 1'-0"

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED DJB
DRAWN MB
CHECKED DJB
DATE AUGUST 2018

ST SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN

BIOSPARGE SYSTEM – PLAN VIEW

WORK ASSIGNMENT NO. WA194
DRAWING NO. M–1
SHEET NO. 18 OF 21

GENERAL NOTES:

1. CONTRACTOR SHALL BE RESPONSIBLE FOR COORDINATING/ORDERING AND INSTALLING ALL THE LOCAL UTILITY SERVICES (ELECTRICAL, AND TELEPHONE) TO ACCOMMODATE THE NEW BUILDING.
2. FOR ITEMS INDICATED AS "FIELD LOCATE", CHECK THE DRAWINGS OF OTHER TRADES FOR INTERFERENCE AND FOR LOCATIONS OF MOUNTING FLANGES, CONNECTIONS POINTS, ETC.
3. INSTALL A SINGLE CONDUCTOR INSULATED (RHW OR XHHW) COPPER GROUND WIRE IN EACH CONDUIT, SIZE AS SHOWN ON DRAWINGS, OR AS A MINIMUM PER THE NATIONAL ELECTRICAL CODE. THIS GROUND WIRE SHALL BE CONNECTED AT EACH END TO THE EQUIPMENT GROUND.
4. THE FOLLOWING EXAMPLE COMPONENT IDENTIFICATION SHALL BE USED AS APPROPRIATE:
   (F) FIELD MOUNTED, NOT AT STARTER OR OTHER CONTROL PANELS
   (CP) AT CONTROL PANEL.
5. CONDUIT ROUTINGS SHOWN ON BACKGROUND PLANS, AND SITE PLANS ARE INTENDED ROUTINGS ONLY. EXACT CONDUIT ROUTINGS FOR ALL CONDUITS, AND LENGTH SHALL BE FIELD LOCATED AND VERIFIED BY THE CONTRACTOR. COORDINATE CONDUIT ROUTING IN FINISHED AREAS WITH OWNER. CONDUIT TO BE CONCEALED IN THESE AREAS.
6. ELECTRICAL MATERIALS AND EQUIPMENT ITEMS SHOWN IN LIGHT LINE WEIGHTS ARE EXISTING ITEMS TO REMAIN. ELECTRICAL MATERIAL AND EQUIPMENT ITEMS SHOWN IN HEAVY LINE WEIGHTS ARE NEW THIS CONTRACT.
7. ITEMS SHOWN CROSSHATCHED (OR NOTED TO BE DEMOLISHED) ON THE DRAWINGS ARE EXISTING ITEMS TO BE REMOVED FROM THE SITE BY CONTRACTOR.
8. NO WIRES SHALL BE TERMINATED TO TERMINAL STRIPS, OR OTHER EQUIPMENT WITHOUT FIRST VERIFYING SIGNAL TYPE. DAMAGES RESULTING FROM LACK OF VERIFICATION SHALL BE BORNE BY CONTRACTOR. CONTRACTOR SHALL COORDINATE SIGNAL TYPE WITH CONTROL PANELS.
9. RACEWAYS, PULLBOXES AND JUNCTION BOXES TO BE INSTALLED WITH CHANNEL STRUT. MINIMUM STRUT LENGTH TO BE 12 INCHES, WHERE POSSIBLE.
10. CONTROL PANELS SHALL BE MOUNTED OFF WALLS WITH STRUT. CONDUITS SHALL BE MOUNTED ON STRUT INCLUDING SINGLE RUNS.
11. CONDUIT ENTERING CONTROL PANELS AND ELECTRICAL EQUIPMENT ENCLOSURES SHALL BE FILLED WITH DUCT SEAL, INCLUDING OPENINGS IN BOTTOM OF PANEL.
12. CABLES (INCLUDING CONTROL WIRE, ETC.) WHERE PASSING THROUGH A PULLBOX SHALL BE LABELED AND COMPLETELY IDENTIFIED WITH IDENTIFICATION NUMBERS AND ORIGINATION/DESTINATION. THIS ALSO INCLUDES ALL CABLE BUNDLES ENTERING CONTROL PANELS, PULLBOXES, ETC.
13. CONTROL WIRES SHALL BE TAGGED WITH THE SOURCE ADDRESS IN THE FIELD, AND IN THE STARTER.
14. CONTRACTOR TO CONTACT MISS DIG (CALL 811) PRIOR TO ANY UNDERGROUND WORK.
15. REFER TO SHEET C-1 FOR EXISTING UNDERGROUND UTILITY INFORMATION.
16. CONTRACTOR TO FIELD LOCATE ANY EXISTING UNDERGROUND ELECTRICAL CIRCUITS TO ENSURE EXISTING CIRCUITS ARE NOT DAMAGED DURING CONSTRUCTION OF WORK. CONTRACTOR TO REPAIR/REPLACE ANY DAMAGED EXISTING ELECTRICAL FEEDS, CIRCUITS, ETC. TO THE SATISFACTION OF THE OWNER/ENGINEER AT NO ADDITIONAL COST TO THE OWNER.

ELECTRICAL SPECIFICATIONS:

A. PROVIDE ALL LABOR AND MATERIALS REQUIRED TO INSTALL ELECTRICAL SYSTEM. THE DESIGN AND METHODS OF INSTALLATION OF THE WIRING MATERIALS, ELECTRICAL EQUIPMENT AND ACCESSORIES SHALL CONFORM TO THE NATIONAL ELECTRICAL CODE AND SHALL COMPLY WITH APPLICABLE FEDERAL, STATE AND LOCAL REQUIREMENTS. ALL MATERIALS SHALL BE UL LISTED AND LABELED.

B. PROCURE ALL NECESSARY PERMITS AND LICENSES. OBSERVE AND ABIDE BY APPLICABLE LAWS, ORDINANCES, AND RULES OF OSHA, EPA, AND THE STATE OR POLITICAL SUBDIVISION WHERE THE WORK IS DONE.

C. UPON COMPLETION OF THE WORK SECURE CERTIFICATES OF INSPECTION FROM THE INSPECTOR HAVING JURISDICTION AND SUBMIT THREE COPIES TO THE OWNER. PAY THE FEES FOR THE PERMITS, INSPECTIONS, LICENSES AND CERTIFICATIONS.

D. ABOVE GRADE CONDUIT SHALL BE RIGID GALVANIZED STEEL (3/4" MINIMUM SIZE) CONFORMING TO ANSI SPECIFICATION C80.1. JUNCTION BOXES, OUTLET BOXES AND FITTINGS SHALL BE CAST TYPE WITH THREADED HUBS COMPLETE WITH GASKETS AND CAST COVERS. PROVIDE GALVANIZED STEEL RACKS/SUPPORT FRAMES WHERE REQUIRED FOR SUPPORT OF ELECTRICAL CONDUIT AND EQUIPMENT. CONDUIT JOINTS SHALL BE MADE WATERTIGHT BY COATING FACTORY AND FIELD THREADS WITH A ZINC POWDER PAINT.

E. WHERE FLEXIBLE CONNECTIONS ARE REQUIRED, LIQUID TIGHT FLEXIBLE METAL CONDUIT SHALL BE USED WHERE PERMITTED BY THE NATIONAL ELECTRICAL CODE (NEC).

F. CONDUIT AND ALL MATERIAL SHALL BE UL LABELED AND THE INSTALLATION SHALL CONFORM TO THE NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA) CLASSIFICATION NOTED ON THE DRAWINGS. AS A MINIMUM, EQUIPMENT ENCLOSURES SHALL BE NEMA 4, 7 OR 12 UNLESS OTHERWISE NOTED ON DRAWINGS. ELECTRICAL WORK WITHIN HAZARDOUS AREAS SHALL COMPLY WITH NATIONAL ELECTRICAL CODE ARTICLE 500.

G. 600V WIRE SHALL BE SINGLE CONDUCTOR WITH STRANDED COPPER CONDUCTORS OF SIZE (AWG) NOTED ON THE DRAWINGS WITH INSULATION:

SIZE	INSULATION	COLOR
No. 8, 10, 12 (7 STRAND) No. 6 AND LARGER	RHW-USE OR XHHW	COLOR BLACK (NEUTRAL WHITE, GROUND GREEN)

H. GROUND CONDUCTORS SHALL BE PROVIDED IN EACH CONDUIT. CONNECT GROUND WIRE AT EACH END TO PANEL BOX, OUTLET BOX AND DEVICE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE ARTICLE 250.

I. ALL BARE METAL SURFACES SUBJECT TO RUSTING SHALL BE PRIMED AND PAINTED WITH GALVANIZING COMPOUND. PAINT SHALL BE EQUAL TO RUST-OLEUM #7785 APPLIED OVER PRIMER #7769 OR #7773. FACTORY FINISHES SHALL BE TOUCHED UP, PRIMED AND PAINTED TO REMOVE ANY MARKS AND SCRATCHES.

J. SUBMIT FOR ENGINEER'S APPROVAL 6 COPIES OF SHOP DRAWINGS, SPECIFICATIONS, AND CATALOG SHEETS DEMONSTRATING COMPLIANCE WITH THE CONTRACT. ALSO SUBMIT 6 COPIES OF INSTALLATION, OPERATION, AND MAINTENANCE INSTRUCTIONS INCLUDING TEST DATA, WIRING DIAGRAMS, AND SCHEMATICS.

K. AT COMPLETION, TEST AND DEMONSTRATE OPERATION OF ALL EQUIPMENT FOR ENGINEER'S AND OWNER'S ACCEPTANCE.

L. POWER SHALL BE MAINTAINED TO ALL AREAS OF THE SITE AT ALL TIMES DURING CONSTRUCTION.ANY POWER SHUTDOWN SHALL BE COORDINATED AND SCHEDULED WITH THE OWNER.

M. ALL PANELBOARDS AND CONTROL PANELS SHALL BE DEAD FRONT SAFETY TYPE IN NEMA 4X STAINLESS STEEL ENCLOSURES WITH MOLDED CASE CIRCUIT BREAKERS, INCLUDING MAIN. INCLUDE SEPARATE NEUTRAL AND GROUND BUSES. CIRCUIT BREAKERS SHALL BE 20A UNLESS OTHERWISE NOTED.

N. COORDINATE ELECTRICAL CONNECTION REQUIREMENTS AND ALL CONDUIT WITH OTHER TRADES.

O. ALL CONDUITS SHALL BE DIRECT BURIED. SEE DETAILS SHEET E-3.

P. INSTALL GROUND RODS BELOW BUILDING EQUIPMENT RACK. CONNECT GROUNDING CONDUCTOR TO SCREEN CONTROL PANEL. SEE GROUND MAT DETAIL.

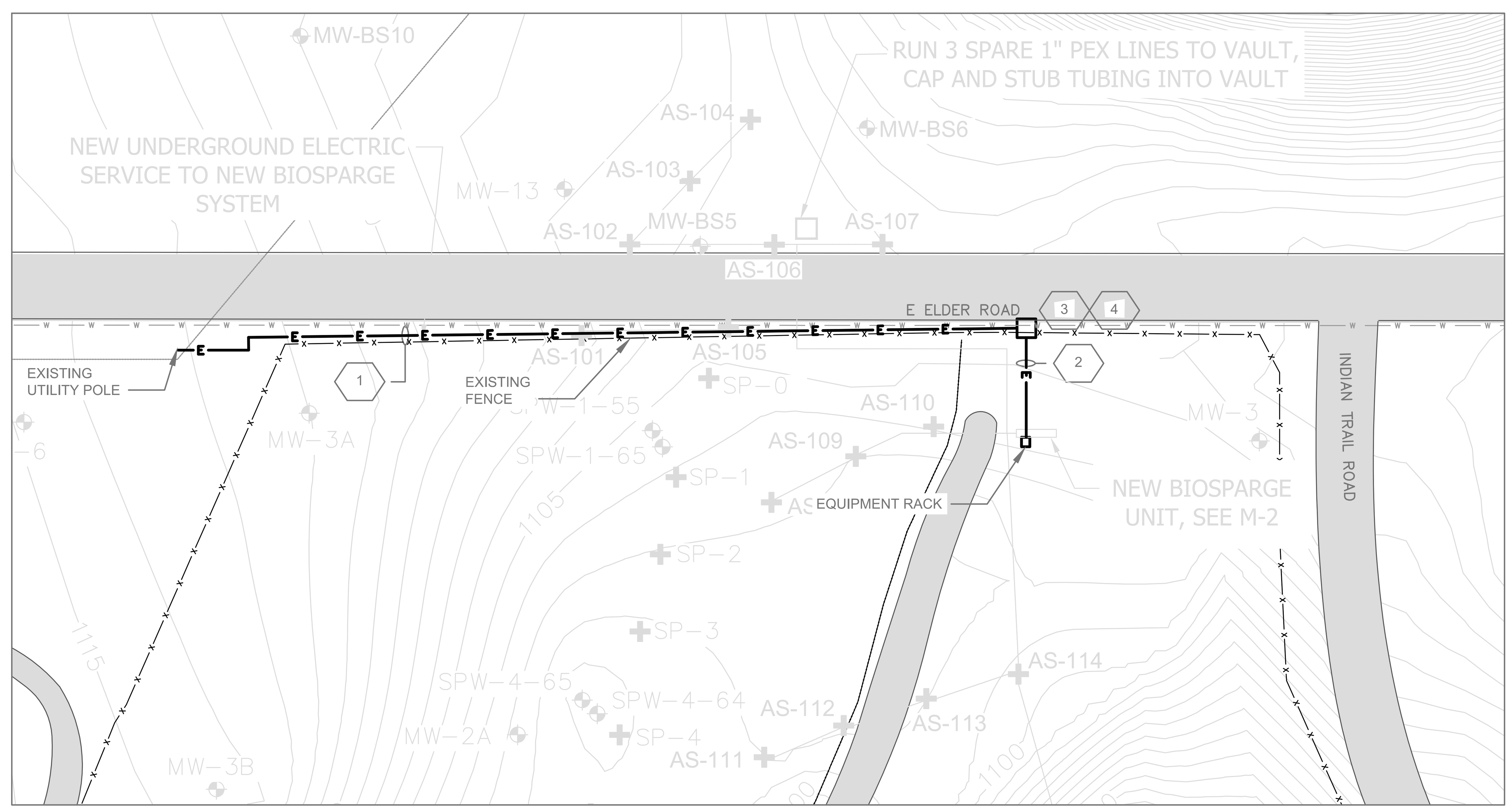
Q. BELOW GRADE CONDUIT, JUNCTION BOXES, TERMINAL BOXES, AND PULL BOXES SHALL BE PVC-COATED RGS, UNLESS OTHERWISE INDICATED.

R. COORDINATE WITH THE OWNER/ENGINEER LOCATIONS OF EXISTING ELECTRICAL EQUIPMENT PANELS, MANHOLES, UTILITIES. CONTRACTOR TO VERIFY ALL EXISTING CONDITIONS.

S. PROVIDE GALVANIZED STEEL UNISTRUT EQUIPMENT RACK FOR LOCATING NEW ELECTRICAL EQUIPMENT. (SEE RACK DETAIL SHEET E-3).

KEY NOTES:

1. APPROXIMATELY 450 LINEAL FEET (LF) BETWEEN TRANSFORMER AND UTILITY POLE. MEASUREMENTS ARE APPROXIMATE. FIELD VERIFY ALL DISTANCES. CONTRACTOR TO VERIFY LOCATIONS OF EXISTING FENCING AND WATER UTILITIES. ADJUST LOCATION OF NEW UNDERGROUND ELECTRICAL TO NOT INTERFERE WITH EXISTING UTILITIES AND FENCING. CONTRACTOR SHALL PAY FOR ANY REPAIRS OR REPLACEMENTS AT NO ADDITIONAL COST TO THE OWNER. (TYPICAL)
2. APPROXIMATELY 100 LF BETWEEN HANDHOLE AND ELECTRICAL RACK.
3. PAD-MOUNTED UTILITY TRANSFORMER.
4. PROVIDE AND INSTALL HANDHOLE LABELED "TELEPHONE".



ELECTRICAL SITE PLAN

0 25' 50' 100'

SCALE: 1" = 50'

N

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED RWS
DRAWN VLM
CHECKED
DATE AUGUST 2018

SulTRAC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE SYSTEM – ELECTRICAL

WORK ASSIGNMENT NO. WA194
DRAWING NO. E-1
SHEET NO. 19 OF 21

8/15/2018
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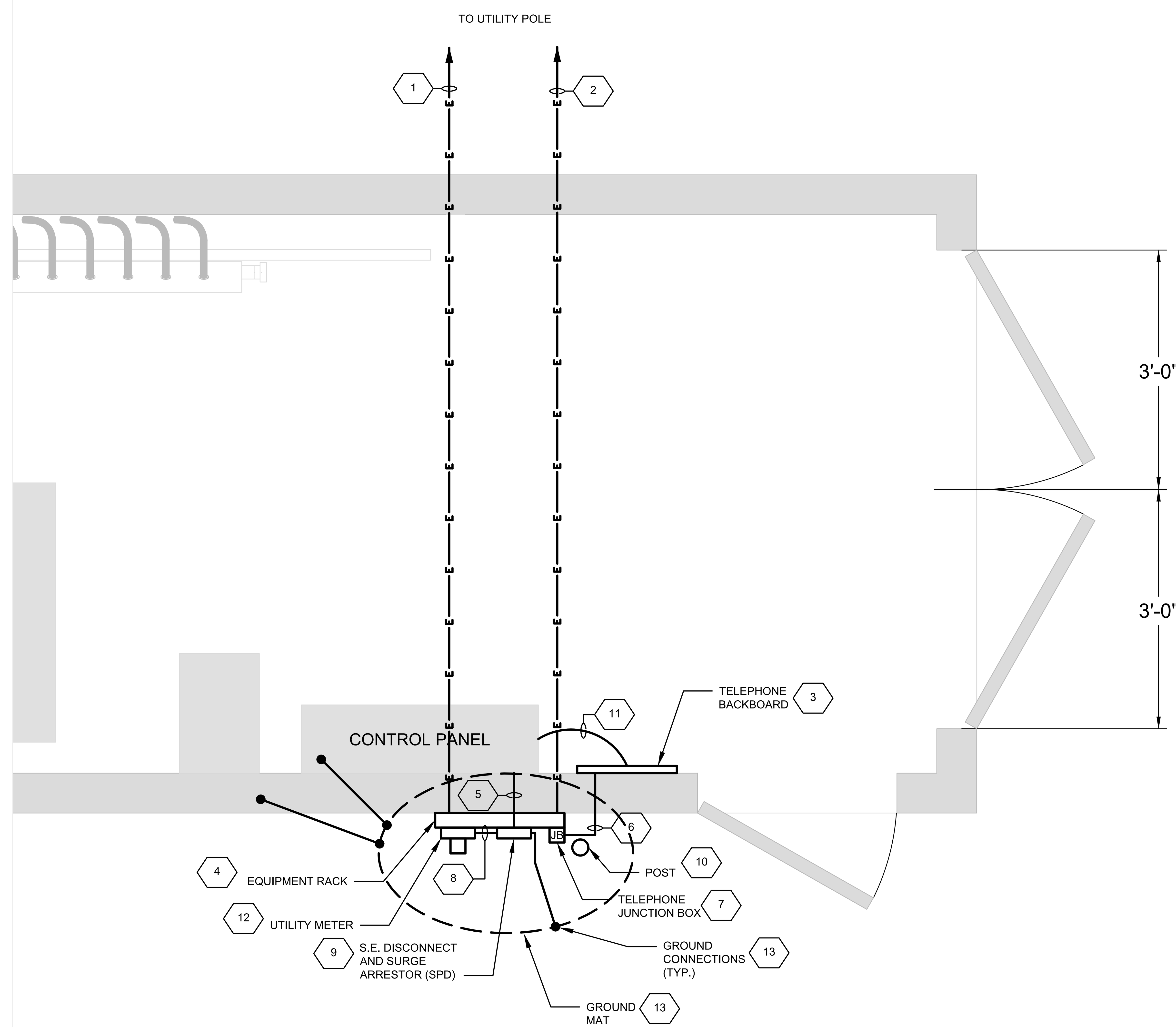
KEY NOTES:

1. 2-4"C(PULL STRING) DIRECT BURIED SCHED. 80 PVC CONDUIT TO ELECTRICAL UTILITY TRANSFORMER AND POLE. SEE SHEET E-1 FOR LOCATIONS. SEE TRENCHING DETAIL SHEET E-1. TURN UP CONDUITS AT UTILITY TRANSFORMER PAD.
2. 1-2"C(PULL STRING) TO TELEPHONE UTILITY POLE VIA HANDHOLE. SEE SHEET E-1 FOR LOCATIONS. SEE TRENCHING DETAIL SHEET E-3.
3. 2' x 2' x 3/4 PLYWOOD TELEPHONE BACKBOARD MOUNTED 5' A.F.F. FOR MOUNTING OF TELEPHONE UTILITY EQUIPMENT. PROVIDE AND TERMINATE RJ-11 JACK.
4. WALL-MOUNTED GALVANIZED STEEL STRUT RACK. SEE RACK DETAIL SHEET E-3.
5. 2"C(3#2, 1#6) TERMINATE AT CONTROL PANEL LINE TERMINALS.
6. 3/4"C(PULL STRING) FOR TELEPHONE CABLE INSTALLATION. TERMINATE AT TELEPHONE BACKBOARD.
7. RACK-MOUNT TELEPHONE JUNCTION BOX.
8. 2"C(3#2, 1#6)
9. 100A SERVICE ENTRANCE RATED DISCONNECT. RACK MOUNTED. NEMA 4, PAD-LOCKABLE. SURGE PROTECTIVE DEVICE (SPD) SCHNEIDER/SQ-D, OR EQUAL. NEMA 3R ENCLOSURE, PAD LOCKABLE.
10. 4 1/2" DIAMETER 7' LONG PRIMED AND PAINTED CONCRETE-FILLED STEEL POST. 4' ABOVE GRADE. BURIED 36" BELOW GRADE, 12" DIAMETER HOLE, CONCRETE-FILLED. PAINTED YELLOW.
11. 3/4"C(4/C TELEPHONE CABLE) TERMINATE AT CONTROL PANEL. CONNECT VIA RJ-11 CONNECTIONS AT EACH END. CABLE SHALL BE MINIMUM 12' LONG.
12. RACK-MOUNTED UTILITY METER.
13. INSTALL GROUND MAT (10' DIAMETER MINIMUM) CONNECT TO EQUIPMENT RACK, SE DISCONNECT, SURGE DEVICE, CONTROL PANEL GROUND LUGS, BUILDING STEEL WITH #4/0 BARE STRANDED COPPER CABLE. REFER TO DETAIL SHEET E-XXX.



BIOSPARGE SYSTEM - PLAN VIEW
1" = 1'-0"

REVISIONS		
NO.	DATE	DESCRIPTION

DESIGNED RWS
DRAWN VLM
CHECKED
DATE AUGUST 2018

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

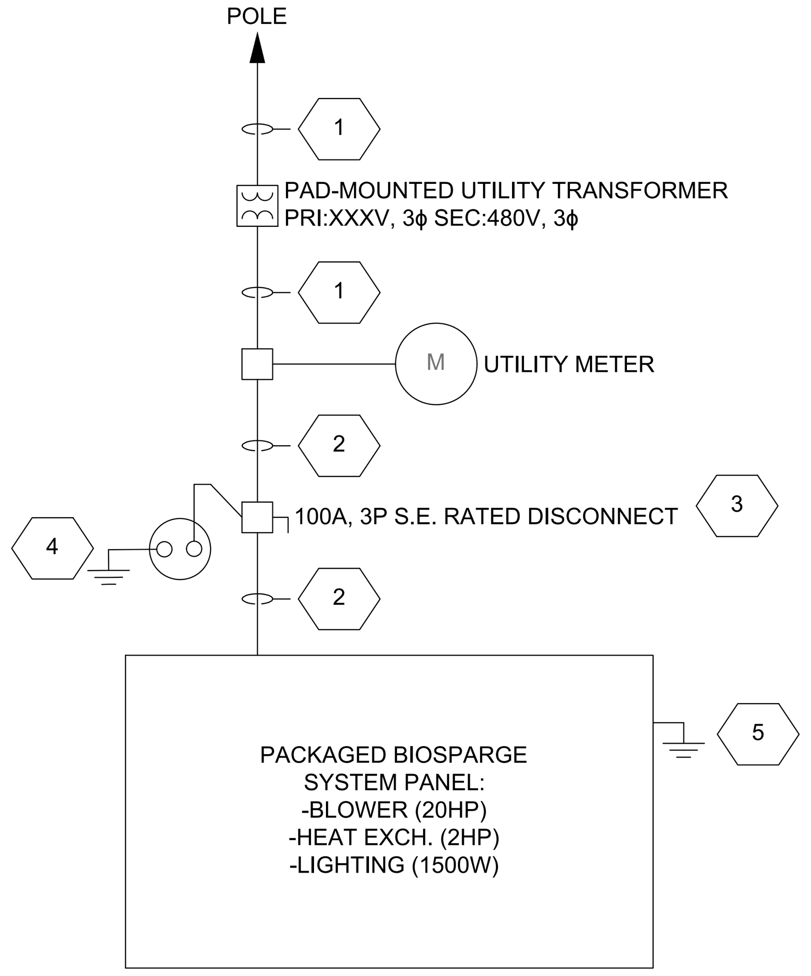
TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE SYSTEM – ELECTRICAL PLAN VIEW

WORK ASSIGNMENT NO. WA194
DRAWING NO. E-2
SHEET NO. 20 OF 21

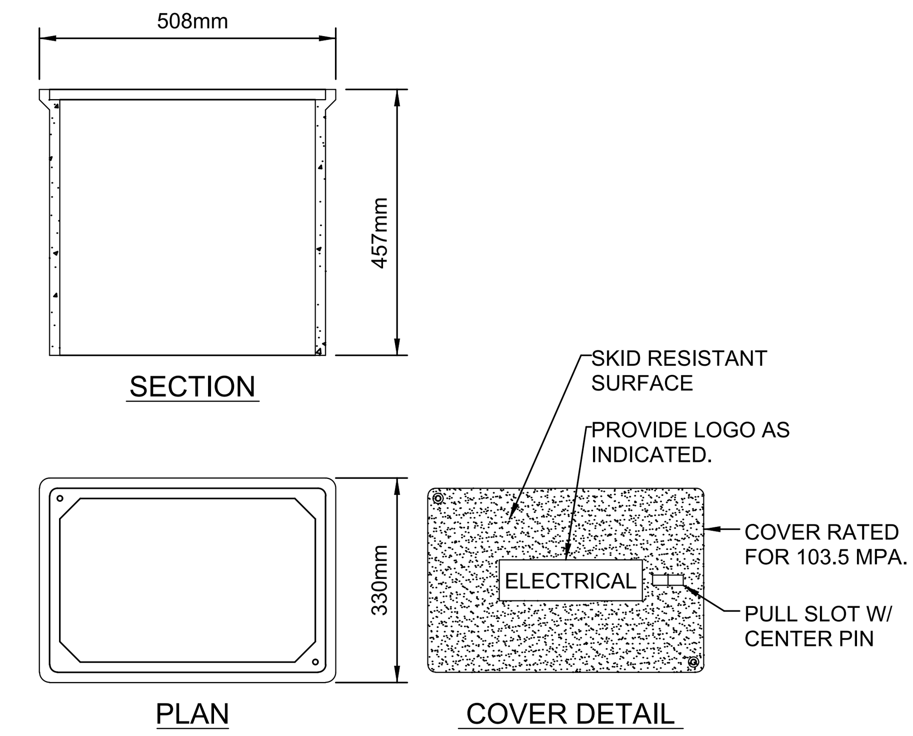
06/27/18

KEY NOTES:

1. 2-4"C(PULL STRING) SEE SHEET E-1 FOR DISTANCE INFORMATION.
2. 2"C(3#2, 1#6) TERMINATE AT CONTROL PANEL LINE TERMINALS.
3. SERVICE ENTRANCE RATED DISCONNECT SHALL BE NEMA 4, PAD-LOCKABLE. SCHNEIDER/SQUARE-D, OR EQUAL.
4. SURGE SUPPRESSOR.
5. SEE SHEET E-2 KEYNOTE 13 FOR GROUNDING INFORMATION.



ONE-LINE DIAGRAM
NO SCALE

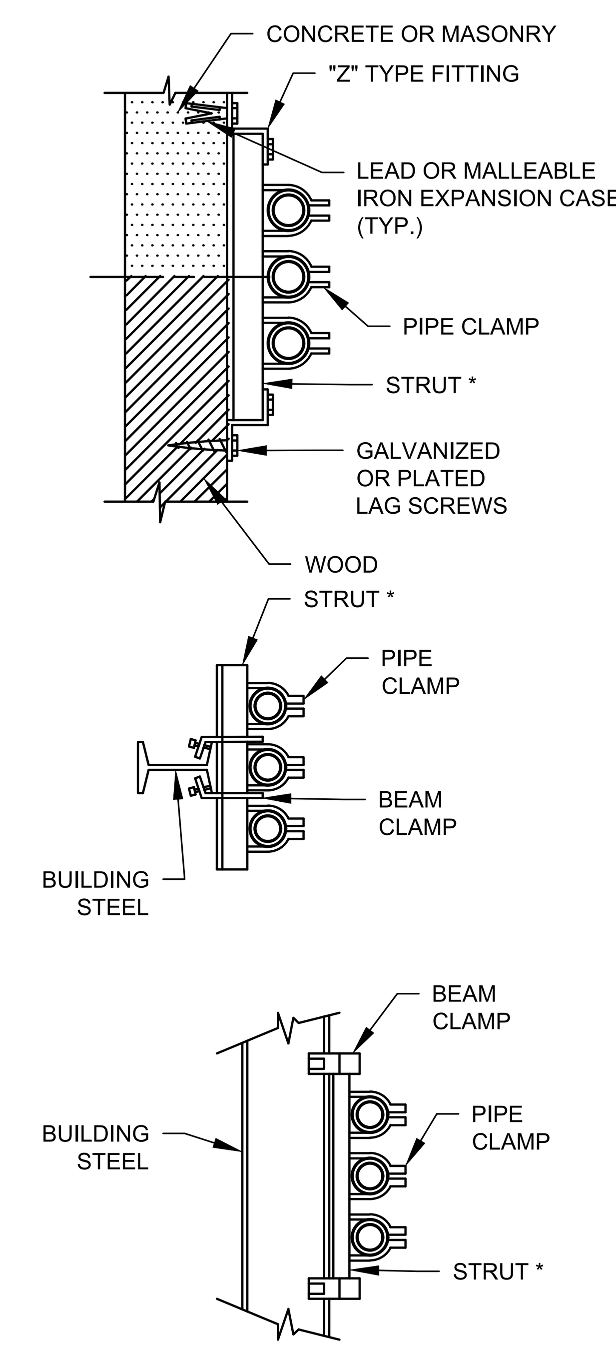


HANDHOLE DETAIL
NO SCALE
QUAZITE COMPOSOLITE OR EQUAL

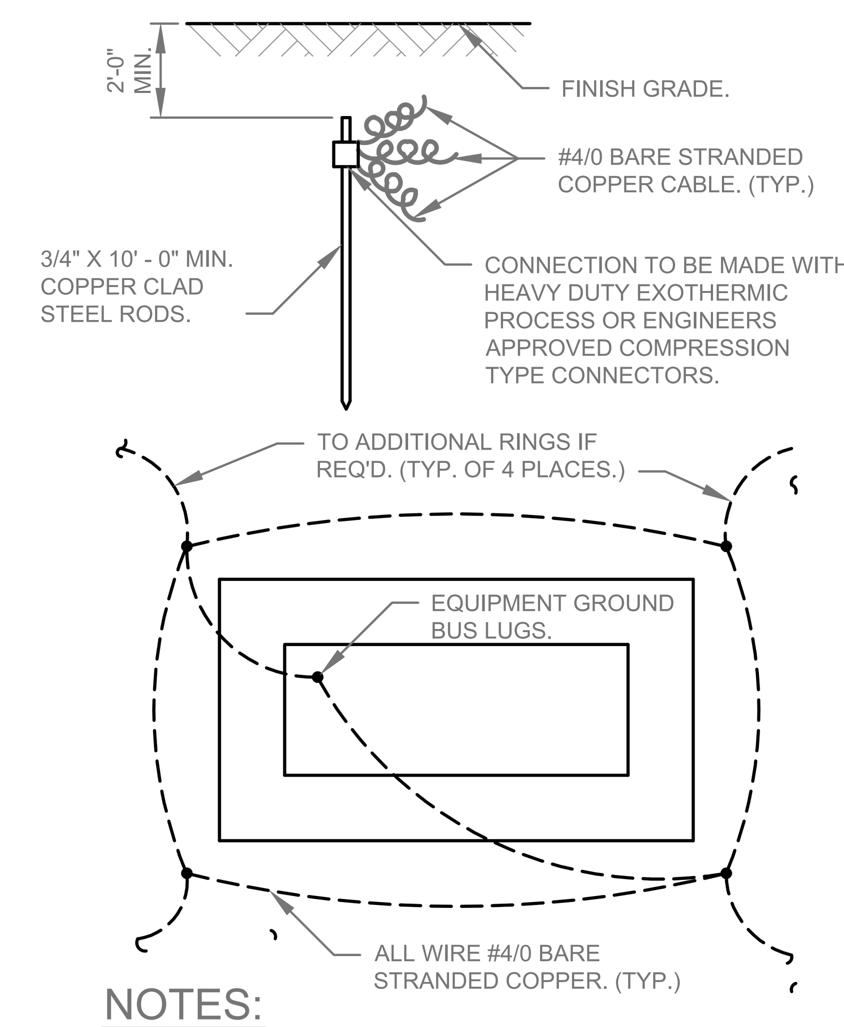
HANDHOLES FOR LOW VOLTAGE CABLES INSTALLED IN PARKING LOTS, SIDEWALKS, AND TURFED AREAS SHALL BE FABRICATED FROM AN AGGREGATE CONSISTING OF SAND AND WITH CONTINUOUS WOVEN GLASS STRANDS HAVING AN OVERALL COMPRESSIVE STRENGTH OF AT LEAST 69 MPA AND A FLEXURAL STRENGTH OF AT LEAST 34.5 MPA. PULLBOX AND HANDHOLE COVERS IN SIDEWALKS, AND TURFED AREAS SHALL BE OF THE SAME MATERIAL AS THE BOX. CONCRETE PULLBOXES SHALL CONSIST OF PRECAST REINFORCED CONCRETE BOXES, EXTENSIONS, BASES, AND COVERS.

IN PAVED AREAS, FRAMES AND COVERS FOR HANDHOLE ENTRANCES IN VEHICULAR TRAFFIC AREAS SHALL BE FLUSH WITH THE FINISHED SURFACE OF THE PAVING. IN UNPAVED AREAS, THE TOP OF MANHOLE COVERS SHALL BE APPROXIMATELY 1/2" ABOVE THE FINISHED GRADE.

DIMENSIONS SHOWN ARE MINIMUMS. CONTRACTOR TO PROVIDE HANDHOLES ADEQUATELY SIZED FOR PROPER APPLICATION.

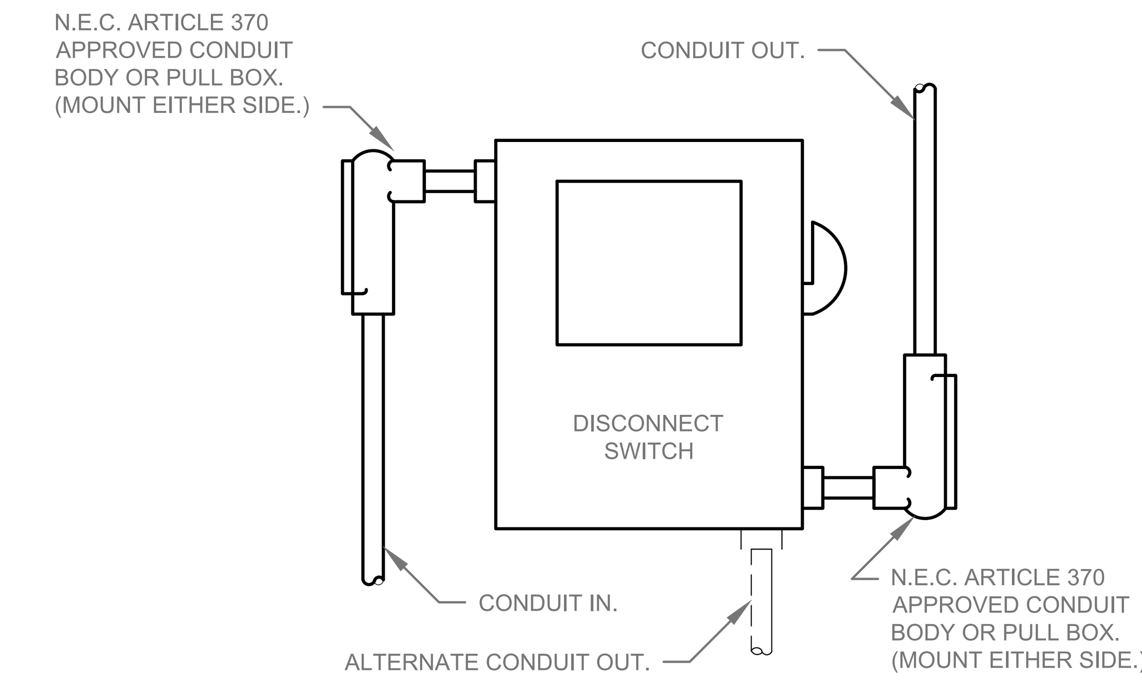


VERTICALLY RACKED AND VERTICAL RUNS
NO SCALE

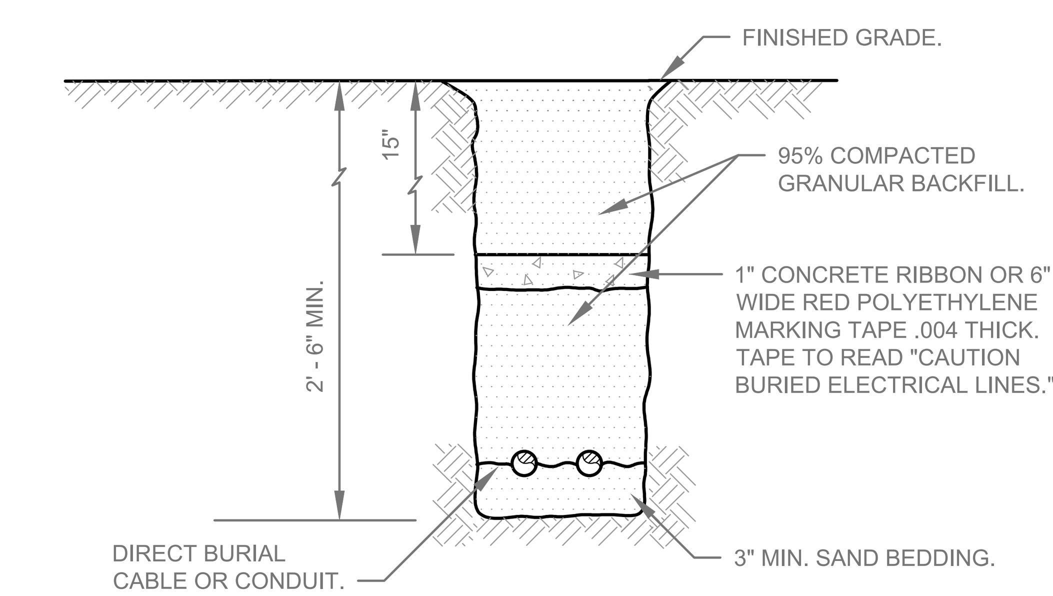


NOTES:
ADDITIONAL CONCENTRIC RINGS SHALL BE ADDED AS REQ'D. TO MEET THE (5) OHM SPECIFIED RESISTANCE. EACH RING TO HAVE 4 GROUND RODS, AND SPACE 10 FEET FROM THE INNER RING.

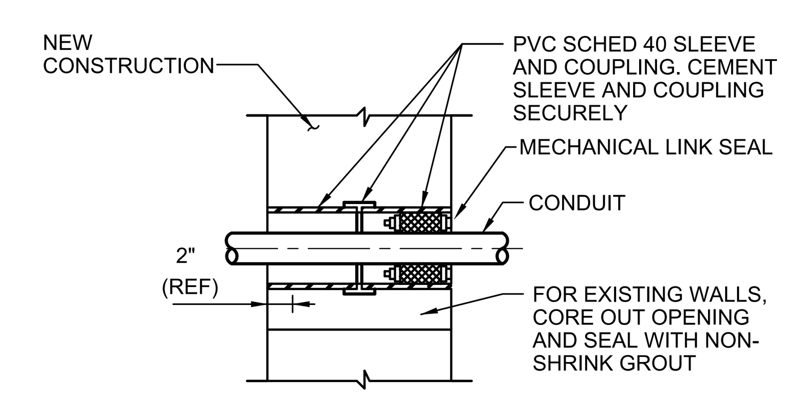
GROUND MAT DETAIL
NO SCALE



SERVICE ENTRANCE AND DISCONNECT SWITCHES
NO SCALE
FOR NO.4 WIRE, AND LARGER.



TRENCHING DETAIL
NO SCALE



EXTERIOR WALL CONDUIT SLEEVE DETAIL
DO NOT USE BELOW GRADE
NO SCALE

BACKGROUND PLAN AND ONE LINE SYMBOLS

SYMBOL	DESCRIPTION
●	CONTROL SWITCH (SEL. OR P.B.) SEE CIRCUITS FOR SPECIFIC TYPE
F	SEE CIRCUITS FOR SPECIFIC TYPE FLOAT SWITCH
L	LIMIT (PROXIMITY TYPE) SWITCH
TB JB	TERMINAL BOX, JUNCTION BOX
▭	AS NOTED (LIGHTING PANEL, CONTROL PANEL, DISTRIBUTION PANEL, ETC.) WALL MOUNTED
PB	PULL BOX
	TRANSFORMER
	CONDUIT WITH CONDUIT SEAL FITTING
	CONDUIT EXPOSED
	CONDUIT CONCEALED
	DIRECT BURIED CONDUIT
	600V, 3 POLE MOLDED CASE CIRCUIT BREAKER, FRAME & RATING AS SHOWN
FT 10	TAG NO. (BALLOON) FOR DEVICE INDICATED
A-3 MCP OR CP-1 FT 10	FOR POWER (SEE SHEET E-100, NOTE 2) 3/4"C(2/C#16SH) CONDUIT AND WIRE RUN FROM DEVICE INDICATED TO LOCATION INDICATED
F C	DISCONNECT SWITCH (F) = FUSED, (C) = CIRCUIT BREAKER
A-3	LOW VOLTAGE HOME RUNS (SEE SHEET E-100, NOTE 2)
NEMA 4	WATERTIGHT
NEMA 4X	WATERTIGHT AND CORROSION PROOF
NEMA 7	EXPLOSION PROOF - CLASS I, DIVISION 1, GROUP D

WIRING DEVICE SCHEDULE

SYMBOL	DESCRIPTION	NEMA TYPE
⏀	125V, 2P, DUPLEX, 3W	5-20 R

8/15/2018

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DATE AUGUST 2018

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

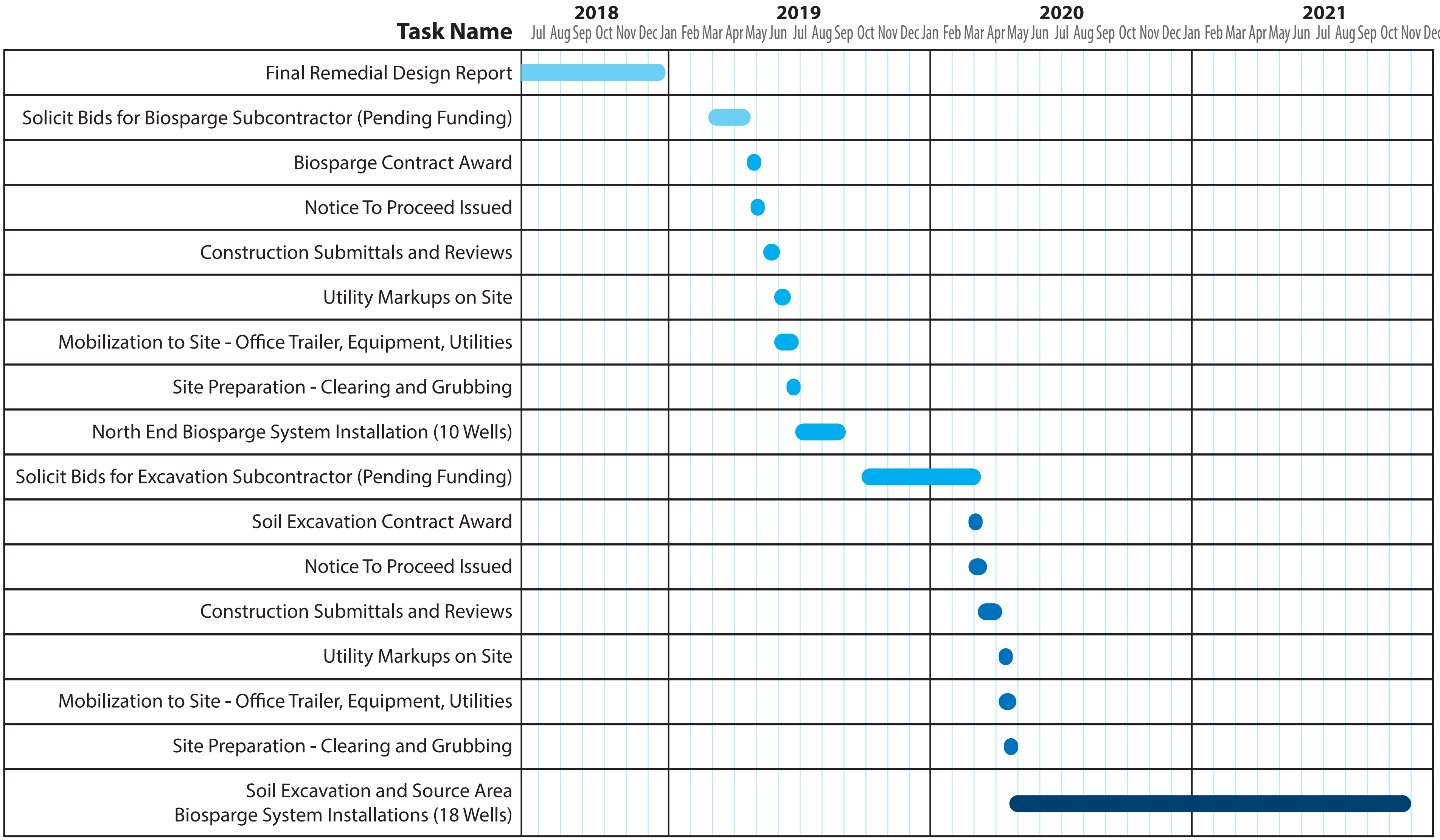
SCALES:
HORIZONTAL SCALE: NA
VERTICAL SCALE: NA

TAR LAKE SITE
MANCELONA TOWNSHIP, MICHIGAN
BIOSPARGE SYSTEM – ELECTRICAL ONE-LINE & DETAILS

WORK ASSIGNMENT NO. WA194
DRAWING NO. E-3
SHEET NO. 21 OF 21

APPENDIX C

SCHEDULE



Task Name
2018
2019
2020
2021
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Final Remedial Design Report
Solicit Bids for Biosparge Subcontractor (Pending Funding)
Biosparge Contract Award
Notice To Proceed Issued
Construction Submittals and Reviews
Utility Markups on Site
Mobilization to Site - Office Trailer, Equipment, Utilities
Site Preparation - Clearing and Grubbing
North End Biosparge System Installation (10 Wells)
Solicit Bids for Excavation Subcontractor (Pending Funding)
Soil Excavation Contract Award
Notice To Proceed Issued
Construction Submittals and Reviews
Utility Markups on Site
Mobilization to Site - Office Trailer, Equipment, Utilities
Site Preparation - Clearing and Grubbing
Soil Excavation and Source Area Biosparge System Installations (18 Wells)

APPENDIX D

COST ESTIMATE

[redacted]

[redacted]

[redacted]