CVOC Interim Remediation Work Plan
for the
Former Contact Metals Welding Facility
Indianapolis, Indiana
IDEM State Cleanup No. 000-00-396

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SMA Project No. CQ167012

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1.0 INTRODUCTION

This CVOC Interim Remediation Work Plan (CIRWP) has been prepared by St. John - Mittelhauser & Associates, Inc., A Terracon Company (SMA) for Contact Metals Welding (CMW) and its insurers[1]. The former CMW facility is located at 70 South Gray Street on the east side of Indianapolis, Indiana (Site). The final demolition of buildings at the Site (Buildings A and B) occurred from late June through August 2019. Since that time, the Site has been sold to Graymor Properties LLC. The Site location is shown on Figures 1.0-1.

On April 9, 2024, CMW submitted a Site Characterization Report (SCR) to the Indiana Department of Environmental Management (IDEM) (IDEM *VFC #83629481)*. The SCR summarizes data collected during investigations prior to 2022 for the Site, presents recent data collection and remediation efforts since early 2022 and presents interpretations based on all the data collection efforts for the Site to date.

CMW is submitting this CIRWP to initiate remedial efforts as soon as reasonably possible to provide a more complete control of CVOC migration from the Site to the combined sewer system under South Gray Street. This vapor migration pathway via the sewers system has been controlled since May 10, 2022 by a vapor extraction system that withdraws vapors from the sewer system. However, this vapor extraction system is costly to operate and requires significant operation and maintenance. It also represents a potential long-term liability that should be addressed through contaminant removal instead of just exposure prevention.

Currently, the only potentially complete contaminant exposure pathway from the Site is the CVOC vapor migration pathway to residential homes via the combined sewer system. However, upon re-development of the Site, exposure to excavation workers and additional cost related to the handling and disposal of hazardous waste soils may occur. The CVOC remedial objectives proposed in this CIRWP take these exposures into consideration, as well as minimizing or

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[1] Pursuant to a Stipulated Judgement entered January 17, 2023, certain insurers of CMW have “complete control” of the remediation to address the Site.

eliminating soils that would need to be managed as hazardous waste if excavated. Soil source removal will additionally reduce the chance that long-term vapor intrusion remedies will be required. Although the soil contamination to be addressed is not believed to be contributing to off-site groundwater contamination to the west of the site, source removal will also curtail any long-term groundwater migration from the Site. These additional exposure and pathway of migration measures are discussed more fully in Section 3.

1.1 PURPOSE

This CIRWP only includes the investigation data and proposed remedial options for the CVOCs because while there are some occurrences of other VOCs at the site, they are co-located with CVOC releases and the CVOC occur at much higher concentrations. A final RWP (to be submitted later), which may potentially include additional investigation and/or remedial measures addressing semi-volatile compounds (SVOCs), polychlorinated biphenyls (PCBs) and metals impacts is planned to be completed prior to CMW receiving regulatory closure for the Site. It is the intention of CMW that this CIRWP be incorporated by reference in the final RWP as the document of record to address the CVOCs that CMW seeks in Closure for the Site. This CIRWP and the SCR will both be utilized to present IDEM with the comprehensive investigation and remediation efforts related to CVOCs at the Site.

The purposes of this CIRWP submittal are to present to the IDEM:

- The proposed Site-specific, non-default CVOC cleanup objectives.
- The evaluation of remedial options for the CVOC source areas and select the chosen remedial option.
- The confirmation sampling to be performed upon implementation of the chosen remedial option.
- The post remedial measures groundwater monitoring.

1.2 LIST VOCs FOR WHICH CMW SEEKS REGULATORY CLOSURE

The scope of the Certificate of Completion and Covenant Not-to-Sue that CMW seeks through this CIRWP covers the release and threatened release of the volatile organic compounds (VOCs) surface soil and subsurface soil from the Site are listed in Table 1.2-1. Groundwater that remains impacted by the remaining CVOCs will be addressed in a RWP to be issued later.

1.3 SCOPE OF WORK

From May through October 2023, SMA conducted additional investigations to delineate the nature and extent of CVOCs at the CMW Site. These additional investigations and all previous CVOC data collection at the CMW Site are summarized in the SCR. The scope of the additional CVOC investigations conducted in 2023 performed by SMA at the Site consisted of the following:

- Reviewing previous reports and documents to determine an appropriate scope of work that would result in obtaining a Covenant-Not-To-Sue (CNTS) from IDEM.
- Conducting subsurface investigations and groundwater sampling to delineate the identified contamination in both the soil and groundwater.
- Conducting evaluations to develop Site-specific, non-default remediation objectives for some CVOCs.
- Preparing and submitting the April 9, 2024 SCR.

Since submitting the SCR report in April 2024, SMA has focused on remediation alternatives, the identification of cleanup objectives for the CVOC remediation and contracting the remedial measures to be undertaken. This CIRWP focuses on the results of those efforts and presents the remediation approach.

SMA’s investigative and remediation activities conducted thus far, including the preparation of the SCR and this CIRWP, were performed under the direction of Ron St. John, Principal Hydrogeologist with SMA and a Licensed Professional Geologist (LPG) in the state of Indiana.

Mr. St. John and IDEM personnel have either met at the Site or participated in conference calls on several occasions leading up to the submittal of this CIRWP. These discussions concerning IDEM's expectations have shaped the nature and content of this CIRWP.

1.4 SITE BACKGROUND

P.R. Mallory & Co., Inc. (PR Mallory)[2] began development of the Indianapolis manufacturing operation in the late 1920's. Figure 1.0-1 identifies the entire PR Mallory property and identifies the CMW portion of that property that was first leased in 1978 and then purchased in 1983. The CMW portion has recently been sold to Graymor Properties LLC. The surviving entity of PR Mallory is Battery Properties, Inc. (BPI). The remaining parcels of the former PR Mallory property depicted on Figure 1.0-1 are owned by entities controlled by the Englewood Community Development Corporation. IDEM has previously voiced some confusions related to which portions of the former PR Mallory site are currently the environmental responsibility of BPI and which are CMW. The BPI and CMW parcels are clearly defined on Figure 1-1 from the SCR.

Figure 1.4-1 shows the location and development date of each of the PR Mallory buildings on the property that was taken over by CMW. CMW operated in each of the Buildings A through G on the CMW Site starting in 1978. CMW ceased operations in the former Plating Department portion of Building D in 1993 when the Plating Department building was demolished. It is well documented that CMW only used 1,1,1-trichloroethane (TCA) from the start of its operations in 1978 until at least early in 1993 to perform all degreasing at the facility. However, the predominant contaminants in the Plating Source Area are trichloroethylene (TCE) and carbon tetrachloride (CT). CMW did not operate the Plating Department during the short time that it used TCE. For these reasons, the Plating Department is the sole responsibility of BPI and the investigations and extent of contamination was not further delineated for the SCR.

[2] This entity is not to be confused with P.R. Mallory LLC, and entity controlled by the Englewood Community Development Corporation.

The demolition of the former Plating Department - Building D in 1993 was followed by the demolition of Buildings C, E, F and G during the period from December 2006 to October 2008. CMW went into receivership and went out of business in February 2014. The Indiana Department of Environmental Management (IDEM) issued a Special Notice of Liability letter dated September 17, 2014 to CMW and Evergreen Holdings as State Cleanup Site No. 0000-00-396. Buildings A and B were demolished from approximately mid-June through mid- August 2019. As of this report writing, the foundations and the concrete slabs of Building A through G are still in-place at the Site.

1.4.1 Site Location and Description

The Site is located at 70 South Gray Street, Indianapolis, Marion County, Indiana on approximately 4.9 acres of property located in a predominantly commercial and residential area. Adjacent properties include residential homes (east), the Purdue Polytechnic High School (north), the Battery Properties, Inc property (west and southwest) and the CSX railroad (south of Building A). Figure 1.4-1 shows the location of the Site and the surrounding property usage.

1.4.2 Previous Investigations and Reports

Previous significant investigative reporting for the Site includes:

Focused Subsurface Investigation Results, Conestoga-Rovers & Associates (now called GHD and will be referred to as GHD for the remainder of this report), 8/15/14 – VFC #80137313.

- Based on GHD's review of information about the CMW operations, inspections of the CMW buildings and employee interviews immediately after CMW went into receivership, GHD performed investigations at CMW operational areas with the potential for releases.

Initial Site Characterization Report, EnviroForensics, 12/1/15 - VFC #80178152

- Initial CMW Site investigations under the State Cleanup program.

Further Site Investigation Report, EnviroForensics, 6/27/16 – VFC #80373088

- Continued CMW Site investigations under the State Cleanup program.

Further Site Investigation #2 Summary Report, EnviroForensics, 8/9/16 – VFC #80342081

- Continued CMW Site investigations under the State Cleanup program.

Volatile Organic Compound Characterization Report, EnviroForensics, 5/17/20 – VFC #83048720

- Summary of CMW Site investigations under the State Cleanup program.

Soil Gas Investigation Work Plan, St. John – Mittelhauser & Associates, 11/19/21 – VFC #83252174

- The soil gas investigations outlined in this work plan were aimed at determining if the vapors within the Gray street residential homes were the result of vapor migration, from the Site, vapors generated from contaminated groundwater or vapor migration associated with migration along the sewer lines.

Soil Gas Investigation Report, St. John – Mittelhauser & Associates, 5/27/22 – VFC #83328725

Results of the Combined Sewer System Vapor Extraction Pilot Testing, St. John - Mittelhauser & Associates, 6/9/22 –

- Successful pilot test of the sewer vapor extraction system to demonstrate capture along South Gray Steet and Moore Avenue adjacent to the Site.

Configuration and Operation of the Continuously Operated Sewer Vapor Extraction System, St. John - Mittelhasuer & Associates, 6/22/22 – VFC #83339246

- Summary of the design, installation and full-scale operation of the sewer vapor extraction system including its effectiveness demonstration.

Summary of the Manhole and Residential Vapor Sampling Data During the First 90-Days of Sewer Vapor Extraction System Operatioin, St. John - Mittelhauser & Associates, 9/3/22 – VFC #83369633

- Manhole and residential vapor sampling demonstrating effectiveness during the first 90 days of full-scale sewer vapor extraction system operation.

Manhole Vacuum and Vapor Sampling Results from September 12, 2022, St. John - Mittelhauser & Associates, 10/12/22 – VFC #83381764

- Further effectiveness testing of the sewer vapor extraction system installation.

Site Characterization Report, St. John – Mittelhauser & Associates, 4/9/24 – VFC #83629481

2.0 CONDUCT OF ADDITIONAL INVESTIGATIONS

SMA initiated Site investigation activities in 2023 by reviewing environmental investigations that had taken place up until that time at the CMW Site. This review concluded that the investigations conducted to date had identified the approximate location of most of the likely source areas. However, the CVOC source areas had not been adequately delineated. Subsequently, SMA completed additional soil and groundwater investigations to define the nature and extent of CVOC impacts at the Site.

2.1 INVESTIGATION OBJECTIVES

The objective of the additional investigations conducted in 2023 and leading up to this CIRWP was to define the source areas of CVOC impacts in soil and then to define the nature and extent of groundwater impacts resulting from the CVOC source areas.

2.2 QUALITY ASSURANCE PROJECT PLAN

SMA personnel reviewed Appendix E – Data Quality Control & Quality Assurance Assessment from EnviroForensics' *Volatile Organic Compound Characterization Report*, dated May 17, 2020 (VFC #83048720) prior to performing additional investigation activities at the Site in 2023. It was determined that, generally, the EnviroForensics investigations to that point were in compliance with the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (QAMS-005-80), the *Region V Model QAPP*, and the *EPA Quality Manual for Environmental Programs* (May 2000). Exceptions to following the QAPP are listed below:

- SMA has used no purge passive diffusion bags (PDBs) for the groundwater sampling at the CMW Site. At this point, PDBs are widely used and accepted by almost all groundwater science and environmental regulatory agencies. Additionally, since BPI has been sampling all of their wells for a number of years with PDBs, it made sense for CMW to adopt this methodology for consistency. SMA anticipates using PDBs for all groundwater sampling going forward at the CMW Site.

Upon beginning work on the CMW project, SMA has used EQuIS as a database management system to ensure the accuracy of reporting. All laboratory data from sampling events performed by SMA have been transferred into tables via electronic data deliverables (EDDs) directly from Pace Analytical. Likewise, all the BPI data was supplied by GHD as a direct EDD transfer from their data base and all the EnviroForensics data was directly input from MS Excel spreadsheets. Plots of this same data have been posted on the mapping images presented in this report and the SCR without transcription and are therefore free of transcription error to the extent possible.

To the extent possible, SMA personnel field-checked and ascertained the location of previous data collection points. Survey coordinates were available for a most of the pre-SMA soil borings and monitoring wells. All of the new locations were surveyed for x, y, z coordinates upon completion. This included a re-survey of the existing monitoring well locations to check for any heaving or settling.

Mr. Ron St. John, PHg, CPG is the SMA Project Manager, and Mr. Scott Hoppel, CHMM is the SMA Field Project Manager. Mr. St. John has been responsible for the identification of data gaps and the development of the scope of work necessary to meet the objectives of the project. Mr. Hoppel has assisted Mr. St. John in these efforts and has managed the conduct of fieldwork related to the project and has performed field Quality Assurance/Quality Control (QA/QC) checks on a regular basis.

3.0 SITE CVOC EXPOSURE EVALUATION AND CLEANUP OBJECTIVES

The exposure evaluation and cleanup objectives discussion within this section assumes the following:

- The Site will remain zoned for commercial/industrial use only, however, the planned use of an athletic facility supporting the neighboring high school will be allowed.
- The installation of wells to develop water for potable and/or process use will be prohibited.
- Excavation of soils at some portions of the Site will need to be performed in conjunction with the development of a soil management plan. At a minimum, this soil management plan will describe how excavation personnel will:
  - Safely perform work in compliance OSHA 1910 Subpart H regulations.
  - How excavated soils will be managed and handled on-Site to minimize exposure.
  - How excavated soils to be disposed of off-Site will be properly characterized for disposal.
- Any new construction at the Site, either as a slab on grade or with a basement, will have a vapor barrier installation and/or a depressurization system installed below it to prevent volatile vapors from entering the new structure after completion.

The CVOC data from all the previous investigations at the Site were imported into the Earth Volumetric Studio (EVS), 3-dimensional (3D) visualization and quantification software for analysis. Quantification and visualization of the contamination at the CMW Site by EVS is more thoroughly discussed and presented in Section 4. However, statistical observations related to the contaminant mass at the CMW Site are also available from the EVS and are available for risk evaluation purposes. This data analysis indicates that CVOC mass occurrence at the CMW Site is as follows:

TCE – 6,474 kilograms (kg) – 98.9% of CVOC total
PCE - 44 kg – 0.67% of CVOC total
CT - 29 kg – 0.18% of CVOC total

TCA - 18 kg – 0.28% of CVOC total

CF – 0.09 kg – 0.001% of CVOC total

Due to its toxicity and potential for migration both in groundwater and as a vapor, TCE generally also has much lower IDEM risk-based screening levels than the other CVOCs occurring at the CMW Site. Additionally, a review of the 3D visualization of contamination in the SCR shows that TCE has also been co-released and requires remediation at each location at the Site where another constituent exceeds a cleanup objective. For these reasons, the discussions below (and for the remainder of the report) related to Site cleanup objectives will be discussed almost exclusively as TCE.

3.1 SOIL EXPOSURE AND CLEANUP OBJECTIVES

Unsaturated zone soils throughout the source areas on Site generally occur from surface grade to approximately 11 feet in depth. These are generally the soils that would be excavated and that construction workers would come in contact with at the Site during re-development. The IDEM Risk-based Closure Guide (R2, July 8, 2022 and as updated) currently only identifies a TCE concentration of 100 mg/kg as the short-term, direct contact screening level for an excavation worker. The U.S. EPA Region 5 Direct Contact Long-Term Screening Level for TCE as surficial soils is 19 mg/kg (using IDEM's risk model of Target Risk =1E-05 and Hazard Quotient = 0.1).

The current plan for portions of the CMW Site is excavate a basement for a new field house that will contain basketball courts. To facilitate this planned use, and the potential for excavation anywhere on the CMW Site, the TCE cleanup objective will be less than 10 mg/kg. The cleanup level of less than 10 mg/kg is identified based on the TCE Toxicity Characteristic Procedure Limit (TCLP) value of 0.5 mg/l and the 1:20 mix of sample to solvent used during the leaching procedure. This generally results in total soil analysis results of less than 10 mg/kg being below the TCE TCLP limit of 0.5 mg/l and being characterized as non-hazardous for off-

Site disposal purposes. This total maximum concentration of less than 10 mg/kg for TCE is the limit identified by U.S. EPA that defines a waste as being D-listed and can be accepted by a landfill.

The only CVOC with a lower D-listing concentration lower than TCE is VC. There is almost no VC occurrence at the CMW Site in the unsaturated zone and where it does occur it is at a much lower concentration and has a co-occurrence with TCE.

3.2 GROUNDWATER EXPOSURE AND CLEANUP OBJECTIVES

As described in the discussions within the SCR, the shallow groundwater under the south source areas at the CMW Site migrates towards and discharges to the combined sewers under Gray and Moore streets and is the primary cause of the vapor intrusion issues in the residential homes there. For this reason, there are multiple issues related to on-Site groundwater impacts from an exposure standpoint. The following is an itemization of the significant issues related to shallow groundwater at the CMW Site:

- Saturated zone soil sampling in each of the source areas on the CMW Site indicate that DNAPL has penetrated the shallow groundwater and sustains the elevated concentrations of TCE observed in monitoring wells CMW-4 and CMW-6 (and likely throughout the remaining portions of the south source areas where there are no monitoring wells).

- Saturated zone soil sampling in south Gray Street indicates that historical leakage from the sewers has resulted in DNAPL penetrating the shallow groundwater to sustain the elevated TCE groundwater concentrations getting into the sewer system. A significant amount of soil and groundwater contamination occurs off-Site in a public right of way.

- A groundwater mound of undetermined origin occurs in the vicinity of monitoring well CMW-4 and currently exhibits the most elevated hydraulic head within the CMW south source areas. As reported in the SCR, it is likely that this mound (and the other groundwater mounds observed within the source areas during the period of investigation) is caused by leaking underground storm water conveyances. During remedial efforts at these source areas, it would be helpful if the source of these storm water leaks was abated (this would also benefit the remedial contractor).

To address the itemized groundwater concerns at the CMW, SMA proposes to use the IDEM commercial-industrial excavation direct contact screening level for TCE of 100 mg/kg to identify the volume of soil below the water table that needs to be remediated, and upon implementation of remedial measures within that volume, the cleanup objective would be the 19 mg/kg U.S. EPA direct contact screening level (modified to use IDEM's risk model of Target Risk =1E-05 and Hazard Quotient = 0.1). Treating the 100 mg/kg volume within the saturated zone is focused on the removal of DNAPL within the shallow groundwater zone. The occurrence of DNAPL TCE within the saturated zone at the Site has the highest potential for TCE groundwater migration at the Site. Removing the DNAPL from the saturated zone at the Site will have the following beneficial effects:

1. It will remove what is currently sustaining the elevated groundwater concentrations from 80 to 120 mg/l observed to be occurring within the shallow groundwater at the Site.

2. Due to #1 above, this will reduce concentrations of TCE entering the sewer system under Gray and Moore streets to cause unacceptable vapor concentrations migrating to the adjacent residential homes through the sewer system.

3. Currently, the upper sand unit under the south source areas at the CMW Site is not impacted by TCE. However, if the DNAPL is allowed to remain within the shallow saturated zone within the south source areas, it is likely only a matter of time before TCE impacts to the upper sand are observed. BPI has already identified the significant exposure risks related to this as the TCE groundwater plume from their former Plating Department source area has been documented to have migrated at least ½-mile west of the Site.

4. It would be helpful to identify and address the leaking storm water conveyance pipe(s) within the south source areas. This should have the beneficial effect of removing the groundwater mound, lowering the water table and stopping the shallow groundwater migration at Site from discharging to the sewers under Gray and Moore streets, reverting to migrating to the west with the topography and documented regional groundwater flow within the area.

5. If the goals listed in 1 through 4 above are successful, the current sewer vapor extraction system will no longer be required to control CVOC vapors from migrating into the sewers along Gray and Moore streets and subsequently to residential homes adjacent to the Site. Additionally, the potential of shallow groundwater to contribute to vapor intrusion issues will be reduced.

3.3 VAPOR EXPOSURE AND CLEANUP OBJECTIVES

After the remedial measures are implemented at the Site to address the soil and groundwater migration and the exposure pathways discussed above, it is currently unclear what the nature of additional vapor exposure will be at the CMW Site. It is assumed that vapor migration to the sewers along Gray and Moore streets will have been abated and the sewer vapor extraction system will be able to shut down. Residual TCE contamination will exist within the unsaturated and saturated zone at the Site, but the extent of this residual TCE occurrence to migrate is currently unknown. For this reason, CMW is recommending any new construction at the Site, either as a slab on grade or with a basement, to have either a vapor barrier installation or a depressurization system installed below it to prevent volatile vapors from entering the new structure after completion. Alternatively, a future developer at the Site could perform specific evaluations to avoid installation of a vapor barrier or depressurization system for all or portions of any future construction by collecting Site specific data, such as, post remediation soil gas investigations to identify if such vapor abatement technologies are necessary for use on a location-by-location basis across the Site.

4.0 CMW SOURCE AREA OCCURRENCE AND CVOC DELINEATIONS

During the summer of 2023, SMA performed 169 additional soil borings at the Site to provide additional delineation of the south source areas (not including the Former Plating Department area) that were not yet sufficiently delineated for remediation purposes and to investigate and delineate the other source areas that were previously uninvestigated. Details related to these investigations are discussed in Section 4 of the SCR and will not be duplicated here. However, to following general description of the subsurface lithologies for the source areas at the Site is provided:

- Surface grade to approximately 18 feet in depth – Soft, dark gray, sandy, silty clay glacial till with a high moisture content.
- At 18 to 22/24-feet in depth – At some locations the sandy, silty clay, glacial till described above is continuous to 24-feet in depth and at other locations this zone is entirely or partially composed of saturated sand and/or gravel.
- Below 22/24-feet in depth – A light gray, dry, very dense silty clay glacial till occurs. The low hydraulic conductivity of this light gray till seems to significantly inhibit the vertical migration of CVOC across the CMW Site and promote horizontal groundwater flow within the dark, shallow sandy, silty clay and sand/gravel units above this dense till.

Included in the descriptions below are quantification of CVOC occurrence at each of the individual CVOC source areas on Site. To visually depict and quantify the contamination occurring in the subsurface at the combined Railroad Spur and Building C Loading Dock areas, the Railroad Spur Area, the Western Source Area and the #3 Degreaser, the CVOC data from all the previous investigations at the Site were imported into the Earth Volumetric Studio (EVS), 3-dimensional (3D) visualization and quantification software for analysis. To review the EVS 3D visualization for the CMW source areas see Attachment A. A summary of the individual source area volumes and the mass of TCE contained in each is discussed below and can be reviewed in Table 4-1.

4.1 SHIPPING/RECEIVING SOURCE AREA

A review of the EVS 3D visualization for the Shipping/Receiving Source Area indicates that the primary source release for this area appears to have been near surface grade at soil borings M15 and N15. A review of the laboratory analysis of the soil sample from M15 at 8 to 10 feet in depth indicates a TCE concentration of 2,070 mg/kg and N15 sample at the same depth interval was 2,840 mg/kg. The occurrence at 8 to 10 feet in depth is above saturated conditions, and an occurrence at this depth would be consistent with a release from an underground conveyance or structure (e.g., sewer). Vertical migration in the vicinity of this source appears to have caused significant lateral migration of the predominantly TCE contamination and once in the groundwater, migration is to the east toward the sewer system under Gray street.

Volume of Unsaturated Zone Soil with TCE ≥ 10 mg/kg = 1,959 cubic yards (yds^3)
Volume of Saturated Zone Soil with TCE ≥l 100 mg/kg = 1,873 yds^3
TCE mass within source volume = 380 kilograms (kg) or 836 lbs.

4.2 BUILDING C LOADING DOCK SOURCE AREA

A review of the EVS 3D visualization for the Building C Loading Dock Source Area indicates that the primary source for this area appears to have been a release near soil boring I17. A review of the laboratory analysis of the soil sample from I17 at 14 to 16 feet in depth indicates a TCE concentration of 4,040 mg/kg and a PCE concentration of 3,100 mg/kg. This soil sample is within the saturated zone and it is unclear if this is related to the former loading dock catch basin or releases within the loading dock. This separate PCE source appears to be from a surficial source near the K16 location. It is the only identified, significant and separate PCE source to exist at the CMW Site but is co-located with TCE contamination requiring remediation.

Groundwater migration in the vicinity of this source appears to have caused significant downgradient comingling of the TCE and PCE within the Shipping/Receiving Source Area groundwater. Ultimately the groundwater migration is to the east toward the sewer system under Gray street.

The EVS volumetric analysis of the Building C Loading Dock Area indicates the following:

Volume of Unsaturated Zone Soil with TCE $\geq$ 10 mg/kg = 122 yds^3
Volume of Saturated Zone Soil with TCE $\geq$l 100 mg/kg = 379 yds^3
TCE mass within source volume = 161 kilograms (kg) or 354 lbs.

4.3 RAILROAD SPUR SOURCE AREA

A review of the EVS 3D visualization for the Railroad Spur Source Area indicates the primary source for this area appears to have been a surficial release at or very near the soil boring O22 location. The soil sample from O22 at 0 to 2 feet in depth indicates a TCE concentration of 230 mg/kg, a CT concentration of 21.2 mg/kg and a CF concentration of 13.1 mg/kg. Additionally, the next deepest sample from the O22 soil boring submitted for analysis at 10 to 12 feet exhibited a CT concentration of 502 mg/kg and a CF concentration of 35 mg/kg. It is currently unclear how the surficial soils immediately below the concrete at the O22 location became contaminated since there are no known sources that operated in this area and there are no physical indications in the concrete of previous operations in this area (e.g., trench drains, stamping presses, etc.). However, Building A was the last of the PR Mallory buildings at the Site to be constructed (1951) and the soil contamination there could have predated the construction of Building A.

Groundwater from the Railroad Spur Source Area migrates to the northeast toward the area of manhole MH-2 at the intersection of Gray and Moore streets. The groundwater discharges into the sewer system there.

The EVS volumetric analysis of the Railroad Spur Source Area indicates the following:

Volume of Unsaturated Zone Soil with TCE $\geq$ 10 mg/kg = 1,469 cubic yards (yds^3)

Volume of Saturated Zone Soil with TCE $\geq$l 100 mg/kg = 995 yds^3

TCE mass within source volume = 400 kg or 880 lbs.

CT mass within that source volume = 47 kg or 103 lbs

CF mass within that source volume = 1 kg or 2 lbs

4.4 WESTERN SOURCE AREA

Due to some relatively elevated TCE concentration determined in the borings performed in this area of the Site by EFI previously, it was decided that further investigation was necessary. After performing the additional delineation borings, EFI soil boring SB-84 still exhibited the highest TCE concentration in the area. As the EVS 3D visualization points out, the further delineation analysis has shown that all the impacts in this area are within the saturated zone and that this is an area of groundwater contamination associated with the release near soil boring SB-84.

The EVS volumetric analysis of the Western Source Area indicates the following:

Volume of Unsaturated Zone Soil with TCE $\geq$ 10 mg/kg = 75 yds^3

Volume of Saturated Zone Soil with TCE $\geq$l 100 mg/kg = 0.04 yds^3

TCE mass within source volume = 2 kg or 4.4 lbs.

4.5 #3 DEGREASER SOURCE AREA

A review of the EVS 3D visualization of the #3 Degreaser Source Area indicates that the primary source for this area appears to have been a surficial release at or very near the soil boring P1-27 location. A review of the laboratory analysis of the soil sample from O22 at 2.5 feet in depth indicates a TCE concentration of 62.6 mg/kg. Additionally, the next deepest sample from the P1-27 soil boring submitted for analysis at 11.75 feet exhibited a TCE concentration of 1,200 mg/kg. When the #3 Degreaser was in operation it had a trench drain located immediately next to it. The subsurface occurrence of TCE appears to be consistent with releases from this trench drain.

Groundwater from the #3 Degreaser Source Area migrates to the north toward the combined sewer located under Moore Avenue. The groundwater discharges into the sewer system there (this will be discussed further in Section 5).

The EVS volumetric analysis of the #3 Degreaser Source Area indicates the following:

Volume of Unsaturated Zone Soil with TCE $\geq$ 10 mg/kg = 501 yds^3
Volume of Saturated Zone Soil with TCE $\geq$l 100 mg/kg = 128 yds^3
TCE mass within source volume = 85 kg or 187 lbs.

4.6 FORMER PLATING DEPARTMENT

As indicated in the SCR, from 1978 when CMW started operations at the Site until 1993 when the Former Plating Department building was demolished, CMW only used TCA in their process operations. Like each of the other source areas on the CMW Site, the contamination at the Former Plating Department source area is composed almost entirely of TCE and as a result, is the responsibility of BPI the cleanup. However, since the unsaturated zone TCE contamination associated with the Former Plating Department releases resides almost entirely on the CMW property and the remedial goals planned for the Site include elimination of hazardous soils for re-development purposes, CMW is choosing to remediate the unsaturated zone soils there. However, the source delineations that took place at the south source areas on the CMW property in 2023 and included in the SCR did not include any delineation work at the Former Plating Department and the source area would benefit from additional delineation for final remedial design purposes (as was the case for the south source areas prior to the 2023 additional delineations).

Figure 4.6-1 shows the location of the soil borings from surface grade to 10 feet in depth (the majority of the unsaturated zone). The delineation shortcomings within the unsaturated zone of the Former Plating Area will be corrected by conducting a data gap investigation prior to the implementation of remedial measures in this area. The initial, additional data gap borings to be performed during the conduct of these additional investigations are also included on Figure 4.6-1.

The current EVS volumetric analysis of the Former Plating Department Area indicates the following estimates:

Volume of Unsaturated Zone Soil with TCE $\geq$ 10 mg/kg = 413 yds^3
TCE mass within source volume = 17 kg or 37 lbs.

4.7 SETTLING BASINS SOURCE AREA

The Settling Basins Source area was investigated with three soil borings during the 2023 investigations. Limited impacts were determined in this area. Only one soil sample from one soil boring SP-1 from eight to 10 feet in depth exhibited a TCE concentration above the Commercial/Industrial Direct Contact screening level at 20 mg/kg. It is assumed that the volume of contamination at this location is small enough and shallow enough to be treated in-place, excavated and disposed of off-Site at a landfill.

5.0 INTERIM REMEDIATION WORK PLAN

This CIRWP addresses only the CVOCs at the Site for which CMW is pursuing closure (other VOCs are co-located with the CVOCs are at significantly lower concentrations). It presents a non-default, risk-based, remedial approach consistent with the IDEM procedures and guidelines, and will achieve the cleanup objectives based on the Site CVOC exposure evaluation in Section 3 of this CIRWP. This section of the CIRWP evaluates the various remedial measure alternatives/technologies for potential use in cleaning up the Site.

5.1 EVALUATION OF REMEDIAL ALTERNATIVES POTENTIALLY APPLICABLE TO THE CMW SITE

In parallel with performing Site investigation and characterization work for the CVOC area, evaluations of remedial technologies were initiated in early 2023 and continued up until the submittal of this CIRWP. This involves the period of time after which a good understanding of the CVOC source area was in hand, the extent of groundwater impacts was well understood and a consistent Site conceptual model of contamination occurrence and migration was developed.

Several important factors impacted the analysis of applicable remedial measures for the CVOC source area soils. The most important factors during these evaluations were: 1) effectiveness to treat or remove the impacted source area soils; 2) cost; 3) the ability to control vapors during soil remedial measures; and 4) the potential for long term impacts to the Site. The evaluation of these remedial measure criteria was weighted as a higher priority when considering the remedial applications at the Site.

5.1.1 Zero-Valent Iron Clay Mixing

ZVI-Clay is an in-situ remediation technology that involves the admixing of reactive media (ZVI) and sodium bentonite to soils impacted by CVOCs using conventional large-scale construction auger equipment. Through implementing a ZVI-Clay remediation, the CVOCs within the source zone are depleted over time and the hydraulic conductivity of the targeted zone is reduced. From this reduction of hydraulic conductivity in the source zone, the ZVI-Clay remedial measure results in a reduction of CVOCs being leached from the source volume after treatment of the source volume. The technology can be used to treat both unsaturated and saturated zone soils (and incorporated groundwater). DuPont and the University of Waterloo developed the ZVI-Clay technology in the late 1990s and early 2000s and donated the patents for the technology to Colorado State University. Colorado State is advancing the technology through research and commercialization initiatives.

ZVI-Clay uses conventional construction equipment, usually in the form of large-scale caisson augers, to mix heterogeneous source zones into relatively uniform, relatively homogenous bodies. In the process, the CVOCs are intimately commingled with ZVI to abiotically treat the CVOCs, and the hydraulic conductivity of the treated source area is reduced. The observed half-lives for most CVOCs treated by ZVI-Clay range from 1 to 30 days (Olson, 2005). After treatment, the CVOC mass within the source zone continues to be reduced due to the abiotic reaction with the ZVI, and due to the hydraulic conductivity decreases because of the clay addition, residence times within the source zone are increased thereby increasing contact time with the ZVI. At the end of ZVI-Clay treatment, the goal is to create a well homogenized, monolith admixture of ZVI, residual CVOCs, and clay in the subsurface.

The evaluation of the primary criteria for implementation of ZVI Clay at the CIOC Site is provided below.

5.1.1.1 Effectiveness of ZVI Clay to Treat Source Area

According to officials at Colorado State University, there are over 35 Sites that have utilized full scale implementation of the ZVI-Clay technology to date. Data provided to SMA suggests successful results at the Sites where data is available for review. Bench-scale testing performed on Site soils from the source area(s) would potentially help to identify if ZVI-Clay would be successful at reducing CVOC concentrations in the source area soils. Without this bench-scale testing it is not known if ZVI-Clay would be able to reduce the concentrations to the proposed Site-specific cleanup levels for the overbank deposits. Based on experience, the contractors that would be employed for the implementation of the ZVI-Clay technology have indicated they would not be willing to guarantee the successfulness of the remedial technology application for the Site.

5.1.1.2 Cost of ZVI Clay

To date, the implementation of ZVI Clay to remediate CVOC source areas has been most cost effectively performed when the soil contamination can be mixed with a long-reach backhoe fixed with a special mixing tool. Due to the depth considerations of needing to treat the saturated zone soil over a large portion of the CMW Site, the large-diameter caisson style augers would be necessary. This would have increased the cost significantly. In addition, it would be virtually impossible to treat the soils adjacent to the sewer lines on the CMW Site and under Gray street via use of the large-diameter augers. For this reason, costing for ZVI clay mixing was not pursued for the Site.

5.1.1.3 Ability to Control Vapor While Implementing the ZVI Clay Technology

There would certainly be some liberation of VOCs during the in-situ mixing of the source area during implementation of the ZVI-Clay technology. The prevailing winds in Indianapolis are predominantly from the southwest. Vapors emitted during the in-situ mixing of the source area would be carried to the northeast, directly over the residential areas east of S. Gray Street. Spray foam vapor suppressants could not be expected to be effective during deep vertical mixing operations. Spray foam vapor suppressants have been used successfully to control VOCs during small, short-term excavations and could be expected to work well through application on portions of the source area that have already been mixed with ZVI-Clay.

5.1.1.4 Potential Long-Term Impacts to the Site as a Result of Utilizing the ZVI Clay Technology

The construction companies that have implemented the ZVI-Clay technology have indicated that the volume expansion of soils due to augering ranges from 20 to 30%. This amount of volume expansion could possibly require the installation of low permeability cap at surface grade to prevent direct contact with the soils if treatment of the source volume soils does not reduce concentrations sufficiently. The installation of a cap would also require vegetation and maintenance and would be an additional upfront and on-going expense not considered in Section 5.1.1.2 above.

In addition to the volume expansion, ZVI-Clay technology could impact redevelopment plans due to the difficulty in meeting compaction requirements necessary for building footings and infrastructure within the treatment area.

5.1.2 In-Situ Chemical Oxidation Mixing

Similar to ZVI-Clay, in-situ chemical oxidation (ISCO) relies on large scale construction caisson augers to mix soil in the subsurface while adding chemical oxidants to oxidize the CVOCs. Unlike ZVI-Clay, the ISCO contractors would not add sodium bentonite in an attempt to increase residence time within the treatment volume and make the source area soils into a lower permeability monolith. Instead, the contractors would rely on direct contact of the ISCO compounds with the CVOCs to breakdown and reduce CVOC concentrations in the subsurface.

5.1.2.1 Effectiveness of ISCO Mixing to Treat Source Area

There are several widely observed problems with implementing ISCO remediations in soil and groundwater. Some of the more problematic factors that may impact ISCO effectiveness in treating the source area soils at the CMW site are:

- Chemical oxidants need to come into direct contact with the CVOCs they are going to oxidize. The problem with the mixing processes in the subsurface is the tendency for soils not to be mixed completely and for excess chemical oxidant and CVOCs to migrate out of the treatment zone once the soils have been disturbed and made more permeable. As a result, good contact between the chemical oxidants and the CVOCs in the subsurface may not be achieved. The ISCO vendors that have been contacted have been reluctant to provide guarantees that the Site-specific cleanup levels can be met using this technology.

- Chemical oxidants oxidize all of the organic matter in the subsurface. The chemical oxidants will be used up oxidizing the organic carbon indigenous to the source area soils, aquifer sediments and any petroleum hydrocarbon constituents that might have been co-released in the source area at the Site (however, there is almost no evidence of this occurring at the CMW site). As a result, significantly more chemical oxidant would be used up oxidizing other organics during the injections than just the CVOCs alone.

- A common observation after the use of chemical oxidation injections below the water table is to observe CVOC concentrations in groundwater increasing above the concentrations observed prior to the injections. This is commonly attributable to the oxidation and destruction of organic carbon in the aquifer sediments and the release of additional CVOCs to groundwater that would otherwise be sorbed to that naturally occurring organic carbon.

- There is a concern that since the ISCO technology does not decrease the permeability of the source area volume to inhibit leaching and would likely cause an increase in the source area volume vertical permeability. Also, sufficient treatment within the source volume may not occur. There is a potential for migration of even more CVOC mass to be released to the groundwater system.

5.1.2.2 Cost of ISCO Mixing

Like ZVI/Clay mixing, the cost/benefit in relation to the potential downsides of deep auger mixing ISCO and potentially creating additional migration pathways, incomplete destruction of the TCE along with the other downsides discussed regarding ZVI/Clay like source increase in volume and instability of soils afterwards lead to no further pursuit of costing. Additionally, no ISCO contractor would guarantee the results of their injection/mixing work.

5.1.2.3 Ability to Control Vapor While Implementing ISCO

There would certainly be liberation of VOCs during the in-situ mixing of the source area during implementation of the in-situ CO mixing technology. The prevailing winds in Indianapolis are predominantly from the southwest. Vapors emitted during the in-situ mixing of the source area would be carried to the northeast, directly over the residential areas east of S. Gray Street. Spray foam vapor suppressants have been used successfully to control VOCs during small, short-term excavations. However, it should be anticipated that significant releases of VOCs will occur during the treatment of the source area while implementing deep auger mixing with ISCO.

5.1.2.4 Potential Long-Term Impacts to the Site as a Result of Utilizing ISCO

No construction companies were found that have any direct experience in performing ISCO mixing with caisson augers in CVOC source areas like the ones at the Site. The construction companies that have implemented similar sorts of remedial measures indicate that the volume expansion of soils due to mixing would likely be about 15% to 20% due to disturbing the soils. This amount of volume expansion could possibly require the installation of low permeability cap at surface grade to prevent direct contact with the soils if treatment of the source volume soils does not reduce concentrations sufficiently. The cap would also require vegetation and maintenance. The cost for cap installation and on-going maintenance is not included in the costs in Section 5.1.2.2.

In addition to the volume expansion, ISCO could impact redevelopment plans due to the difficulty in meeting compaction requirements necessary for building footings and infrastructure within the treatment area.

5.1.3 Excavation with On-Site Treatment and Off-Site Disposal

Under this option, soils within the source area would be excavated and treated on-Site prior to off-Site disposal. The excavated source area soils would be treated with chemical oxidation chemicals directly adjacent to the excavation. Soils within the source area that can be excavated and treated to less than 20 times the TCLP values can be disposed of at a Subtitle D landfill. Soils excavated from the source area that are less than 10 times the Land Disposal Restrictions (LDRs) can be disposed of at a Subtitle C landfill. Soils exceeding these limits would require additional treatment prior to landfilling. The costs for this option would include both the treatment of the soils, the loading and cartage cost to a landfill and the tipping fees at the landfill. The size and volume of in-situ soils currently requiring treatment at the CMW site would likely result in treatment and disposal over several months. This would further increase costs due to having to treat and discharge rain water occurring in excavations.

5.1.3.1 Effectiveness of Excavation with Treatment and Off-Site Disposal to Address the Source Area

Excavation with off-Site disposal is an effective means by which the identified cleanup objectives can be achieved if certain obstacles related to the length of the project could be overcome.

5.1.3.2 Cost of Excavation with Treatment and Off-Site Disposal

The cost of excavation with treatment and off-Site disposal and backfilling would be approximately $18M. However, these costs do not take into consideration the additional cost associated with how long an excavation with treatment would take (likely many months) and the additional problems of dealing with precipitation within the excavations. The costs for potentially dealing with contaminated precipitation during these excavations could be $1M to $3M. These costs are associated with dewatering the excavation, treatment and discharge to the local POTW, but do not include costs for continued shoring of excavations during work.

5.1.3.3 Ability to Control Vapor While Implementing Excavation with Treatment and Off-Site Disposal

The duration of the source area excavation, treatment and backfilling project would be on the order of three to six months. Contaminated soils would be treated in the working excavation prior to being generated. It is likely that significant vapor emissions would result from these excavation and treatment processes. The prevailing winds in Indianapolis are predominantly from the southwest. Vapors emitted during the in-situ mixing of the source area would be carried to the northeast, directly over the residential areas east of S. Gray Street. While spray foam suppressants have proven to work well for small, short-term excavation projects, the size, nature, and duration of an excavation, treatment, and off-Site disposal of the impacted soils is not feasible.

5.1.3.4 Potential Long-Term Impacts to the Site as a Result of Utilizing Excavation with Treatment and Off-Site Disposal

There are no anticipated long-term impacts to the Site that would result from excavation with off-Site disposal. Compaction of backfill material can be tested to demonstrate the remediation area meet the compaction requirements necessary for building footings and infrastructure within the treatment area.

5.1.4 In-situ Thermal Remediation Technology

In-situ Thermal Remediation Technology (ITRT) is a remediation technique that is most cost effective in remediating volatile organic compounds in low permeable soils, and in addressing LNAPL/DNAPL on or below the water table. ITRT was developed in the early 1990s and has been used successfully at approximately 600 sites around the world to date.

The ITRT process relies on heating the subsurface through the placement of electrodes or heating wells within the area of remediation to heat the subsurface. The subsurface is then heated, either through the resistance of the earthen materials to conducting the electricity between electrodes (electrical resistive heating, or ERH), or through thermal transfer of heat generated from heating wells (thermal conductive heating, or TCH).

The degree of heating can be controlled by the amount of energy (electrical or heat) supplied. Typically, sub-surface temperatures reach close to the boiling point of water. This causes steam generation, cracking/dessication of the clays, and liberation of the CVOCs since their boiling point is less than the boiling point of water. The steam/CVOC mixture is brought to the surface by a vacuum system, the steam and CVOCs are separated, and the CVOCs are either directly discharged to the atmosphere or treated (typically by use of activated carbon or through thermal destruction). SMA personnel have used this technology to successfully complete work at 16 Sites under State and Federal clean-up programs to date.

5.1.4.1 Effectiveness of ITRT to Treat Source Area

ITRT processes are fully capable of reducing CVOCs from the vadose and saturated zones in the fine-grained glacial till deposits at the Site to the remedial objectives identified in Section 3.

5.1.4.2 Cost of ITRT

Vendor quotes to implement this technology at the Site estimate the cost to be on the order of approximately $8.3M. The spacing of the electrodes to remediate the Site utilizing ERH and the spacing of heater wells to remediate the Site utilizing TCH are similar. As a result, the cost to install an ERH or TCH system are similar and usually come down to the local cost of electricity (ERH) or natural gas (TCH). These costs do include costs to perform soil confirmation sampling.

5.1.4.3 Ability to Control Vapor While Implementing ITRT

The use of ITRT would allow nearly complete control of the CVOC vapors generated from the treatment of the source area.

5.1.4.4 Potential Long-Term Impacts to the Site as a Result of Utilizing ITRT

There are no known or anticipated negative long-term impacts related to implementing of ITRT. Once the electrodes or heat wells and supporting process control equipment are removed from the Site, the Site will appear unchanged. ITRT does not involve disturbing a significant volume of the subsurface like ZVI-clay, ISCO, or excavation. Therefore, there is no impact to the native soils or requirements for compaction to meet the requirements necessary for building footings and infrastructure within the treatment area.

5.2 SELECTED REMEDIAL TECHNOLOGY

The defined volume of source area soils impacted with CVOCs will be remediated using in-situ thermal remedial measures. The remedial measures will be implemented over the area where the CVOCs are at or exceed the Site-specific remediation objectives of 10 mg/kg in the unsaturated zone or 100 mg/kg in the saturated zone as determined by the EVS 3D contaminant modeling of all investigation data included in Attachment A. The source area unsaturated and saturated zone soils impacted with CVOCs above the cleanup objectives will be remediated by thermal conductive heating (TCH). Additional details of the remedial activities are presented in this section.

5.2.1 Unsaturated and Saturated Zone Impacted with CVOCs and Extent of Remediation Effort

The volume of saturated and unsaturated zone soils that exceed the cleanup objectives at the CIOC Site is identified as 13,810 yds^3 in Table 4-1. The configuration of this soil volume can be reviewed on in the 3D EVS visualization in Attachment A. However, to achieve the cleanup objectives within these volumes, the TCH system will need to heat a much larger volume of soil. This is necessary for two reasons: 1) The primary reason for this heating volume increase is due to the need to heat the unsaturated zone soils above all areas where the deeper saturated zone soils require heating so that the contaminants, once vaporized from the deeper saturated zone do not condense and contaminate the shallow zone soils; and 2) A review of the TCE occurrence in the 3D visualization in Attachment A indicates a very irregular configuration and it is simply impossible to “surgically” remediate the irregular configuration with in-situ heating technologies that precisely. The tendency for deeper saturated zone soils to cool and re-condense within more shallow soils that are not heated discussed in #1 above, will be taken into consideration during the confirmation sampling discussed in Section 5.3.3, below.

The area of the impacts has been determined by reviewing the analytical data and comparing the results to the Site-specific cleanup criteria based on the 3-D visualization kriging in Attachment A. The overwhelming majority of CVOC occurrence in the source areas is composed of TCE. The soil CVOC area will be remediated across the complete extent of its surface expression depicted by the outline shown on Figure 5.2-1. This figure shows the distribution of the TCH wells across the source areas and the conveyance piping that connects each of the TCH well fields to the TCH process treatment equipment. The draft design shows that there will be approximately 302 TCH wells needed to remediate the source areas.

At the north end of the CMW Site is the Former Plating Department source area. Heating within the Former Plating Department source area will only take place to approximately 11-feet in depth to remediate the unsaturated zone. The TCH and vapor recovery wells in this area will be installed in a shallow fashion within this area to facilitate this contaminant removal only.

The only other Site-specific design consideration for the TCH installation involves vapor recovery along the sewer lines on-Site and under South Gray Street where heating will take place. A review of Figure 5.2-1 indicates that vapor recovery wells will be installed to the top of the sewer lines on-Site and under Gray street in all areas where heating will take place. CMW intends to work with the City of Indianapolis to close the south end of South Gray Street just south of the north side of Building B for the duration of the thermal remediation project.

Figure 5.2-2 illustrates the location of the perimeter fence that will be installed on the CMW property and within City right-of-ways to encompass the entirety of the thermal remediation process equipment. The perimeter security fencing will be fitted with barbed or razor wire overhangs for its entirety. Additional Site security will include the following:

- Perimeter motion sensors within the fencing.
- Motion activated CC TV security cameras.
- After hours virtual remote monitoring.
- Nighttime overhead security lights.
- Alarms and call outs.

Figure 5.2-1 illustrates the general layout of the conveyance piping. This piping shows that the process equipment will be positioned at the south end of Building C on CMW property. The TCH power control unit (PCU), cooling tower, condenser, and vapor recovery blower will be installed in this area. This location is the most centrally located on the Site and the farthest away from the local residential homes.

The distribution of the temperature monitoring probes to be installed to monitor subsurface temperatures during the thermal remediation, and the confirmation sampling locations are also illustrated will be available for review once the final detailed design is completed. The number and total potential confirmation sampling locations will also be available once the detailed design is complete. The general approach to how the confirmation sampling will be performed is outlined in Section 5.3.3.

The TCH wells will be installed to varying depths within the source areas to address the variable depths of CVOC impacts. Figure 5.2-3 identifies the depth of TCH well installation within the various CMW source areas. Figure 5.2-3 also contains a table that identifies the area of each of the treatment zones (in square feet), the subsurface volume of the that treatment zone (TTZ in cubic yards) and the subsurface volume that will require heating (in cubic yards) to remediate that the contaminated volume. A review of this table indicates that the TCH remediation will need to heat approximately 36,000 yds^3 to remediate the source zones at the CMW Site.

A process flow diagram for the TCH installation is provided as Figure 5.2-4.

5.2.1.1 Technical Feasibility to Address the Physical and Chemical Characteristics of Media

There is no question as to the ability of TCH to effectively remediate TCE in fine-grained, unsaturated and saturated zone lithologies. The technology has successfully completed dozens of projects in similar lithologies in the Midwest. The implementation of the TCH technology in the source area at the CMW Site is expected to reduce the TCE source mass by as much as 96%.

The TCH technology relies on the heating of subsurface soils through the conductive heating supplied by each TCH well. By heating the subsurface, VOCs such as PCE, TCE and TCA volatilize and become much more mobile due to secondary permeabilities created within the fine-grained soils and are removed from the subsurface by placing a series of vacuum extraction wells within the TCH well network.

5.2.1.2 Projected Removal and Treatment of CVOC Impacts

Table 4-1 provides an estimate of the mass of TCE in the CMW source areas that the TCH soil remediation and the projected remaining mass of the same constituents after the ERH remedial measure is completed. The volume in Table 4-1 was generated by the 3-dimensional EVS kriging analysis, and the mass calculations is based on the TCE concentrations within each of the source volumes. The model was then used to reduce each of the areas to just below the cleanup objective to determine the worst case (most TCE mass remaining) and determined a

TCE mass reduction of 82%. In practice, the TCE reduction will be significantly greater than this and far less TCE will remain in the soil because the TCH process cannot precisely control the amount of heating that is taking place to reduce concentrations a fixed amount. Many portions of the heated volume within the source areas will be reduced to non-detect concentrations or nearly so.

5.2.1.3 Protectiveness of Human Health

The proposed remedial measures utilizing TCH to remove CVOCs from soils at the Site will result in concentrations that are acceptable based on the following criteria:

- Direct contact exposure to surface soils.
- Direct contact exposure to subsurface soils by an excavation worker.
- Will result in CVOC concentrations in unsaturated zone that will no longer be characteristically hazardous for off-Site disposal.
- Will likely destroy most if not all of the DNAPL TCE occurrence within the subsurface at the Site and thereby reduce the mass of TCE that partitions into solution to cause additional groundwater contamination for many future decades. This will, in turn, lessen the amount of time that other groundwater control measures (e.g., permeable reactive barriers) will need to be maintained at the Site.

5.2.1.4 Ability of Remedial Technology to Achieve the Cleanup Criteria

TCH has been demonstrated on a number of occasions to successfully be able to achieve TCE cleanup levels similar to those identified for the CMW Site.

5.2.1.5 Community Acceptance

To the extent possible, in-situ remediation technologies have been evaluated at the Site for implementation, thereby minimizing the exposure of local residents to the Site constituents. Except for the minor amount of soil contamination that occurs at the former Settling Basins, it is currently anticipated that no soils will be excavated for off-Site disposal during the remediation process. Additionally, exposure of off-Site residents to vapor emissions will be limited to the extent possible by treating the vapor emissions from the TCH system. Off-Site traffic of wastes from the Site will be limited to the soil cuttings generated from the installation of TCH wells, vacuum wells and temperature monitoring probes (TMPs). By limiting the community exposure to the remediation traffic exiting the Site, off-Site receptor exposure is minimized to the extent possible, and in a manner that protects all completed exposure pathways. This is in the community's best interest and is anticipated to be well received.

Upon approval of this CIRWP, local interested parties and the adjacent property owners will be notified of anticipated work. The Community Relations Plan to be implemented during the remediation efforts at the Site is provided in Attachment B.

5.2.1.6 Anticipated Volume of CVOC Impacted Soil to be Remediated

Table 4-1 provides an estimate of the volume of soil containing VOCs that will be treated and/or removed at the Site, and the mass of the individual CVOCs estimated to be present in the soils currently.

5.2.1.7 Ease of Technology Application or Implementation

Use of TCH to remove CVOCs in soil and groundwater is a reasonably complex technology to implement. It requires relatively consistent monitoring of subsurface temperatures, heating, soil moisture conditions, recovered vapor concentrations, and monitoring of process equipment. That being said, SMA has had experience at multiple Sites implementing the technology in very similar geologic conditions and involving a similar suite of chemical constituents (i.e., CVOCs and in particular, TCE). Further technical details related to implementing the TCH remediation at the CMW site are available for review in the contractor proposal in Attachment C

5.2.1.8 Dimensions of Technology and Space Limitations

The TCH technology will require some Site space to situate the PCU, the vapor recovery blowers and the water/steam cooling tower/condenser. The physical size of the area necessary to store and operate this equipment is approximately 125 feet by 125 feet. The Site currently has a large amount of space available to locate the TCH process equipment on the west-central portion of the Site without any significant noise or vapor issues impacting the Purdue Polytechnic High School or the local residents.

5.2.1.9 Process Parameters

The most important process parameters that will influence the effectiveness of the TCH and its removal of CVOCs from the subsurface soils are soil temperature and concentration of CVOCs in the vapor recovery system. From experience in operating and managing other TCH systems, it is anticipated that subsurface VOCs will start to be liberated and be removed in the vapor recovery system once the subsurface temperatures reach approximately 60^o C (140^o F). The VOCs will continue to evolve from the subsurface soils and be captured in the vapor recovery system as the soil temperatures rise to their maximum temperature of between 90^o and 100^o C at which time a drop off of the VOCs is generally observed in the vapor recovery stream. This is the result of the VOC mass being depleted within the treatment area soils.

Unlike electrical resistance heating (ERH), TCH systems do not have operational concerns related to soil moisture for them to operate optimally.

5.2.1.10 Cleanup Time Frames

It is anticipated that all the source volumes will be remediated by TCH simultaneously, but that the Former Plating Department source and the #3 Degreaser will be completed sooner than the remainder of the source areas. The Former Plating Department will be completed quicker because only the unsaturated zone there will be remediated and the #3 Degreaser because it is smaller than the other source areas and has a limited saturated zone of treatment.

It is currently estimated that the TCH remediation will take approximately 15 months to achieve the cleanup objectives and demobilize from the Site.

5.2.1.11 Transportation Distances

The relatively minor amount of contamination that occurs at the Former Settling Basins is the area that will disposed of off-Site. It is anticipated that the soils will be treated during excavation with chemical oxidants to reduce TCE concentrations so they are not characteristically hazardous. The soils will then be available to be disposed of at a local Subtitle D landfill.

5.2.1.12 Operation and Maintenance Costs

The TCH remediation of soils at the Site is considered all inclusive, and once performed, it is not anticipated that there will be any operation and maintenance costs going forward associated with the TCH system. However, groundwater monitoring will be performed after the TCH remedial measure is complete to validate the effectiveness of the remediation.

5.2.1.13 Other Considerations

A review of Table 4-1 indicates that there is approximately 9,265 lbs of TCE mass in the TCM treatment volume. Making a conservative assumption that all of it is removed, approximately 4.63 tons of hazardous air pollutants (HAPs) primarily in the form of TCE that would need to be discharged to the atmosphere. This is well below IDEM's requirement for treatment of air streams generating greater than 10 tons of any individual HAP or 25 tons of total HAPs on a yearly basis. Additionally, TCE have not been identified to harm the ozone layer. As a result, air treatment of the vapor recovery system associated with the TCH remediation is not required.

However, due to the proximity of residential homes to the CVOC source area, treatment of the TCH system vapor emissions with activated carbon to provide for a treatment goal of 95% removal of the CVOCs will be implemented, and less than one-pound of total CVOCs per day will be discharged.

5.2.2 Summary of Interim Remediation Work Planned for the SVOC Source Area

Two general types of remedial activities to address the CVOC impacts that exist in the CVOC source areas at the CMW Site will be performed. Both remedial activities will be completed by TCH and are: 1) the unsaturated zone soils to a depth of approximately 11-feet will be remediated to achieve TCE concentrations of less than 10 mg/kg; and 2) the saturated zone soils will be remediated from approximately 11-feet in depth to a variable depth ranging from 18 to 36 feet based on soil sampling of the source volumes and generally where the dense, lower gray till occurs. Soils within this saturated zone volume will have all TCE concentrations at or greater than 100 mg/kg treated to less than 19 mg/kg.

The purpose of #1 above is to treat unsaturated zone soils to concentration where they will no longer be characteristically hazardous and can be disposed of in Subtitle D landfill if necessary during the excavation of basements at the Site during redevelopment. Additionally, these soils will then be well below the IDEM, short-term direct contact screening level for an excavation worker of 100 mg/kg.

The purpose of #2 above is to treat saturated zone soils for the removal of DNAPL. Saturated zone soils exhibiting TCE concentrations at or greater than 100 mg/kg (roughly 10% of the solubility limit of TCE) will be treated to less than 19 mg/kg (and likely much lower due to treatment by TCH). The removal of DNAPL zones within the groundwater system at the CMW Site will likely result in shallow TCE groundwater concentrations being improved substantially.

5.3 DATA GAP AND CONFIRMATION AND SAMPLING PLANS

During the procurement and installation stage of the TCH remediation and prior to its startup, additional data gaps will be filled within the Former Plating Department source unsaturated zone and all the monitoring wells and piezometers that are within all the treatment areas of the TCH system will be abandoned. Further details are provided below.

5.3.1 Data Gaps and Additional Investigations

Figure 4.6-1 shows the locations of the soil borings that have taken place from surface grade to completion depth at and in the vicinity of the Former Plating Department and identifies the TCE concentration in the soil samples that were acquired there. The expression of the contamination that occurs within the area was developed by the EVS model with the limited zero to 10-foot depth data and in combination with the data known to occur in the depth interval from 10 to 20 feet, immediately below it. The additional delineation borings that SMA plans on performing to address these current data gaps are show on the figure. The soil sampling to be performed will utilize the same procedures that were outlined in the SCR for the investigations that took place in 2023.

5.3.2 Monitoring Well and Piezometer Abandonment and Replacement

All the monitoring wells installed at the Site are constructed of PVC. Those wells installed in the areas to be remediated by TCH will need to be abandoned prior to TCH startup otherwise they will melt during its operation. This list of monitoring wells includes: PRMW-7, CMW-4, CMW-17, CMW-3, CMW-6 and CMW-8. This list also includes piezometers: PZ-20, PZ-24, PZ-15, PZ-25, PZ-17, PZ-21, PZ-22 and PZ-18.

After the completion of the TCH project, monitoring wells PRMW-7, CMW-4, CMW-17, CMW-3, CMW-6 and CMW-8 will be replaced by installing new wells at approximately the same locations. The replacement monitoring wells will be screened at the same elevations as the original wells and will be constructed of stainless steel due to the residual temperature of the soils. These monitoring wells will be sampled along with other monitoring wells at the Site according to the procedures and schedule described in Section 6.

5.3.3 TCH Soil Confirmation Sampling Plan

When performing in-situ soil heating remediations, it is necessary to do reconnaissance sampling to determine the progress within the treatment area because soils may heat up in a variable manner. SMA will conduct this reconnaissance and confirmation sampling for CMW and will coordinate the timing of those efforts with the TCH contractor based on temperature monitoring data, thermal input and off-gas concentrations. The confirmation sampling described below will be performed in approximately the same manner each time.

The areas of soil determined to exceed the TCE cleanup objective of 10 mg/kg in the unsaturated zone and 100 mg/kg in the saturated zone will undergo TCH treatment as identified in Attachment A and Figure 5.2-1. After the contractor has heated the soils within the treatment volume or subarea(s) of the treatment volume to at least 70^{o} C for a duration of time sufficient to document a significant increase and dissipation of vapor emissions from that area/subarea, SMA will begin initial confirmation sampling.

Confirmation sampling points will be located as far from the TCH heater well as possible, in the most difficult portion of the soil within the remediation volume to heat. These sample locations are generally located at the center point of each triangle formed by three TCH heater wells, where temperature monitoring points are also typically located. A review of Figure 5.3-1 indicates that there will be approximately 227 total potential confirmation sampling locations within the 302 TCH wells array installed across the various treatment volumes. CMW will perform confirmation sampling at 30% of the total potential sample locations (68 locations). This indicates that there will be approximately a total of be the following number of heater wells and potential confirmation sampling points in each of the three areas:

Area of Remediation	Number of TCH Wells	Potential Confirmatory Sampling Points
Former Plating Depart Area	15	9
Shipping/Receiving Area	167	128
Rail Spur Area	57	41
#3 Degreaser Area	25	15
City Property – Gray Street	38	34
TOTAL	302	227

CMW will perform unbiased confirmation sampling at 25% of the total potential confirmation sampling points. To perform this confirmation sampling in an unbiased manner, the potential sampling points will be numbered, and a random number generator will be used to identify which locations are utilized for confirmation sampling. This will result in the following number of unbiased confirmation sampling points in each of the five treatment areas:

Area of Remediation	Unbiased Sampling Points
Former Plating Depart Area	2
Shipping/Receiving Area	32
Rail Spur Area	10
#3 Degreaser Area	4
City Property – Gray Street	9
TOTAL	57

In addition, CMW will perform biased confirmation sampling at 5% of the total potential confirmation sampling locations occurring across the five treatment areas. SMA and the IDEM will determine the location of the biased sampling points based on the unbiased sampling locations identified. It is currently expected that each of the areas will include the following number of biased confirmation sampling points (the resulting total number of points is 69 due to a biased sample being added to the Former Plating Department area):

Area of Remediation	Biased Sampling Points
Former Plating Depart Area	1
Shipping/Receiving Area	6
Rail Spur Area	2
#3 Degreaser Area	1
City Property – Gray Street	2
TOTAL	12

Confirmation soil borings will either be performed by hollow-stem augur with split-spoon sampling or by direct push with a similar diameter sampler. Confirmation sampling will be performed in the following manner:

1. The heat to the TCH well field will be turned off for 48-hours prior to the start of confirmation sampling.

2. Split spoon sampling will be performed. It is anticipated that 2-1/4 ID augers or direct push methods will be utilized to minimize the volume of soil cuttings generated during the confirmation sampling.

3. Upon acquisition of the soil sample, the split spoon will be opened as soon as possible; the lower six inches of each one-foot interval will be immediately labeled, wrapped in aluminum foil, and placed in a cooler with ice. The temperature of the upper six inches of each one-foot interval will be recorded using a meat thermometer and then placed in a labeled Ziploc bag for PID headspace analysis.

4. Samples placed in Ziploc bags will be allowed to sit for at least one hour prior to headspace analysis with the PID. The results of the headspace analysis will be recorded in the field logbook and/or on boring logs.

5. At the completion of each confirmation sampling boring, the six-inch interval that exhibits the highest PID headspace measurement within each ten-foot depth interval will be selected for laboratory analysis. The corresponding six-inch interval (from the original one-foot interval) being held on ice in the cooler will be prepared using EPA method 5035A for submittal for VOC analysis by EPA method 8260B.

6. In the instance that a boring ends before completing the next 10-foot section, say for instance at 46 feet, then the highest PID headspace measurement from 40 to 46 feet will be selected for laboratory analysis.

7. All confirmation sample borings will be terminated at the depth of heating within that treatment volume subarea.

5.3.3.1 Saturated Zone Soil Confirmation Sampling

Once confirmation sampling analytical results are obtained, the data will be reviewed to determine compliance with the cleanup objectives of a TCE concentration less than 10 mg/kg in the unsaturated zone and a TCE concentration of less than 19 mg/kg in the saturated zone area that was greater than 100 mg/kg prior to treatment. If analytical results indicate that TCE concentrations in a given *saturated zone* sample are less than the cleanup objective, the entirety of the 10-foot interval from which the sample came will be considered to have met the cleanup objective and further sampling from that 10-foot depth, saturated zone interval at that boring location will not be performed again during subsequent sampling at that location. At any borings where any intervals exceed the 19 mg/kg TCE saturated zone cleanup standard, those locations and intervals will be sampled again during the next round of confirmation sampling. When necessary, additional confirmation sampling at the same location will be performed by sampling two to three feet away from the previous sample location.

5.3.3.2 Unsaturated Zone Soil Confirmation Sampling

Due to the potential for TCE during heating within the saturated zone to be mobilized and condensed within the unsaturated zone, additional confirmation sampling within the unsaturated zone will occur during each sampling event within the saturated zone. The final sampling of the unsaturated zone will correspond to the final sampling within the saturated zone at that location where the entirety of the saturated zone is demonstrated to have achieved the 19 mg/kg cleanup objective. The unsaturated zone sample acquired during this sampling event will then need to be less than the 10 mg/kg cleanup objective.

Since the saturated zone at the Former Plating Department will not be heated, the special provisions related to sampling within the unsaturated zone within this section do not apply to this treatment area.

5.4 INTERIM REMEDIATION SCHEDULE

The timeline for the TCH remediation completion from the notice to proceed is provided as Figure 5.4-1.

6.0 GROUNDWATER MONITORING PLAN

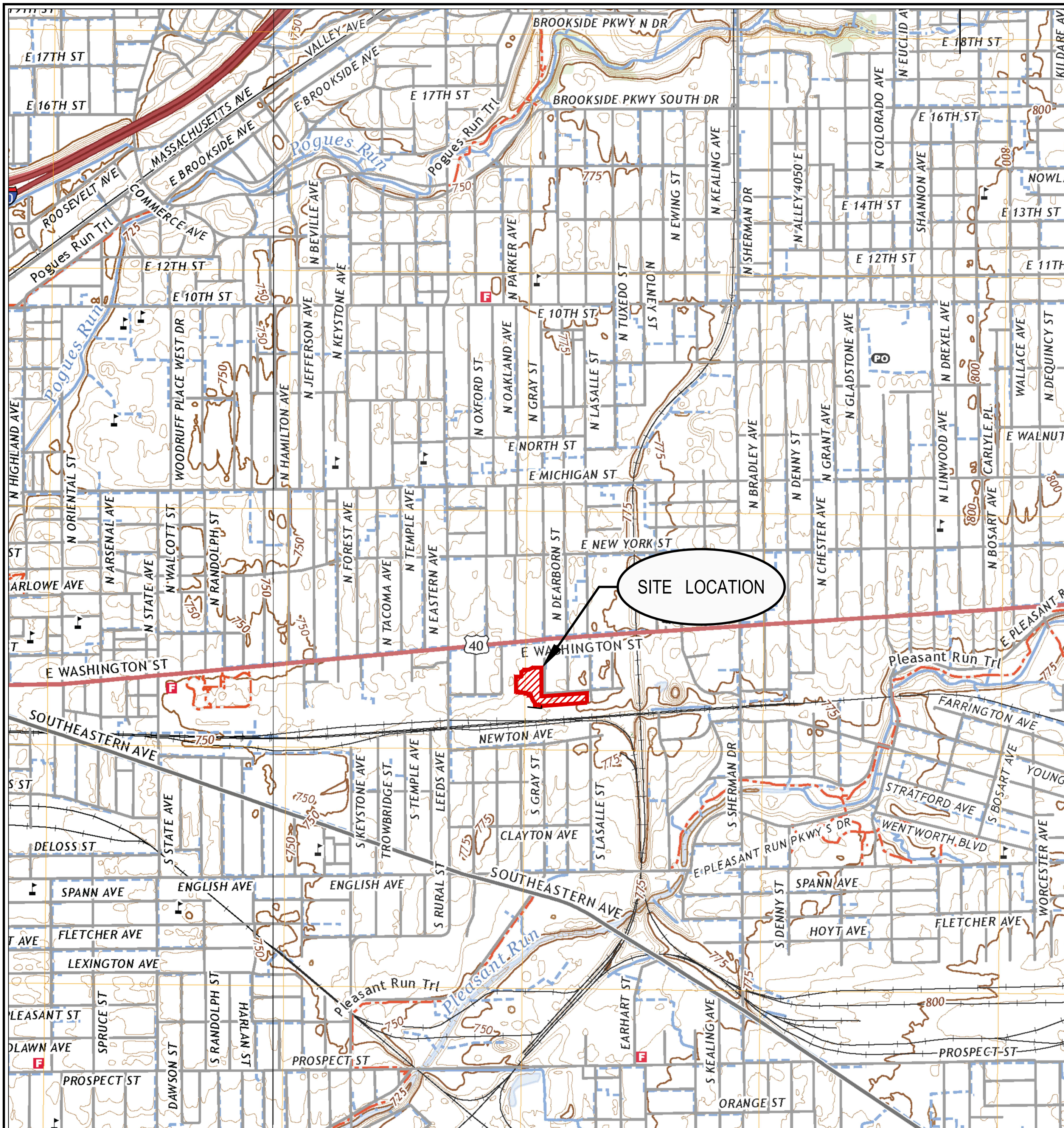
After completion of the TCH remediation of the source areas at the Site, the replacement monitoring wells for the abandoned wells PRMW-7, CMW-4, CMW-17, CMW-3, CMW-6 and CMW-8 will be reinstalled. These wells will be constructed of stainless steel to avoid the potential for PVC wells being compromised by the subsurface temperatures. These replacement monitoring wells will be surveyed for x, y and z coordinates.

There will be an equalization period of three-months after the completion of the TCH remediation before the monitoring wells at the CMW Site are sampled. Depending on the temperature of the groundwater within the wells, the sampling will be performed through use of passive diffusion bags (PDBs) similar to previous events and will include wells:

CMW-3	CMW-4	CMW-5	CMW-6	CMW-8	CMW-9
CMW-15	CMW-16	CMW-17	PRMW-2	PRMW-3	PRMW-7
PRMW-8	PRMW-9	PRMW-14	PRMW-15	PRMW-16	PRMW-19

If the groundwater is determined to be still too hot after three months completion of the TCH system for PDBs to be used, stainless steel bailers will likely be used for sampling the wells. After this first post TCH remediation groundwater sampling event, CMW will review the data and propose the schedule for remaining sampling events.

FIGURES



QUADRANGLE LOCATION

Scale 1:24000

0 1/2 1 MILE

1000 0 1000 2000 3000 FEET

(SOURCE OF MAP IS USGS 7.5 MINUTE QUADRANGLE MAP, BURLINGTON (2019), NORTH CAROLINA)

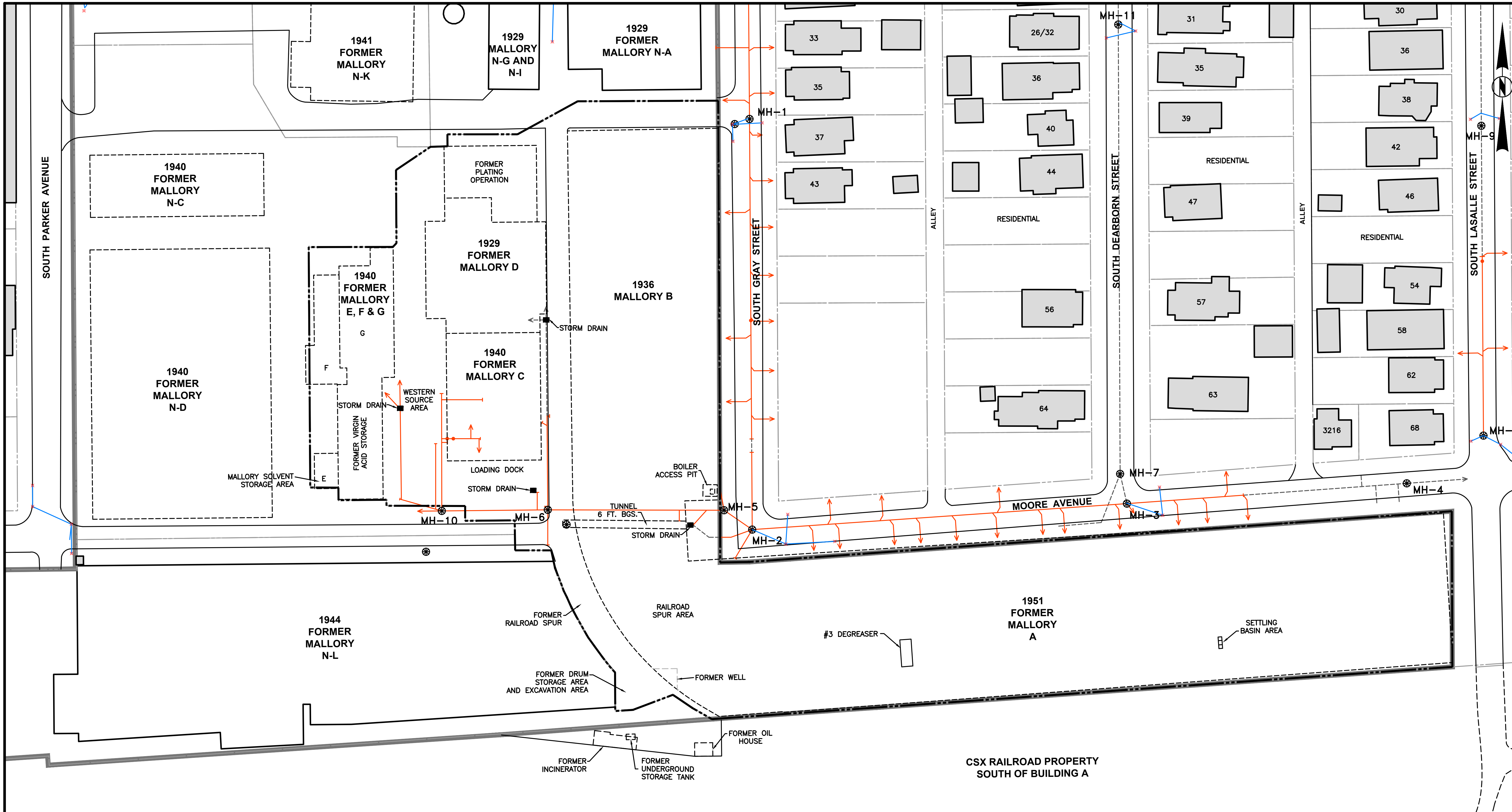
CHECK BY	RBS
DRAWN BY	OS
DATE	6-25-24
SCALE	AS SHOWN
CAD NO.	16012
PRJ NO.	CQ167012

SITE LOCATION MAP

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
ST. JOHN-MITTELHAUSER & ASSOCIATES
A Terracon COMPANY

FIGURE
1.0-1



LEGEND

- CMW PROPERTY BOUNDARY
- P.R. MALLORY LEGACY PROPERTY BOUNDARY
- 52 RESIDENTIAL HOME AND ADDRESS
- FORMER BUILDING
- MANHOLE
- COMBINED STORM AND SANITARY SEWER
- CURB DRAIN CONNECTIONS TO COMBINED SEWER

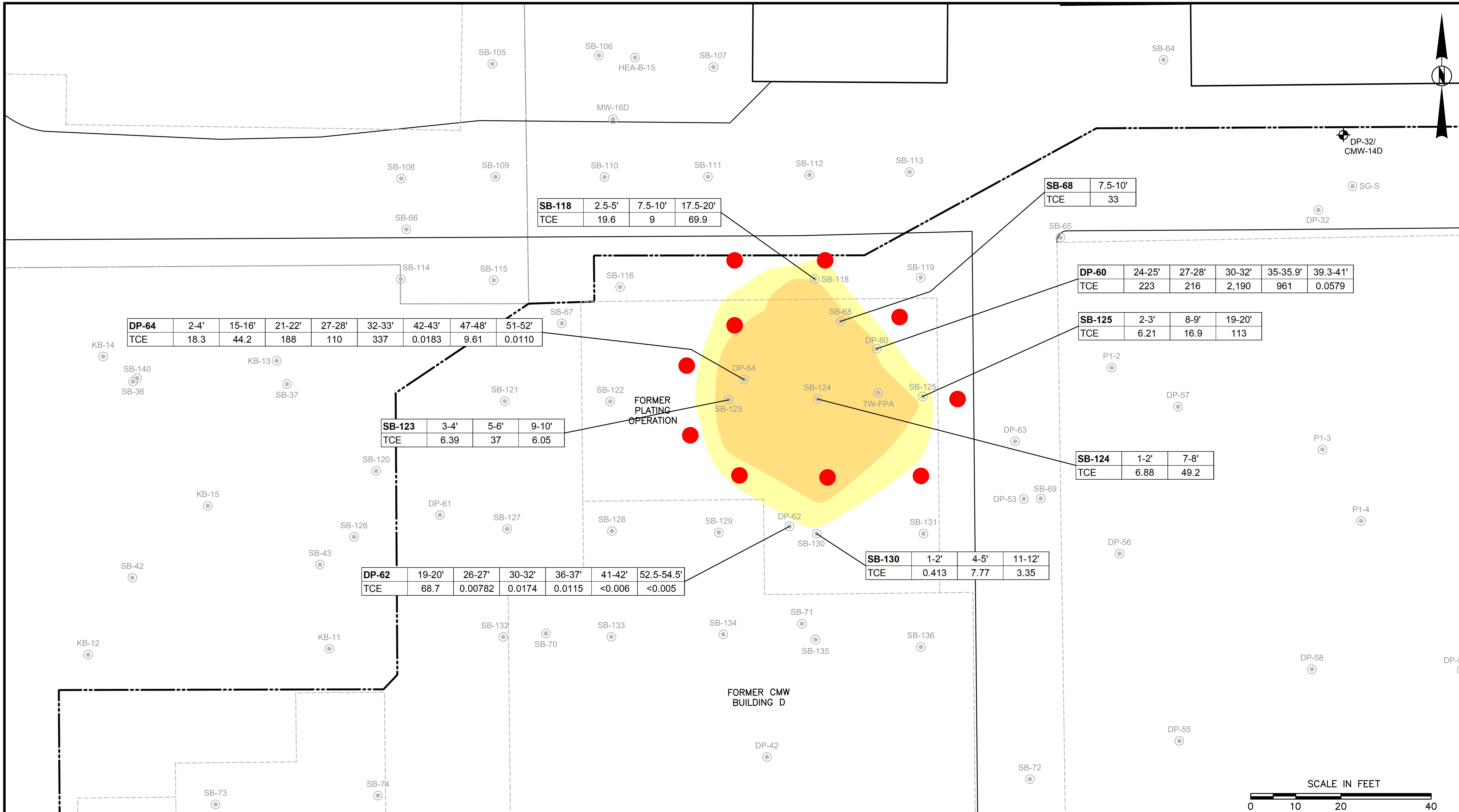
CHECK BY	RS
DRAWN BY	OS
DATE	6-25-24
SCALE	AS SHOWN
CAD NO.	CQ167012B[4G2]
PRJ NO.	CQ167012

IDENTIFICATION AND DEVELOPMENT DATE OF BUILDINGS AT CMW

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
ST. JOHN - MITTELHAUSER & ASSOCIATES
A Terracon COMPANY

FIGURE
1.4-1



LEGEND

- CMW PROPERTY BOUNDARY
- MONITORING WELL LOCATION
- PREVIOUS SOIL BORING
- DATA GAP
- FORMER BUILDING

CHECK BY	RBS
DRAWN BY	OS
DATE	6–25–24
SCALE	AS SHOWN
CAD NO.	CQ167012C[6E10]
PRJ NO.	CQ167012

FORMER PLATING DEPARTMENT SOIL BORINGS, SOURCE AREA & DATA GAP BORINGS

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
ST. JOHN - MITTELHAUSER & ASSOCIATES
A Terracon COMPANY

FIGURE
4.6–1

Notes:

Graphic Scale

60 0 30 60 120

(In Feet)

1 inch = 60 ft.

APPROVED	DATE	The Environmental Remediation Group A Division of CES	
DRAWN RD	05/01/24	TITLE CMW ISTR Project - Indianapolis, IN	
CHKD RD	05/03/24	SIZE 11x17	DWG NO. Wellfield Layout Summary Drawing
APVD RD	05/29/24	SCALE NA	UNITS: NA SHEET 1 OF 1

CHECK BY	RS
DRAWN BY	OS
DATE	6-21-24
SCALE	AS SHOWN
CAD NO.	CQ167012B[4I]
PRJ NO.	CQ167012

IN-SITU TCH REMEDIATION WELLS & PROCESS PIPING

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
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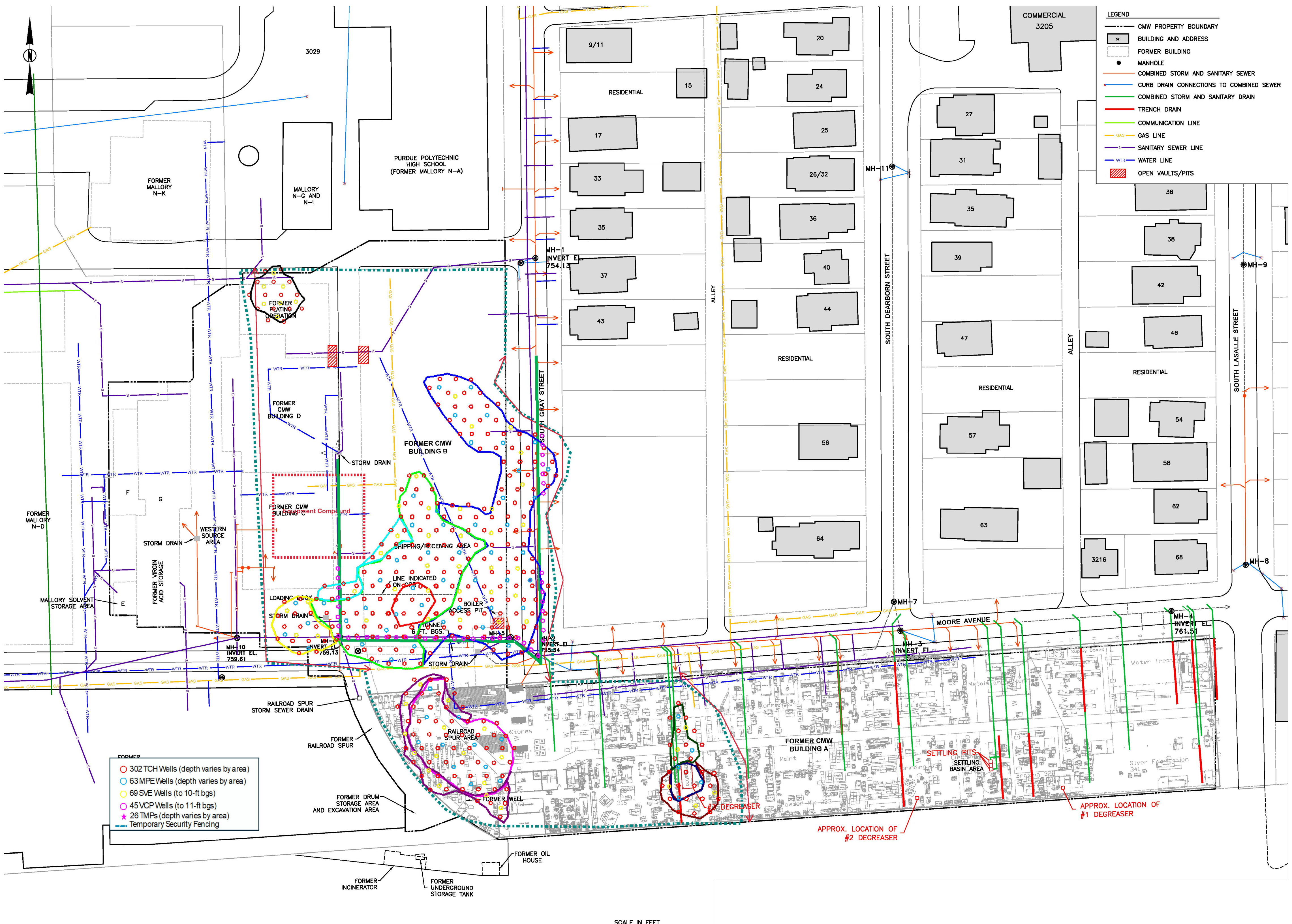
FIGURE
5.2-1



CHECK BY	RS
DRAWN BY	OS
DATE	6-21-24
SCALE	AS SHOWN
CAD NO.	CQ167012B[4I]
PRJ NO.	CQ167012

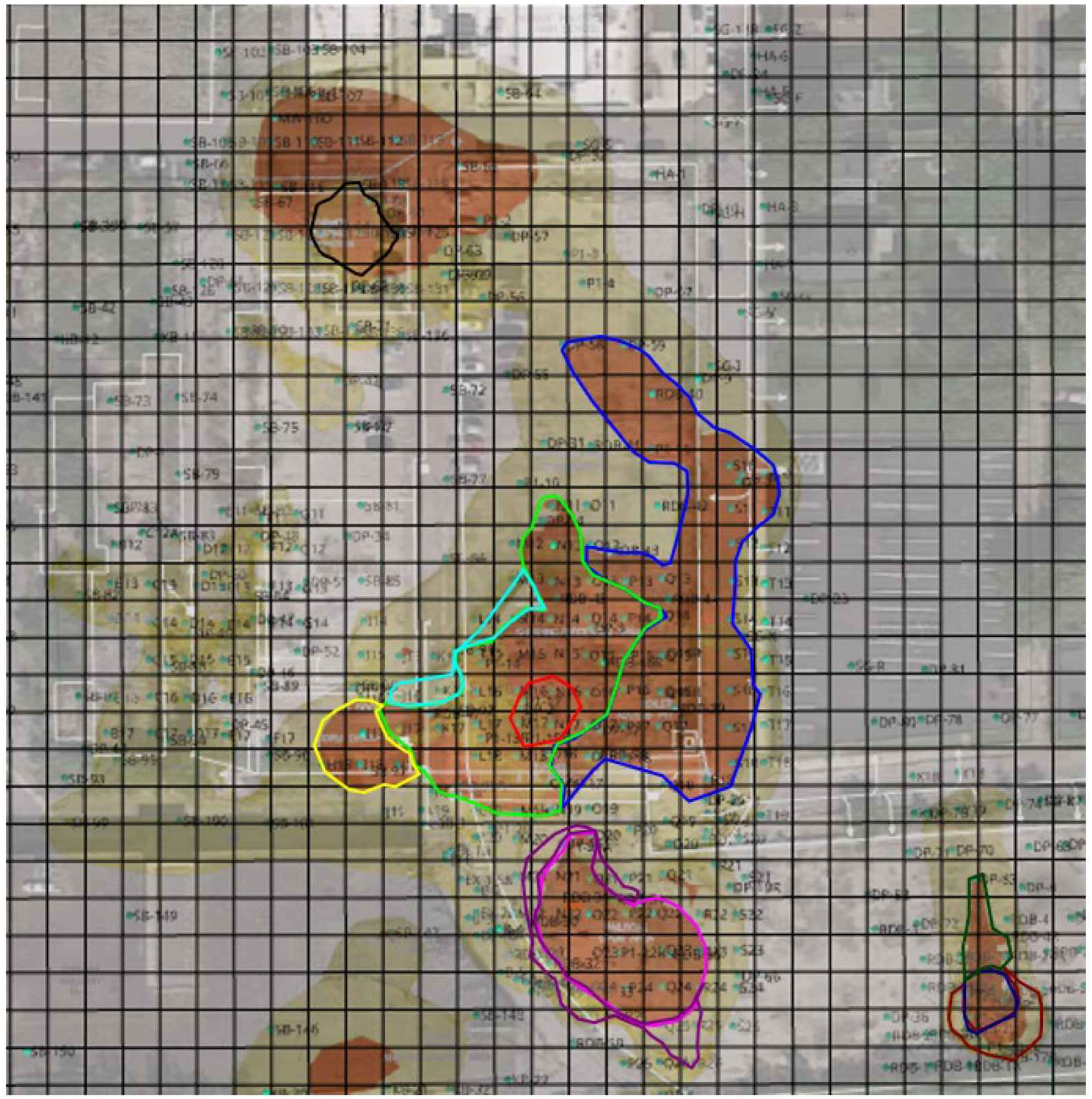
FENCE LOCATION AROUND THE CMW IN-SITU THERMAL REMEDIATION

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A ST. JOHN-MITTELHAUSER & ASSOCIATES A Terracon COMPANY

FIGURE 5.2-2

Target Treatment Zone



ERG's Basis of Deisgn						
Location	**Area color on TTZ Overview Drawing**	**Top of Contamination**	**Bottom of contamination**	**Area ((Ft2)**	**TTZ Volume**	**Heated Volume**
	Blue	5	22	14,474.0	10,185.4	12,865.8
	Green	0	26	10,000.0	9,629.6	11,481.5
	Light Turquoise	0	10	1,005.0	372.2	558.3
	Yellow	8	18	1,746.0	776.0	1,099.3
Shipping Receiving	Red	0	32	971.0	1,150.8	1,330.6
	Purple	0	10	1,903.0	704.8	1,057.2
Rail Spur / Loading Dock	Pink	0	20	5,468.0	4,050.4	5,063.0
Former Plating Operations	Black	0	11	1,495.0	609.1	885.9
	Dark Green	10	20	790.0	351.1	497.4
	Dark Blue	0	20	700.0	518.5	648.1
Degreaser #3	Dark Red	0	12	1,077.0	478.7	678.1
Total				39,629.0	28,826.6	36,165.3

CHECK BY	RS
DRAWN BY	OS
DATE	6-21-24
SCALE	AS SHOWN
CAD NO.	CQ167012B[4I]
PRJ NO.	CQ167012

TREATMENT ZONES, DEPTHS AND VOLUMES OF TCH REMEDIATION

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
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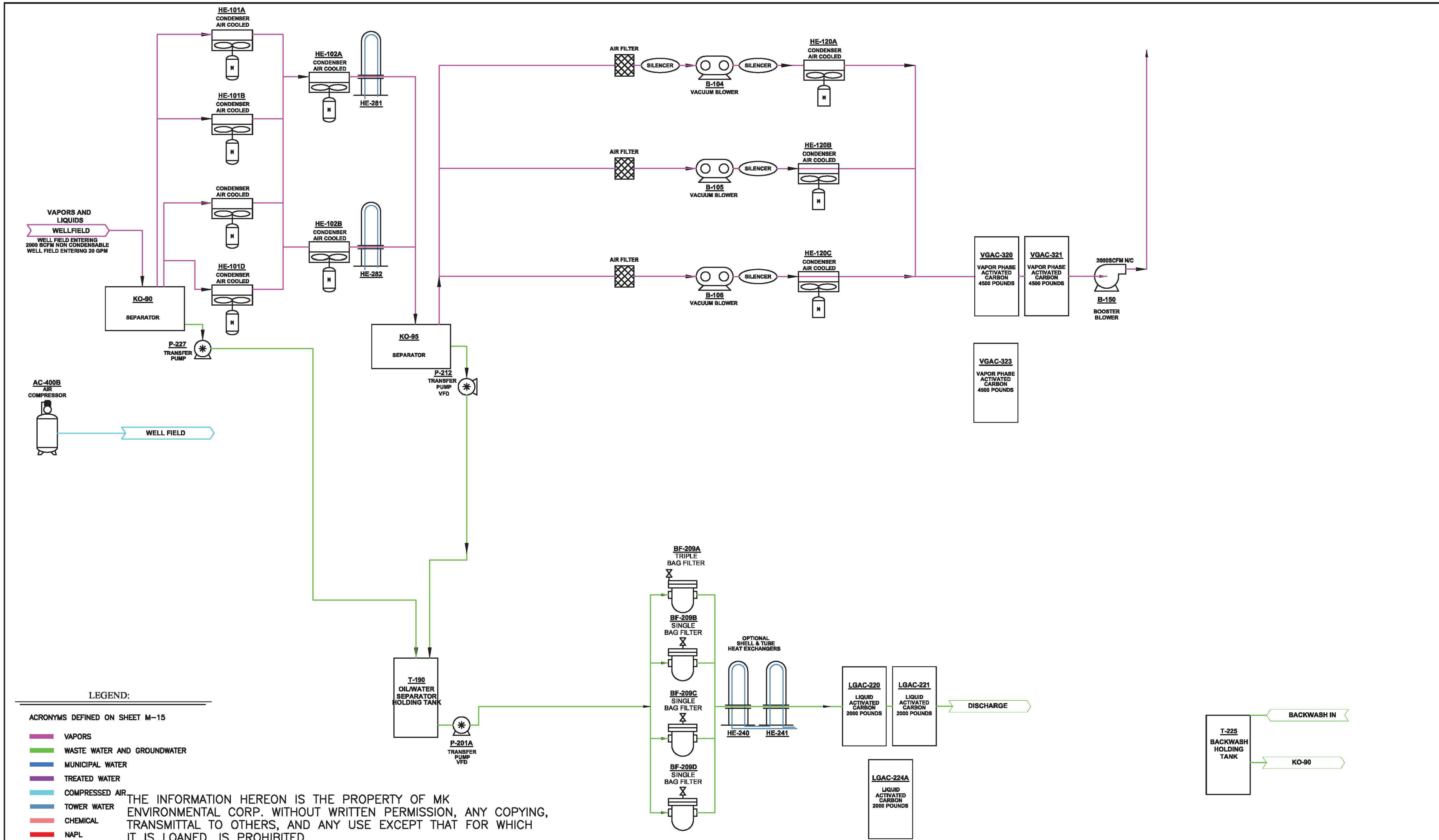
A Terracon COMPANY

FIGURE
5.2-3



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SCALE:	JOB:
NONE	224523
DESIGNED: EHT	CHECKED BY: EHT
DRAWN BY: EHT	DRAWN DATE: 03/12/2024

MK ENVIRONMENTAL INC.

PROCESS FLOW DIAGRAM
WATER AND VAPOR
TREATMENT SYSTEM

ERG
70 SOUTH GRAY STREET
INDIANAPOLIS, IN

No.	DATE:	BY:	REVISION:

FIGURE NUMBER
M-1

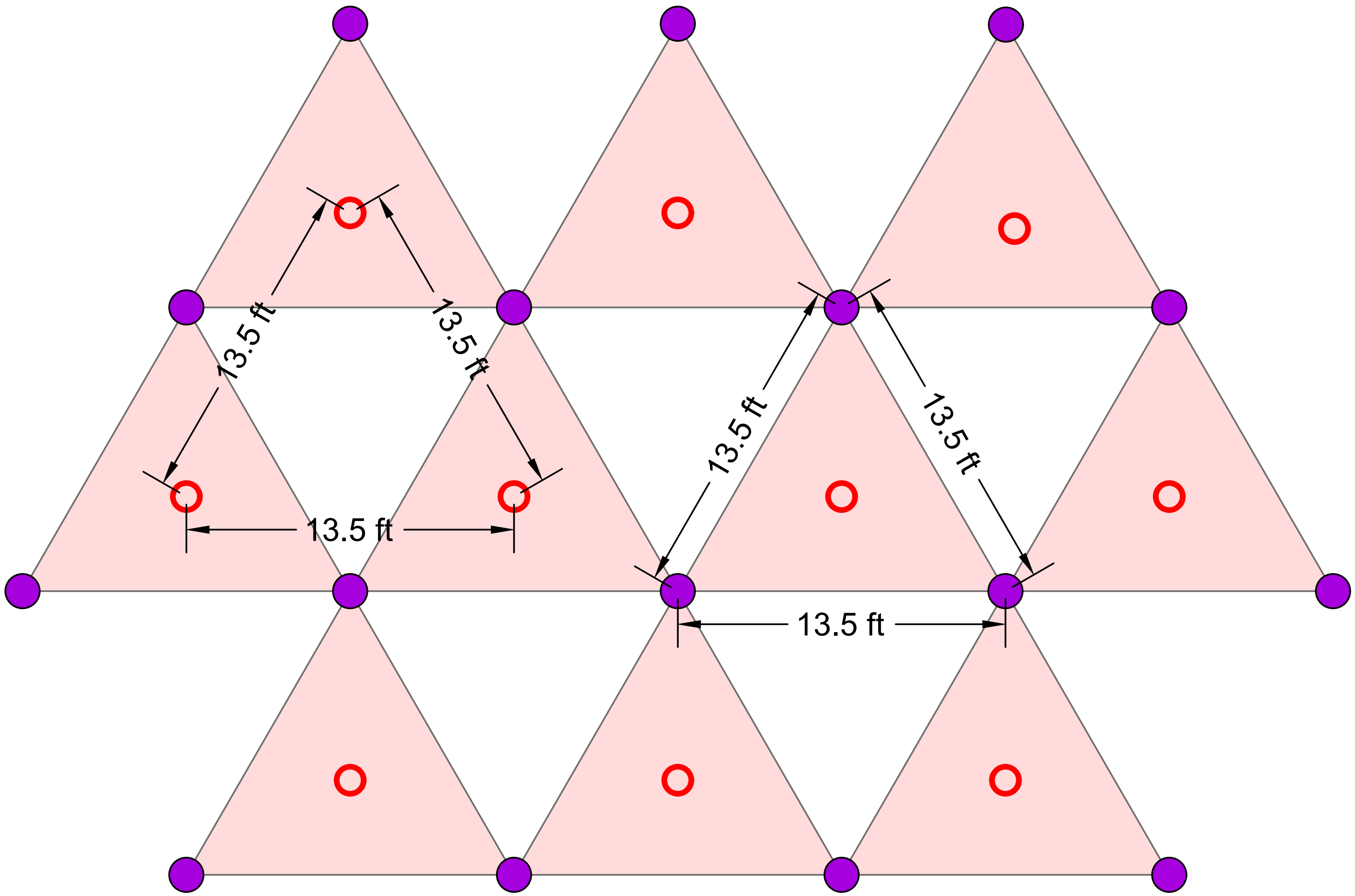
CHECK BY	RS
DRAWN BY	OS
DATE	6–21–24
SCALE	AS SHOWN
CAD NO.	CQ167012B[4I]
PRJ NO.	CQ167012

TCH REMEDIATION PROCESS FLOW DIAGRAM

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
ST. JOHN · MITTELHAUSER & ASSOCIATES
A Terracon COMPANY

FIGURE
5.2–4



LEGEND

- CONFIRMATION SAMPLE LOCATION
- TCH HEATER WELL

CHK BY	RBS
DWN BY	OS
DATE	6-24-24
SCALE	AS SHOWN
CAD NO.	CQ167012C[6E11]
PRJ NO.	CQ167012

REPRESENTATIVE LAYOUT OF POSSIBLE CONFIRMATORY SOIL SAMPLING LOCATIONS

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

SM&A
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A Terracon COMPANY

FIGURE
5.3-1

CHECK BY:	RBS
DRAWN BY:	OS
DATE:	6-24-24
SCALE:	AS SHOWN
CAD NO.:	CQ167012B[12]
PRJ NO.:	CQ167012

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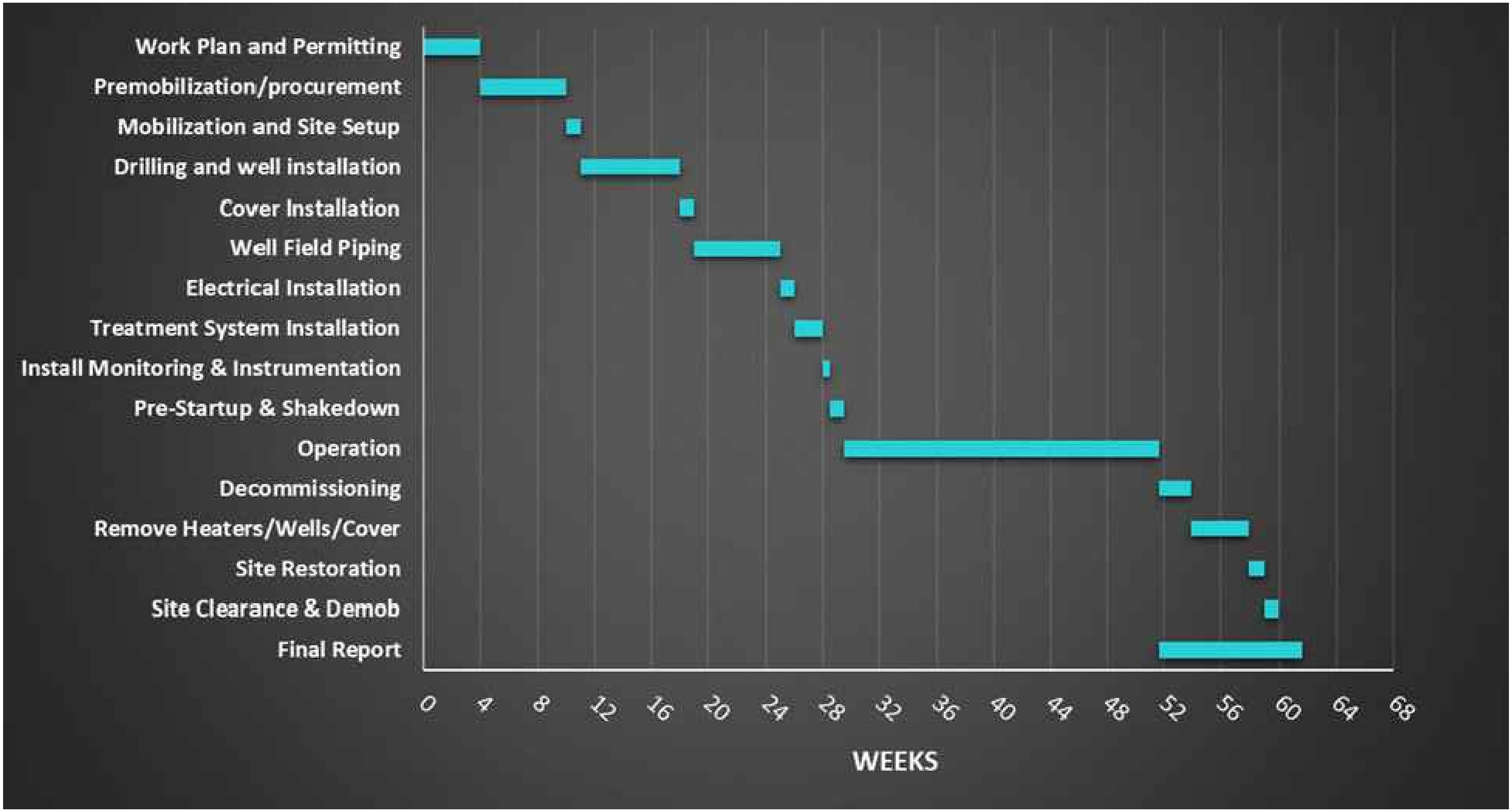
A Terracon COMPANY

POSSIBLE CONFIRMATORY SOIL SAMPLING LOCATIONS

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

FIGURE
5.3-2



CHK BY	RBS
DWN BY	OS
DATE	6-24-24
SCALE	AS SHOWN
CAD NO.	CQ167012C[6E11]
PRJ NO.	CQ167012

CMW ISTR PROJECT SCHEDULE (WEEKS)

CONTACT METALS WELDING
70 SOUTH GRAY STREET
INDIANAPOLIS, INDIANA

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A Terracon COMPANY

FIGURE
5.4-1

ST. JOHN - MITTELHAUSER & ASSOCIATES
A Terracon COMPANY

TABLES

TABLE 1.2-1
Constituents for Which CMW Seeks a Covenent Not to Sue
CMW / Indianapolis, Indiana

COMPOUNDS
Volatile Organic Compounds
Acetone
MEK
Carbon Tetrachloride
cis-1,2-DCE
1,1-DCA
1,1-DCE
Ethylbenzene
Isopropylbenzene
p-Isopropyltoluene
2-Methylnaphthalene
Naphthalene
n-Propylbenzene
PCE
sec-Butylbenzene
tert-Butylbenzene
Toluene
Trans-1,2-DCE
1,1,1-TCA
TCE
1,2,4-TMB
1,3,5-TMB
Vinyl Chloride
Chlorobenzene
Chloroethane
m/p Xylene
Dibromomethane
1,2-Dichloropropane
Methylene Chloride
Chloroform
1 -Methylnaphthalene
1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloro-1,2,2-trifluoroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichloropropene
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (EDB)

TABLE 1.2-1
Constituents for Which CMW Seeks a Covenent Not to Sue
CMW / Indianapolis, Indiana

COMPOUNDS
Volatile Organic Compounds
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloroethene (Total)
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,3-Dichloropropane
1,4-Dichlorobenzene
1,4-Dioxane
2,2-Dichloropropane
2-Butanone
2-Chloroethyl Vinyl Ether
2-Chlorotoluene
2-Hexanone
2-Methylnaphthalene
4-Chlorotoluene
4-Methyl-2-Pentanone
Acetone
Acrolein
Acrylonitrile
Benzene
Bromobenzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon Disulfide
Carbon Tetrachloride
Chlorobenzene
Chlorobromomethane
Chlorodibromomethane
Chloroethane
Chloroform
Chloromethane
Chloroprene
Cis-1,2-Dichloroethene
Cis-1,3-Dichloropropene
Cyclohexane
Dibromomethane
Dichlorodifluoromethane
Ethyl Acetate
Ethyl Methacrylate
Ethylbenzene
Hexachlorobutadiene
Hexane

TABLE 1.2-1
Constituents for Which CMW Seeks a Covenent Not to Sue
CMW / Indianapolis, Indiana

COMPOUNDS
Volatile Organic Compounds
Iodomethane
Isopropylbenzene
m,p-Xylenes
Methyl Acetate
Methyl Tert-Butyl Ether (MTBE)
Methylcyclohexane
Methylene chloride
m-Xylene
Naphthalene
n-Butanol
n-Butylbenzene
n-Propylbenzene
O-Xylene
p-Isopropyltoluene
sec-Butylbenzene
Styrene
tert-Butylbenzene
Tetrachloroethene
Toluene
Total Xylenes
Trans-1,2-Dichloroethene
Trans-1,3-Dichloropropene
trans-1,4-Dichloro-2-butene
Trichloroethene
Trichlorofluoromethane
Vinyl Acetate
Vinyl Chloride

TABLE 4-1

Volumes and Mass of TCE Impacted Soil Within the Unsaturated and Saturated Zones at CMW
CMW / Indianapolis, Indiana

Volumetrics - TCE - 10 mg/kg - Unsaturated				
Location	**Total Soil Volume Cubic Yards**	**Total Soil Mass Kilograms**	**Total Chemical Mass Kilograms**	**Confidence Level %**
#3 Degreaser	501	708,430	41	80
South Gray Street - On Site Included	81	114,680	2	80
South Gray Street - Off Site	--	--	--	80
Shipping/Receiving	1,959	2,770,500	94	80
CMW Building C	122	172,300	4	80
Plating Operation	413	584,660	17	80
Rail Spur	1,469	2,078,100	106	80
Western Source Area	75	105,620	2	80
Total without Plating	4,206	5,949,630	250	
Total	4,620	6,534,290	267	

*Using volumetric module of entire plume
*Volumes ABOVE groundwater surface to soil surface

Volumetrics - TCE - 100 mg/kg - Saturated				
Location	**Total Soil Volume Cubic Yards**	**Total Soil Mass Kilograms**	**Total Chemical Mass Kilograms**	**Confidence Level %**
#3 Degreaser	128	181,510	44	80
South Gray Street - On Site	2,167	3,064,500	980	80
South Gray Street - Off Site	812	1,149,000	404	80
Shipping/Receiving	1,873	2,649,400	436	80
CMW Building C	379	536,510	157	80
Plating Operation	2,836	4,010,800	1,629	80
Rail Spur	995	1,407,400	294	80
Western Source Area	0.04	50	0.01	80
Total without Plating	6,355	8,988,370	2,315	
Total	9,190	12,999,170	3,944	

*Using volumetric module of entire plume
*Volumes BELOW groundwater surface

ATTACHMENT A

3D VISUALIZATION

ATTACHMENT A

This attachment includes link to a 3D visualization file and a web site that hosts the viewer to allow the visualization to open and be reviewed. The 3D visualization may be rotated and tilted to view the volume from nearly any angle outside of the volume. Right click on the URL below and then left click on "open hyperlink" to go to the web site and open the viewer. This viewer must be opened first.

https://viewer.ctech.com/

Once the viewer web site above is opened, click on the OneDrive link below that is the 3D visualization and download that 9 MB file to your local drive:

CMW - Visualization

Once you have the 3D visualization file above downloaded to your local drive, you can click and drag the file into the CTech viewer you already have open and the visualization will automatically open.

Helpful Operating Procedures for Viewing the 3D Picture in Sketch Fab

Using a Mouse:
Rotate: Hold Left Mouse Button and Move Mouse
Pan: Hold Right Mouse Button and Move Mouse
Zoom: Scroll Wheel

Using a Trackpad and Keyboard:
Rotate: Hold Left Button and Move Finger on Trackpad
Pan: Hold Right Button and Move Finger on Trackpad
Zoom: Hold Ctrl + Left Button and Move Finger on Trackpad

Shortcuts:
F = Fullscreen
K = See next point of interest
J = See previous point of interest

To View/Hide Additional Features Within the 3D Visualization

Locate and click on the three, small, horizontal bars in the upper left-hand corner of the visualization. This will open a menu that provides a variety of options for the reviewer to choose from by simply clicking on that option. These options open to reveal more options and all are toggles that turn the option on or off. The reviewer is encouraged to review the options available to gain a better understanding of the 3D visualization. Note: The surface topography of the visualization and the combined sewer north of manhole #2 are still a work in progress.

ATTACHMENT B

COMMUNITY RELATIONS PLAN

COMMUNITY RELATIONS PLAN

This Plan has been prepared by St. John - Mittelhauser & Associates, Inc., a Terracon Company of behalf of the former Contact Metals Welding, for the facility located at 70 South Gray Street, Indianapolis, Indiana. The organization and content follows the guidelines described in the IDEM Non-rule Policy Document, WASTE-0049-NPD, dated April 20, 2001.

1.0 Identify all property owners and property occupants, which include property owners or occupants affected or likely to be affected by the contamination that is the subject of the proposed Voluntary Remediation Project and all owners or occupants of adjacent or closely proximate land.

Any property owners or property occupants that may potentially be affected by the proposed remedial activities for this Voluntary Remediation Project will be notified by letter. The notification will include a brief description of the planned activities, some information about thermal conductive heating and the anticipated duration of the project.

2.0 Identify all known or registered neighborhood organizations serving the location of the Voluntary Remediation Project, if any.

East Downtown Indianapolis Neighborhoods Inc
Sarah Goldblatt
1114 N Bancroft St
Indianapolis, IN 46201
edineighborhoods@gmail.com

Englewood Neighborhood Association
Matt Hostetler
48 N. Dearborn Street
Indianapolis, IN 46201
E-Mail: hostetlermatt@yahoo.com

Englewood Community Development Corp.
Joe Bowling
57 N. Rural Street
Indianapolis, IN 46201
E-Mail: joe.englewood@gmail.com

Near East Area Renewal
Joe Smoker
960 N Rural St
Indianapolis, IN 46201
E-Mail: joe@nearindy.org

Near Eastside Community Organization
Chris Staab
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Indianapolis, IN 46201
E-Mail: nescopresident@gmail.com

Southeast Community Organization
Rachel Cooper
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Indianapolis, IN 46203
E-Mail: secocooper@yahoo.com

Southeast Neighborhood Development, Inc.
Kelli Mirgueax
3230 Southeastern Ave
Indianapolis, IN 46203
E-Mail: send@sendcdc.org

3.0 ***Identify all known or reasonably apparent sensitive community institutions within two (2) miles, including, but not limited to schools, health care facilities, child care facilities, senior citizen residential or care facilities and the administrative office or owner of parks and playgrounds*****.**

Purdue Polytechnic High School, 3029 E Washington St., Indianapolis, IN

The Oaks Academy – Brookside, 3092 Brookside Parkway N. Drive

Paramount Brookside, , 3020 Nowland Avenue,

Little River Catholic School, 1401 N. Bossert Avenue

Brookside School 54, 3150 E. 10th Street

Theodore Potter School 74, 1601 E 10th Street

Paramount Cottage Home, 1203 E. St. Clair Street

Thomas Gregg Neighborhood School IPS #15, 2302 E. Michigan Street

S.t Philip Neri School, 545 Eastern Avenue

Ralph Waldo Emerson School 58, 321 N. Linwood Avenue

Trinity Christian School, 440 St. Peters Street

Escuelas, 328 Dearborn Street

Christian Park School 82, 4700 English Avenue

Invert Learning Hub, 1849 E. Pleasant Run Parkway S Drive

Bethel Park Elementary, 2710 Bethel Avenue

People's Health Care, 2340 E 10th Street

Omni Care Solutions, 3126 E 10th Street

Wishard Linwood Health Care, 4401 E 10th Street

Primary Personal Services, LLC, 55 S. State Avenue

Tiny Blessings Early Learning, 1338 N. Ewing Street

Eat tenth United Method Children and Youth Center, 2327 E. 10th Street

Precious Jewels Child Care, LLC, 601 N. Rural Street

Brighter Minds Learning Center, 301 N. Forest Avenue

Our Little Angels Daycare, 729 N. Grant Avenue

Happy Angels Centro, 627 S. Sherman Drive

Day Early Learning Center at Howe, 4900 Julian Avenue

Small Small World Day Care, 330 St. Peter Street

Many Mirciles Childcare, 1033 S. State Avenue

Indy Stars Bilingual Daycare, 3849 Terrace Avenue

4.0 Include a sample of a written notice to be sent to the property owners and property occupants, neighborhood organizations, and sensitive community institutions

The written notice that will be sent to property owners and property occupants, neighborhood organizations, and sensitive community institutions is provided as Attachment B-1.

5.0 Provide the name(s) and mailing address(es) of all affected local governmental units with jurisdiction within one (1) mile of the property affected by the proposed Remediation Work Plan

City of Indianapolis
200 E. Washington Street
Indianapolis, Indiana 46204

Indianapolis Parks & Rec. Department
200 E. Washington Street
Indianapolis, Indiana 46204

Indianapolis Department of Public Works
2420 East Riverside Drive
Indianapolis, Indiana 46202

Indianapolis School District
120 E. Walnut Street
Indianapolis, Indiana 46204

6.0 *Provide the name(s) and mailing address(es) of the newspaper(s) or other appropriate circulars in which notice of the public comment period will be published*.

As this is only an interim workplan, publication of a legal notice is not needed and will not enhance community relations.

7.0 Identify the location of the public library and other public repositories in which a copy of the proposed Remediation Work Plan will be placed. The proposed Remediation Plan must be placed in the public library closest to the site and in the county or counties affected by the project.

Upon approval of this CIRWP by IDEM, a hard copy of this CIRWP will be place in the library below for public review:

Indianapolis Public Library – East Washington Branch
2822 E. Washington Street
Indianapolis, IN 46201

8.0 In Addition, VRP Participants shall post a sign.

Currently, the CMW site is not enrolled in the VRP program with IDEM. However, the CMW site is in the State Cleanup Program and will comply with the similar policies related to posted signage:

a. Identifies the location as a State Cleanup site.
b. Gives the IDEM State Cleanup site number.
c. Shall meet the following criteria;
    - Be visible/readable from 20 feet.
    - Be in English
d. Shall be posted starting with the end of the public comment period for the CIRWP, before any work begins and remain until the site work is complete.

NOTICE

This notice is being provided to inform you that an environmental cleanup will be occurring in your neighborhood under the oversight of the Indiana Department of Environmental Management (IDEM). This notice is a part of a Community Relations Plan developed by the party performing the cleanup. The Community Relations Plan includes provisions for notifying all neighboring property owners and occupants, neighborhood organizations and other local entities.

An Interim Remediation Work Plan describing the cleanup work has been prepared and submitted to IDEM. If you wish to learn more about the Community Relations Plan and the Interim Remediation Work Plan, you may review the documents in a repository that has been set up at:

Indianapolis Public Library – East Washington Branch
2822 E. Washington Street, Indianapolis, IN 46201

Document name: *Former CMW Property Interim Remediation Work Plan*
State Cleanup Program Site No. 000-00-396

The Interim Remediation Work Plan may also be viewed on IDEM's online file repository at the following link and QR code:

[insert link to work plan on VFC] [insert QR code]

The site is located at 70 S. Gray Street in Indianapolis, Indiana. The site was formerly operated by PR Mallory and Company, a manufacturer of mercury and alkaline batteries, capacitors and timer switches, and Contacts Metals Welding, which manufactured bulk metals and custom and standard metal products.

The site is contaminated with chlorinated volatile organic chemicals (CVOCs). The remedial activities will address CVOC impacts to soil and groundwater at the site. The elevated concentrations of CVOCs in the site soils will be addressed using Thermal Conductive Heating (TCH) and Soil Vapor Extraction (SVE). Additionally, one or more areas will be excavated, and the soils will be disposed of off-site.

The TCH technology uses heater wells to heat soils and vaporize the CVOCs. Once the CVOCs are vaporized in the subsurface, they are captured with a soil vapor extraction system, which is a type of vacuum system. The CVOCs that are removed from the ground via the vapor extraction system will be captured by granular activated carbon. The TCH technology is described in more detail in the Interim Remediation Work Plan. Groundwater at the site is impacted by CVOCs. The extent of contamination has been identified by an extensive network of monitoring wells both on and off the site. The TCH technology will also remove CVOCs from the groundwater.

Comments on the Remediation Work Plan may be addressed to:

Mr. Jeff Kavanaugh / Senior Environmental Manager
IDEM Office of Land Quality
100 N Senate Avenue
Indianapolis, IN 46204
Office - (317) 234-0970
e-mail jkavanaugh@idem.in.gov

Mr. Ron St. John, PHg, LPG
St. John – Mittelhauser & Associates
A Terracon Company
192 Exchange Boulevard
Glendale Heights, IL 60139
Office: (630) 429-8111
email: rons@st-ma.com

ATTACHMENT C

TCH CONTRACTOR PROPOSAL

The Environmental Remediation Group
A Division of CES

Contact Metals Welding - Fixed Firm Price Guaranteed Remediation

Final Design, Approach, & Cost Breakdown For In Situ Thermal Remediation (ISTR)

Detailed Proposal Summary Slides

Tuesday, April 23, 2024

Company Overview

The Environmental Remediation Group (ERG, "The Group") is a recognized leader in the environmental remediation industry. The Group has been at the forefront of remediation technology development and project implementation for over eighteen (18) years. With hundreds of remediation projects successfully implemented around the country using traditional, cutting edge, and combined technologies including; In Situ Thermal Remediation (ISTR), Advanced Bioremediation, Groundwater Recirculation Systems, and Air Movement technologies (SVE, MPE, AS). The Group offers its clients and project stakeholders an unparalleled breadth and depth of expertise in remediation system design and implementation over any other environmental remediation technology provider.

Our Team

Robert D'Anjou

President

Allen Swift

Executive Vice President

Jim Keegan

Chief Financial Officer

Skye Green

VP of Engineering

Danny Baysa

VP of Field Operations

Michael Dodson

Strategic Advisor

The Environmental Remediation Group and its core team members have industry leading experience in the design, construction, and implementation of all three thermal remediation technologies as well as advanced combined in situ remediation strategies.

As a company, we have implemented twenty-one (21) thermal remediation projects. Within our organization, our team of thermal remediation experts have collectively designed, built, and operated 112 different thermal remediation projects using ERH, TCH & SEE as well as 500+ bioremediation, groundwater recirculation, air movement, and combined remedy implementations.

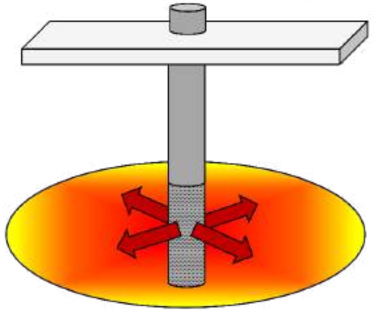
Starting with the very first commercial ISTR projects in the 1990's, our team has been the heartbeat of the thermal remediation industry for over 28-years, designing and implementing some of the most advanced thermal projects ever endeavored, with accolades that include:

- ✓ Seventy-Nine (79) ERH Projects (1995-2020).
- ✓ Twenty-Two (22) TCH projects using electric and fuel based TCH (2016-2024).
- ✓ Ten (10) SEE Projects (2000-2020)
- ✓ Seven (7) highly innovative Combined Remediation Technology projects using ISTR source zone remediation with heat enhanced biotic and abiotic removal and degradation mechanisms.

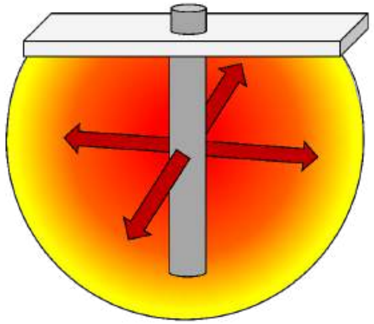
Our Technologies

THERMAL REMEDIATION

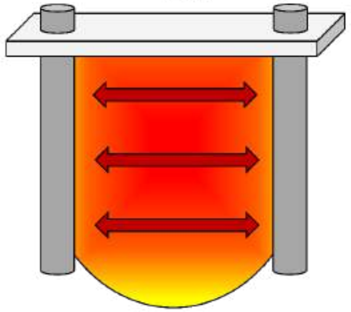
Steam Enhanced Extraction (SEE)



Thermal Conduction Heating (TCH)

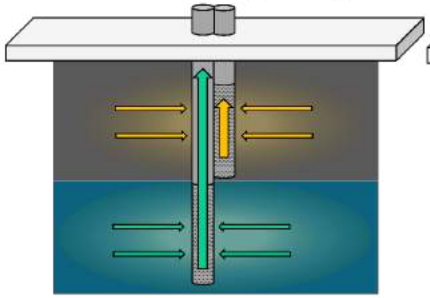


Electrical Resistance Heating (ERH)

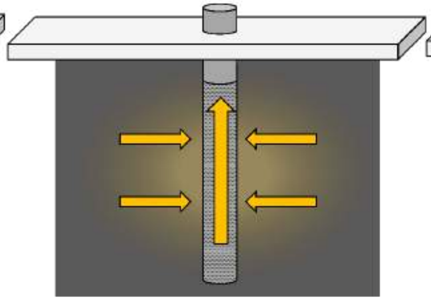


AIR MOVEMENT TECHNOLOGIES

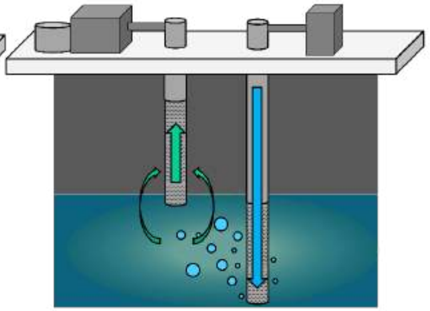
Multi-Phase Extraction (MPE)



Soil Vapor Extraction (SVE)

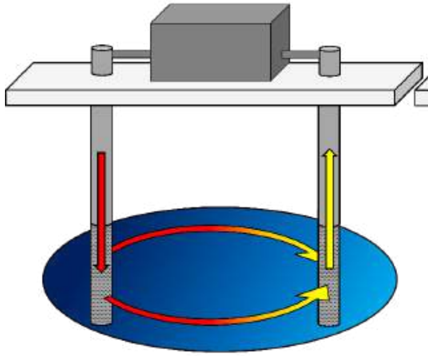


Air Sparging (AS)

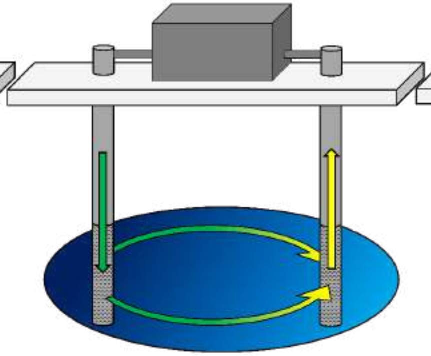


BIOREMEDIATION

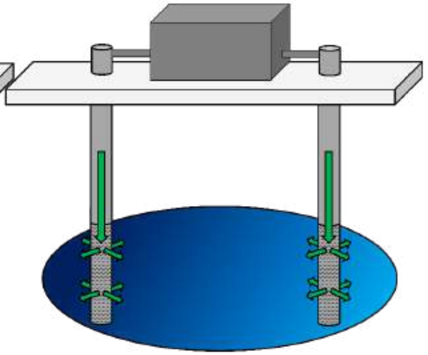
Heat Enhanced Recirculation Systems



Groundwater Recirculation Systems

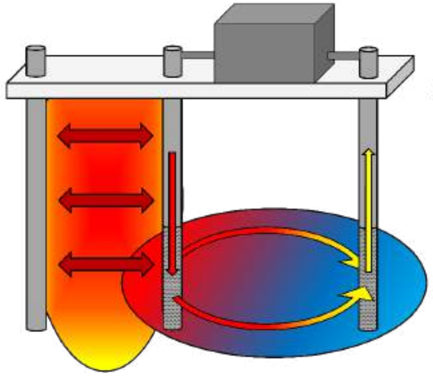


Amendment & Augmentation Injections

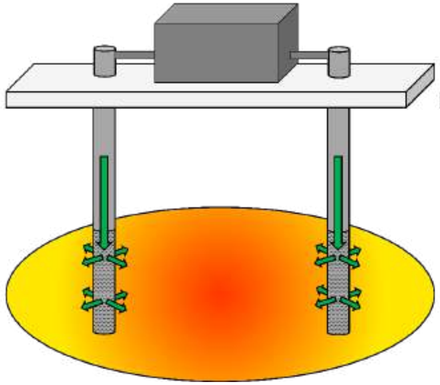


COMBINED REMEDIATION SYSTEMS

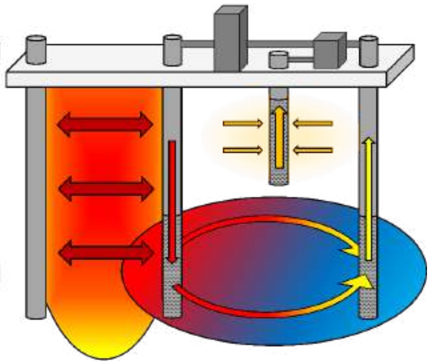
ISTR Source Zone With HERS



Post ISTR Bio-Polishing

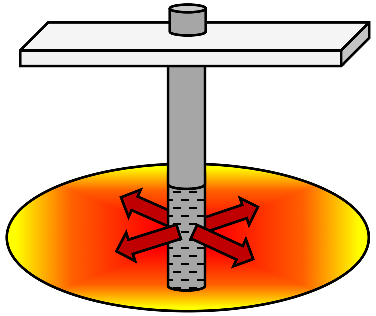


Custom Combined Remediation Strategies

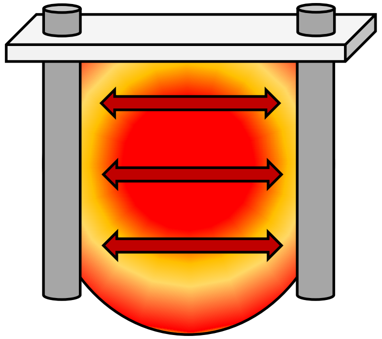


Thermal Remediation Technologies, Temperatures, and Applications

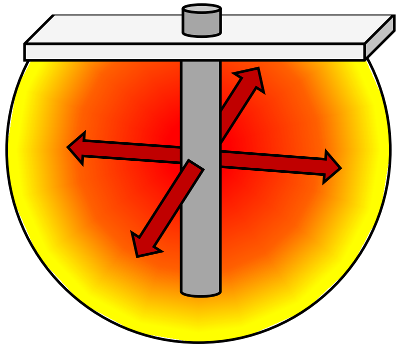
Steam Enhanced Extraction (SEE)

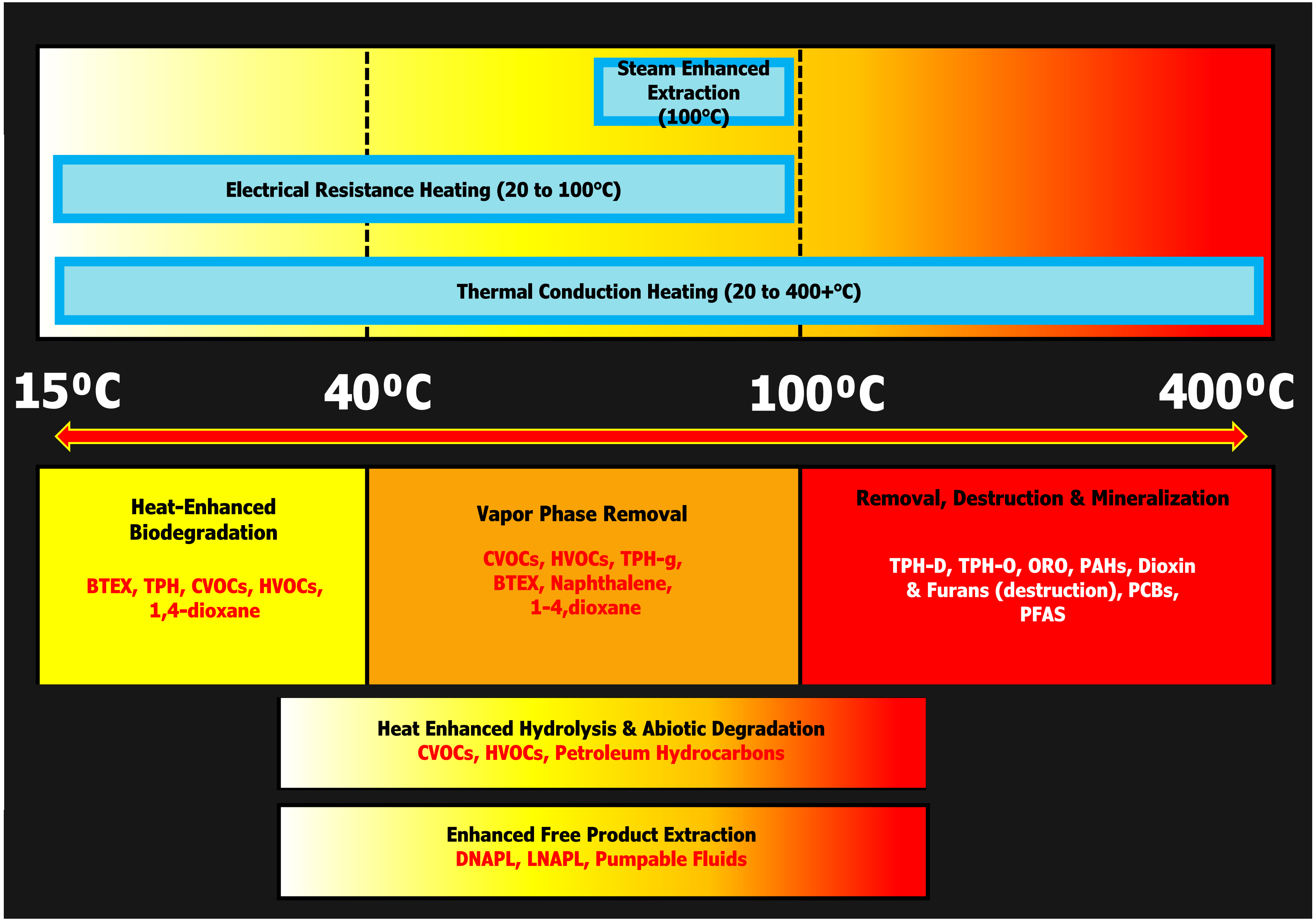


Electrical Resistance Heating (ERH)



Thermal Conduction Heating (TCH)





Site Background

Site Location: **70 South Gray Street, Indianapolis, IN**

Consultant: St. John – Mittelhauser & Associates

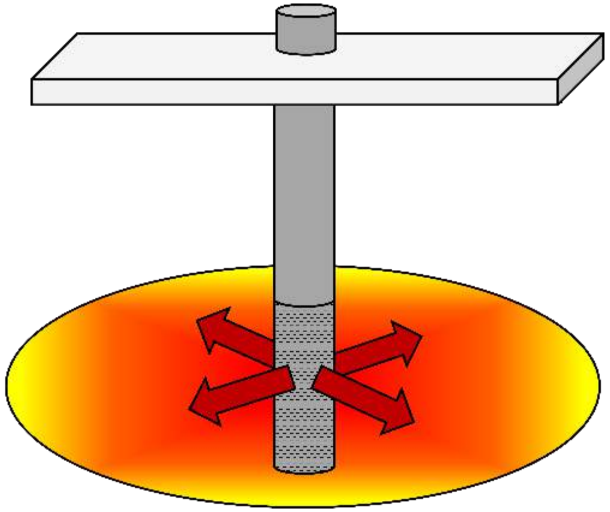
Client: Insurers for Contact Metals Welding (CMW)

Summary of Remedial Objectives: Reduce CVOCs in soil to project cleanup criteria with TCE as driver at 10-mg/kg in Unsaturated Zone and 19-mg/kg in Saturated Zone soils.

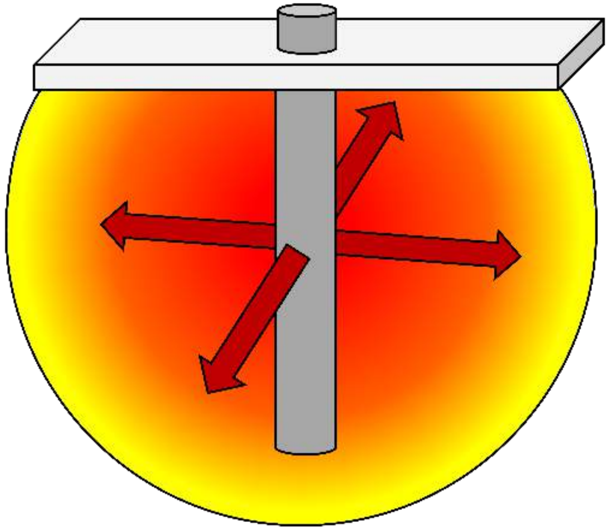
Contaminants of Concern: TCE & Carbon Tetrachloride (PCE, Chloroform, and 111-TCA as minor COCs)

Technology Selection

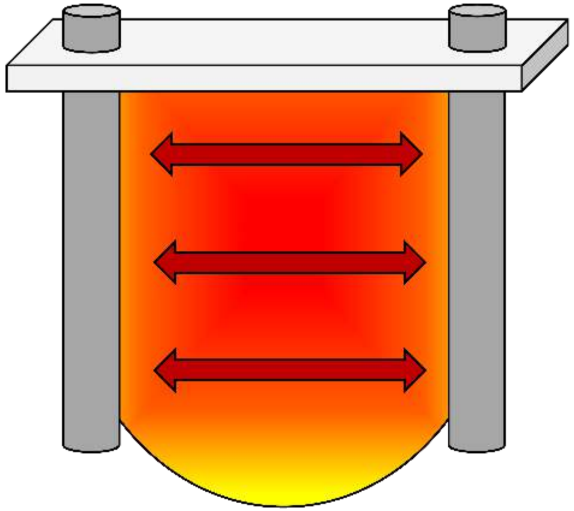
Steam Enhanced Extraction (SEE)



Thermal Conduction Heating (TCH)



Electrical Resistance Heating (ERH)



HETR^{TM} Thermal Conduction Heating

Examples of Similar Sized Project Constructions, Components & Equipment

Wellfield Examples

Vapor Extraction & Treatment System

Technical Approach

Summary of Treatment Approach

The developed approach has been designed around a 10-mg/kg clean-up objective (and 10-mg/kg TCE isocontour) in the Unsaturated Zone, and a 19-mg/kg clean up objective within the 100-mg/kg isocontour in the Saturated Zone, except in the former plating operations area, in which **only** the Unsaturated zone impacts will be included in the ISTR TTZ.

The Contractor guarantees to achieve clean-up levels of 10 mg/kg TCE or lower within the Unsaturated Zone soils, and 19-mg/kg TCE or lower in the Saturated Zone soils contained within the respective Thermal Treatment Zone (TTZ) area and volume, which is approximately 28,826.6 cubic yards in volume and 39,630 ft^2 with varying depths of impact up to 32 ft bgs. This guarantee is restricted to the terms & conditions defined in the supporting Proposal documents.

As per the Scope of Work (SOW) (**Attachment A**) , the work shall consist of all labor, materials, equipment, travel, services, and supplies required for completing the project. The major remedial action components that make up the scope of work for ERG's efforts on the CMW In Situ Thermal Remediation (ISTR) project are summarized in the list below:

- Completion of a Remedial Design to finalize the layout of the heating and extraction wells.
- Installation of heater borings, extraction wells, conveyance piping, electrical conduits, natural gas lines, gas distribution system(s), power delivery, equipment, and ex situ (aboveground) treatment equipment.
- Initiation and operation of the ISTR system for an estimated three-month heating period to bring the subsurface to the design temperature above the heteroazeotropic co-boiling point of the identified contaminants of concern (COCs) and water or soil moisture.
- Operation of the ISTR system for an estimated period of ~50-days at the design temperature to mobilize, extract, and treat the contaminants to the intended cleanup goals.
- Completion of performance monitoring during the heating and design temperature operation periods to assess temperatures, mass removal rates, extracted groundwater and vapor treatment effectiveness and electricity use. ISTR system operation and energy use.
- Post-treatment soil sampling which will be performed by others, will be assessed in conjunction with the operational data to determine whether additional operation of the ISTR system, or parts of the ISTR system is warranted and, if so, how it will be optimized to complete the treatment process.
- Completion of a cool-down period, ISTR system decommissioning, and site restoration.

Summary of Changes

1. Updated detailed Basis of Design Engineering has produced final/firm well counts, equipment sizing/selection, and operational strategy (run time, utility consumption, etc.).

2. Firm costs have been integrated into the project costs, including all major subcontractors, materials, equipment, & utilities.

3. Guaranteed cleanup objectives have been modified to a more stringent 10mg/kg TCE in Unsaturated zone soils (from 19-mg/kg). Saturated Zone soil clean up objectives remain unchanged at 19-mg/kg TCE in soil.

4. Costs to manage and pay for Electrical service upgrades/modifications, including temporary power drop (and associated electrical gear) have now been included in final project costs.

5. Costs have been included to locate, daylight, cut, and abandon in place (flowable fill) the stormwater runoff line (source of groundwater mounding).

6. Augmented Site security measures now incorporate perimeter motion sensors, motion activated CC TV security cameras, after hour virtual remote monitoring, nighttime overhead security lights, alarms and call outs, and a fully enclosed, locking, security fencing with barbed wire or razor wire overhangs surrounding the entire wellfield and all on Site equipment.

7. Contingency measures for system winterization are included as Task Item 800-815 in the Detailed Bill Schedule (**Attachment B**). These costs have not been included in the overall project total, and this Option to be exercised, only as needed up to specified amount, as per Proposal Terms, and with authorization from the Client.

Treatment Scenario

__Single Phase Treatment__

10-mg/kg clean-up objective (and 10 mg/kg TCE isocontour) in the Unsaturated Zone, and a 19-mg/kg clean up objective within the 100-mg/kg isocontour in the Saturated Zone

Contamination & Clean Up Goals

Contact Metals Welding (CMW) Site - Final Detailed FFPGR					SMA, A Terracon Company
Summary of Site Contamination in Soil					
COC (mg/kg)	Average (mg/kg)	Max (mg/kg)	Treatment Goal (mg/kg)	% Reduction from Max	Mass Removal (lbs)
Trichloroethylene (TCE)	39.0	4,400.0	19.0	99.5682%	4,663.8
Tetrachloroethylene (PCE)	1.7	6,100.0	5.0	99.9180%	214.7
Chloroform	0.0	220.0	0.5	99.77%	3.9
Carbon tetrachloride	0.2	502.0	0.5	99.90%	18.5
Trichloroethane (TCA)	0.1	308.0	5.0	98.38%	15.5

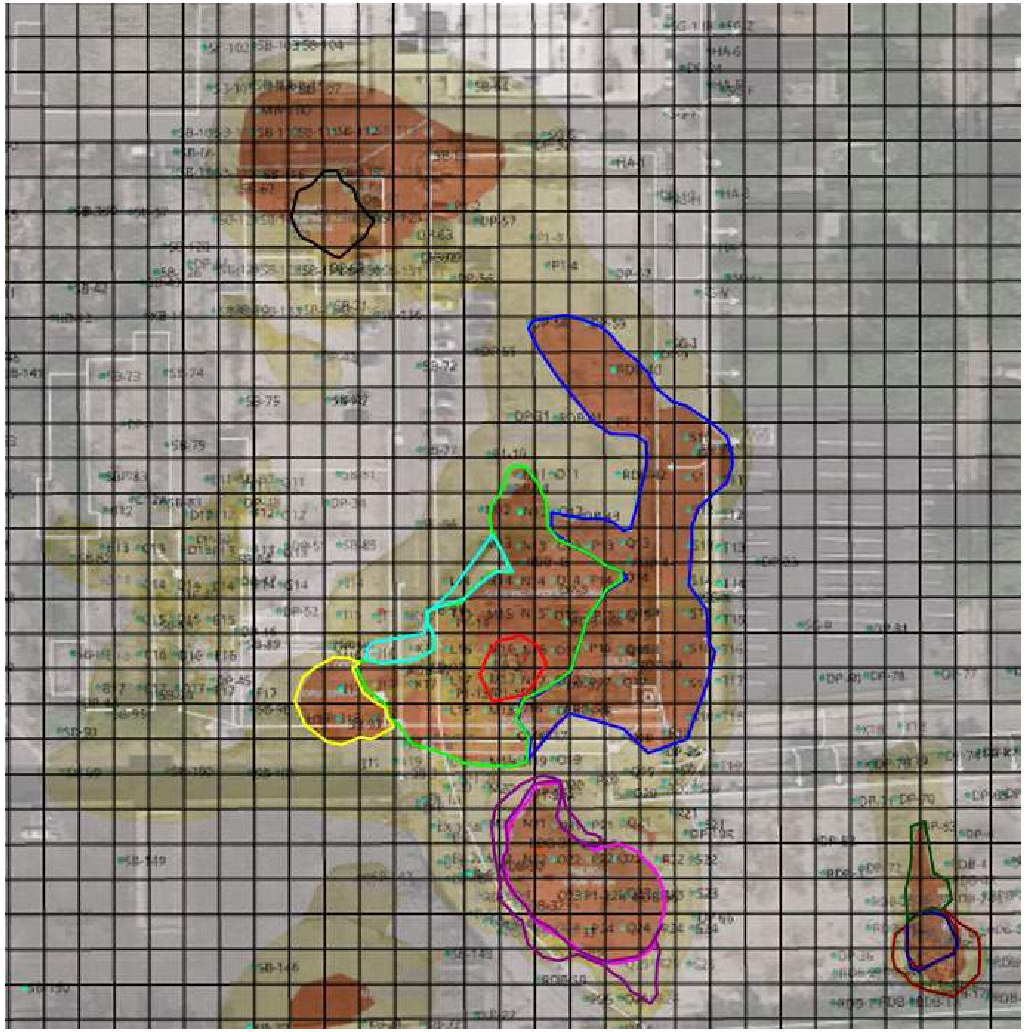
ERG's Basis of Deisgn						
Location	**Area color on TTZ Overview Drawing**	**Top of Contamination**	**Bottom of contamination**	**Area ((Ft2)**	**TTZ Volume**	**Heated Volume**
Shipping Receiving	Blue	5	22	14,474.0	10,185.4	12,865.8
	Green	0	26	10,000.0	9,629.6	11,481.5
	Light Turquoise	0	10	1,005.0	372.2	558.3
	Yellow	8	18	1,746.0	776.0	1,099.3
	Red	0	32	971.0	1,150.8	1,330.6
Rail Spur / Loading Dock	Purple	0	10	1,903.0	704.8	1,057.2
	Pink	0	20	5,468.0	4,050.4	5,063.0
Former Plating Operations	Black	0	11	1,495.0	609.1	885.9
Degreaser #3	Dark Green	10	20	790.0	351.1	497.4
	Dark Blue	0	20	700.0	518.5	648.1
	Dark Red	0	12	1,077.0	478.7	678.1
Total				39,629.0	28,826.6	36,165.3

Subsurface Characteristics

Contact Metals Welding (CMW) Site - Final Detailed FFPGR							SMA, A Terracon Company
Summary of Site Geology							
HydroStratigraphic units	Soil Type	Top (ft bgs)	Bottom (ft bgs)	Density (lbm/ft^3)	Moisture Content (W_{water}/W_{dry})	TOC %	Soil Porosity (V_V/V_T)
Unit 1	glacial till/clay		31	105	0.225	0	0.25
Unit 2	Tight glacial till/clay	31	43	115.5	0.28	0	0.35

Contact Metals Welding (CMW) Site - Final Detailed FFPGR	SMA, A Terracon Company	
Assumed Average Groundwater Flux		
Parameter	Value	Unit
Width of upgradient edge	199.1	ft
Aquifer thickness	11.2	ft
Hydraulic conductivity, K, average	7.50E-04	cm/sec
Hydraulic gradient, I	0.0500	ft/ft
Area of inflow cross-section under water	2221.7	ft^2
Water flow velocity v = K I	3.75E-05	cm/sec
Water flow velocity v = K I	2.25E-05	m/min
Water flow velocity v = K I	7.38E-05	ft/min
Water flow velocity v = K I	38.8	ft/year
Influx of water q = v A e = K I A	0.164	ft^3/min
Influx of water q = v A e = K I A	1.2	gpm
Total influx	1.21	gpm
As Velocity	0.106	ft/day

Target Treatment Zone



ERG's Basis of Deisgn						
Location	**Area color on TTZ Overview Drawing**	**Top of Contamination**	**Bottom of contamination**	**Area ((Ft2)**	**TTZ Volume**	**Heated Volume**
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	Green	0	26	10,000.0	9,629.6	11,481.5
	Light Turquoise	0	10	1,005.0	372.2	558.3
	Yellow	8	18	1,746.0	776.0	1,099.3
Shipping Receiving	Red	0	32	971.0	1,150.8	1,330.6
	Purple	0	10	1,903.0	704.8	1,057.2
Rail Spur / Loading Dock	Pink	0	20	5,468.0	4,050.4	5,063.0
Former Plating Operations	Black	0	11	1,495.0	609.1	885.9
	Dark Green	10	20	790.0	351.1	497.4
	Dark Blue	0	20	700.0	518.5	648.1
Degreaser #3	Dark Red	0	12	1,077.0	478.7	678.1
Total				39,629.0	28,826.6	36,165.3

Conceptual Approach

Approach: In order to minimize project timeline, the TTZ will be remediated as a single phase of treatment. Total active ISTR operations (heating) are anticipated to last ~ 131-days of active heating operations, with an additional 5-days of start-up and shakedown, and 10-days of post treatment cooling after ISTR system shutdown.

ISTR Wellfield: The total project Wellfield consists of 302 TCH heater wells placed ~between 12.5 and 14-ft on center (Depending on starting TCE impacts, hydrogeologic conditions, spatial considerations and cleanup criteria). TCH wells, are designed to heat from ground surface, top of Saturated Zone, or a minimum of 3-ft above the top of impacts, to ~5-ft below the bottom of the TTZ in all areas. Sixty-three (63) multi-phase extraction (MPE) wells will be used as primary extraction points, targeting vapor and liquid phase removal of CVOCs below the groundwater table, and helping maintain hydraulic control during ISTR operations. These wells will also serve to create pathways for deep volatilized contaminants to be more efficiently removed during the ISTR process. Sixty-nine (69) soil vapor extraction (SVE) wells will be used as additional shallow vapor extraction points, maintaining pneumatic control throughout operations. An additional forty-five (45) vertical vapor control points (VCPs) screened 1-ft above and 1-ft below the Sewer Line(s), and spaced every ~5 to 10-ft along the line where it intersects the ISTR TTZ to mitigate heat impacts, contaminant vapor infiltration and migration, and to allow the existing SVE system to continue operations unimpacted during ISTR treatment.

An insulating plenum designed to meet an insulative value of R-8 using lightweight air entrained concrete will be placed over the entire TTZ where heating extends to ground surface, minimizing unnecessary heat loss, ensuring adequate heating in the shallow Vadose, and acting as a tertiary engineering control to mitigate any fugitive emissions potentials.

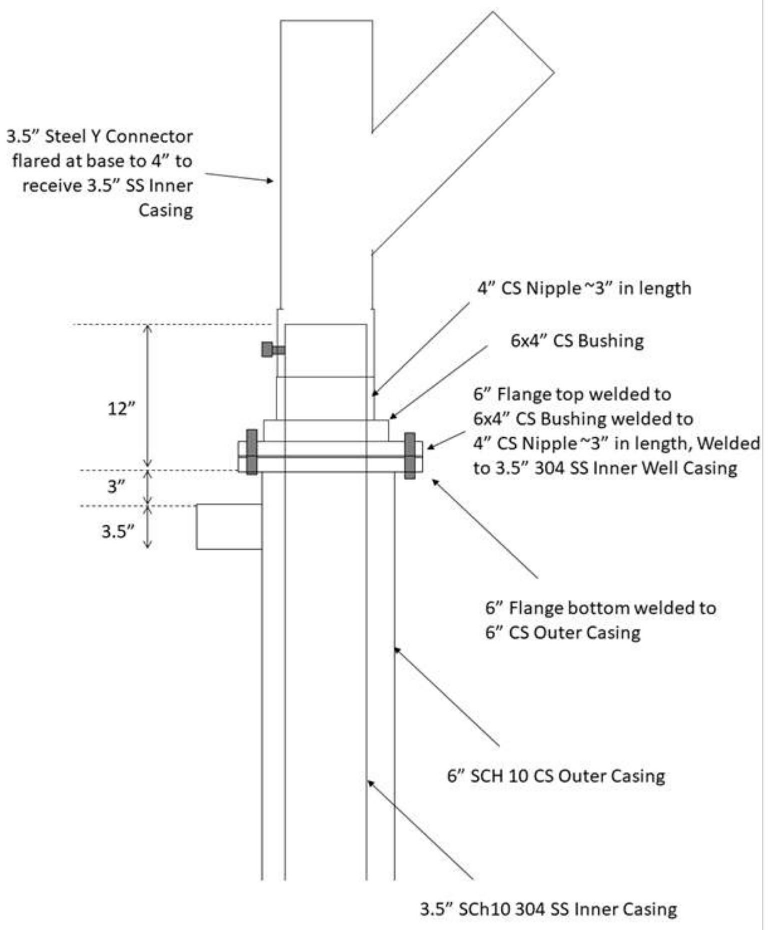
Treatment System: The Treatment system consists of Vapor Treatment unit(s) (VTUs) to cool and condition extracted off-gas prior to treatment/abatement using vapor phase granular activated carbon (VGAC). The VTU system(s) produce a combined wellfield extraction flow rate of ~2,000-SCFM @ 12"Hg (1800 @ 16" Hg), which provide a conservative >10-pore volumes per day (PV/day) of extraction throughout the heated volume. The liquid Treatment system consists of a bag filter skid, density separation tanks, and LGAC vessels/media.

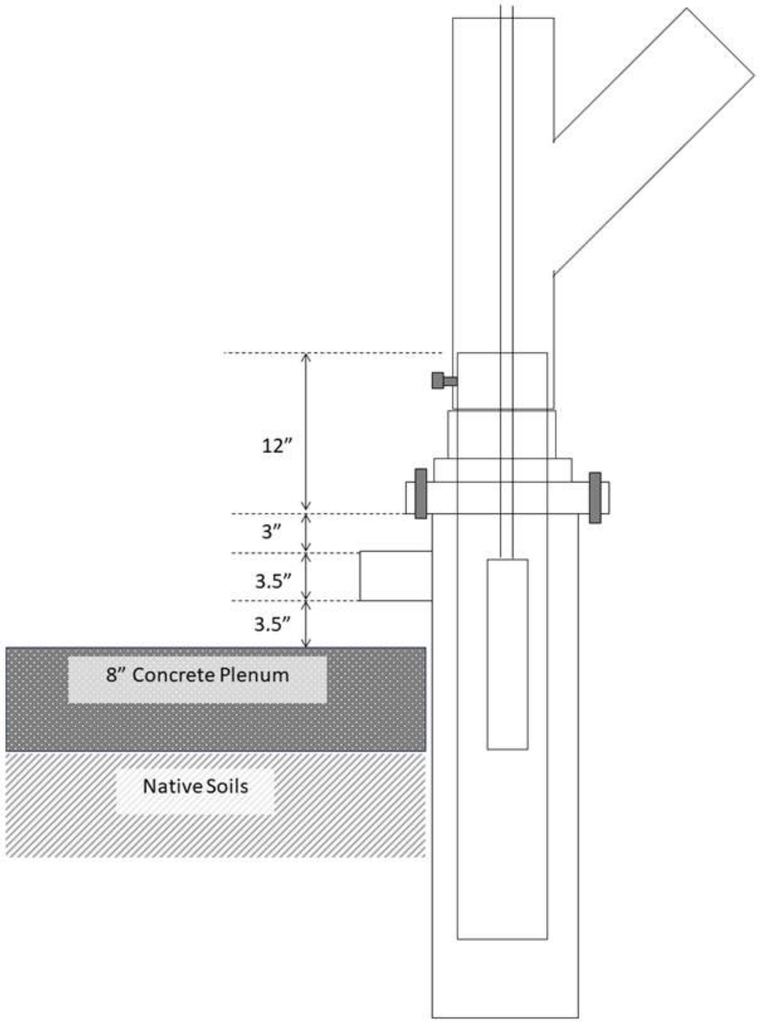
Wellfield Design – Well Counts & Details

ERG's Basis of Deisgn											
Location	Area color on TTZ Overview Drawing	Top of Contamination	Bottom of contamination	Top of Heating	Bottom of Heating	Number of Wells		Depth of Well	Area ((Ft2)	TTZ Volume	Heated Volume
						TCH	103	27			
						MPE	24	22			
						SVE	17	10	14,474.0	10,185.4	15,546.1
						VCP	29	11			
	Blue Area Wells	5	22	5	27	TMP	9	22			
						TCH	71	31			
						MPE	16	26			
						SVE	17	10	10,000.0	9,629.6	13,333.3
						VCP	12	11			
	Green Area Wells	0	26	0	31	TMP	6	26			
						TCH	5	15			
						SVE	3	10			
	Light Turquoise Area Wells	0	10	0	15	VCP	4	11	1,005.0	372.2	744.4
						TCH	14	23			
						MPE	4	18			
						SVE	4	10			
	Yellow Area Wells	8	18	5	23	TMP	1	18	1,746.0	776.0	1,616.7
						TCH	12	37			
						MPE	3	32			
						SVE	2	10			
Shipping Receiving	Red Area Wells	0	32	0	37	TMP	1	32	971.0	1,150.8	1,510.4
						TCH	12	15			
						SVE	8	10			
	Purple Area Wells	0	10	0	15	TMP	1	10	1,903.0	704.8	1,409.6
						TCH	45	25			
						MPE	11	20			
						SVE	7	10			
Rail Spur / Loading Dock	Pink Area Wells	0	20	0	25	TMP	3	20	5,468.0	4,050.4	6,075.6
						TCH	15	16			
						SVE	7	10			
Former Plating Operations	Black Area Wells	0	11	0	16	TMP	2	11	1,495.0	609.1	1,162.8
						TCH	8	25			
						MPE	2	20			
						SVE	2	10			
	Dark Green Area Wells	10	20	5	25	TMP	1	20	790.0	351.1	790.0
						TCH	9	25			
						MPE	3	20			
	Dark Blue Area Wells	0	20	0	25	TMP	1	20	700.0	518.5	777.8
						TCH	8	17			
						SVE	2	10			
Degreaser #3	Dark Red Area Wells	0	12	0	17	TMP	1	12	1,077.0	478.7	877.6
Total									39,629.0	29,602.6	44,943.7

ERG's Basis of Deisgn							
Location	Area color on TTZ Overview Drawing	Well Type	Number of Wells	Depth of Well	Bore Diameter	Depth of Bore	Total Feet of Drilling
		TCH	103	27	12"	27.5	2832.5
		MPE	24	22	8-1/4"	23	552
		SVE	17	10	6-3/4" to 7-1/4"	11	187
		VCP	29	11	6-3/4" to 7-1/4"	12	348
	Blue Area Wells	TMP	9	22	6-1/4" or Direct Push	22.5	202.5
		TCH	71	31	12"	31.5	2236.5
		MPE	16	26	8-1/4"	27	432
		SVE	17	10	6-3/4" to 7-1/4"	11	187
		VCP	12	11	6-3/4" to 7-1/4"	12	144
	Green Area Wells	TMP	6	26	6-1/4" or Direct Push	26.5	159
		TCH	5	15	12"	15.5	77.5
		SVE	3	10	6-3/4" to 7-1/4"	11	33
	Light Turquoise Area Wells	VCP	4	11	6-3/4" to 7-1/4"	12	48
		TCH	14	23	12"	23.5	329
		MPE	4	18	8-1/4"	19	76
		SVE	4	10	6-3/4" to 7-1/4"	11	44
	Yellow Area Wells	TMP	1	18	6-1/4" or Direct Push	18.5	18.5
		TCH	12	37	12"	37.5	450
		MPE	3	32	8-1/4"	33	99
		SVE	2	10	6-3/4" to 7-1/4"	11	22
Shipping Receiving	Red Area Wells	TMP	1	32	6-1/4" or Direct Push	32.5	32.5
		TCH	12	15	12"	15.5	186
		SVE	8	10	6-3/4" to 7-1/4"	11	88
	Purple Area Wells	TMP	1	10	6-1/4" or Direct Push	10.5	10.5
		TCH	45	25	12"	25.5	1147.5
		MPE	11	20	8-1/4"	21	231
		SVE	7	10	6-3/4" to 7-1/4"	11	77
Rail Spur / Loading Dock	Pink Area Wells	TMP	3	20	6-1/4" or Direct Push	20.5	61.5
		TCH	15	16	12"	16.5	247.5
		SVE	7	10	6-3/4" to 7-1/4"	11	77
Former Plating Operations	Black Area Wells	TMP	2	11	6-1/4" or Direct Push	11.5	23
		TCH	8	25	12"	25.5	204
		MPE	2	20	8-1/4"	21	42
		SVE	2	10	6-3/4" to 7-1/4"	11	22
	Dark Green Area Wells	TMP	1	20	6-1/4" or Direct Push	20.5	20.5
		TCH	9	25	12"	25.5	229.5
		MPE	3	20	8-1/4"	21	63
	Dark Blue Area Wells	TMP	1	20	6-1/4" or Direct Push	20.5	20.5
		TCH	8	17	12"	17.5	140
		SVE	2	10	6-3/4" to 7-1/4"	11	22
Degreaser #3	Dark Red Area Wells	TMP	1	12	6-1/4" or Direct Push	12.5	12.5
Total			**505.0**				**11,435.0**

Wellfield Design – Well Counts & Details

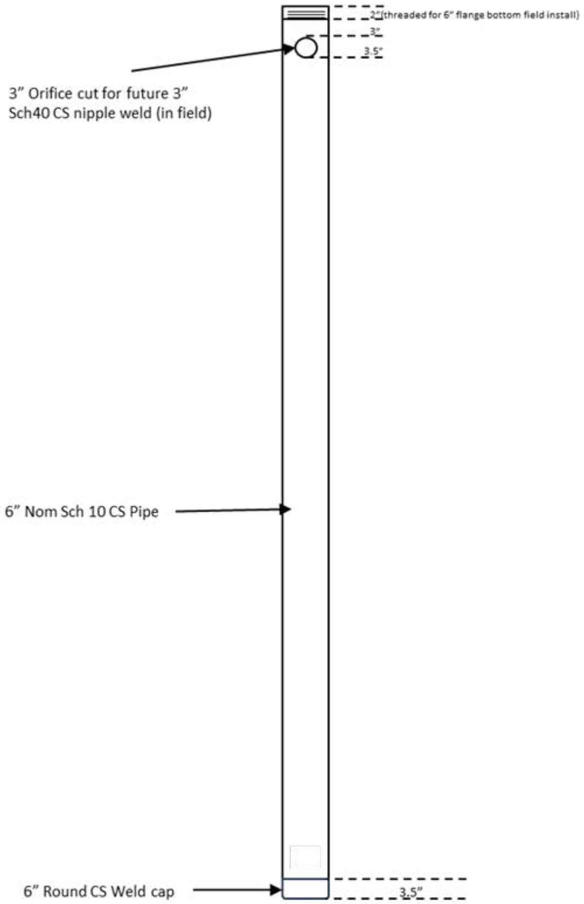




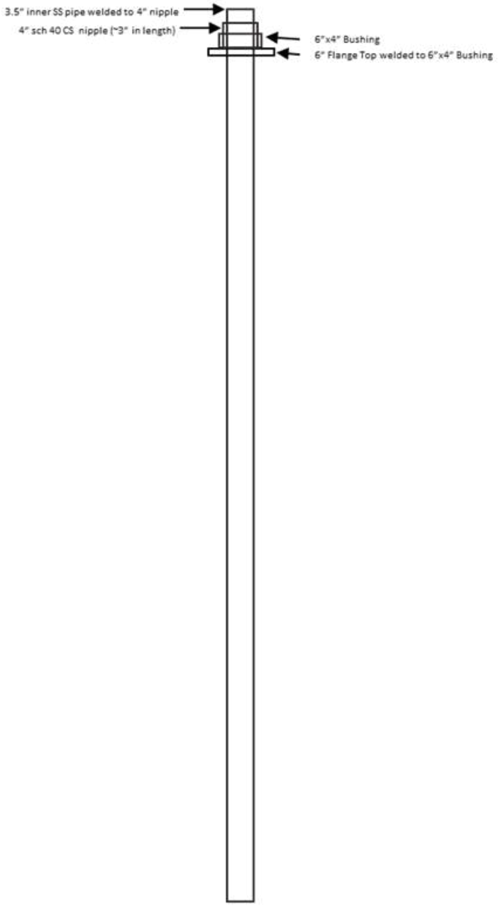
Wellfield Design – Well Counts & Details

General TCH Well Details

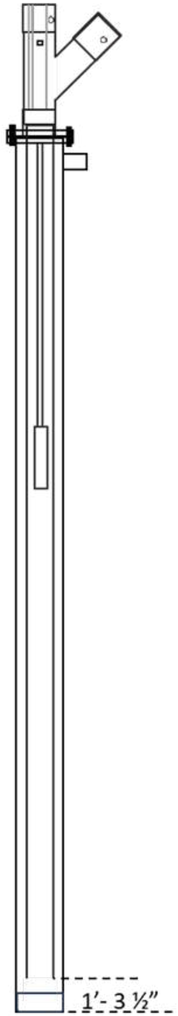
Outer TCH Well Casing



Inner TCH Well Casing

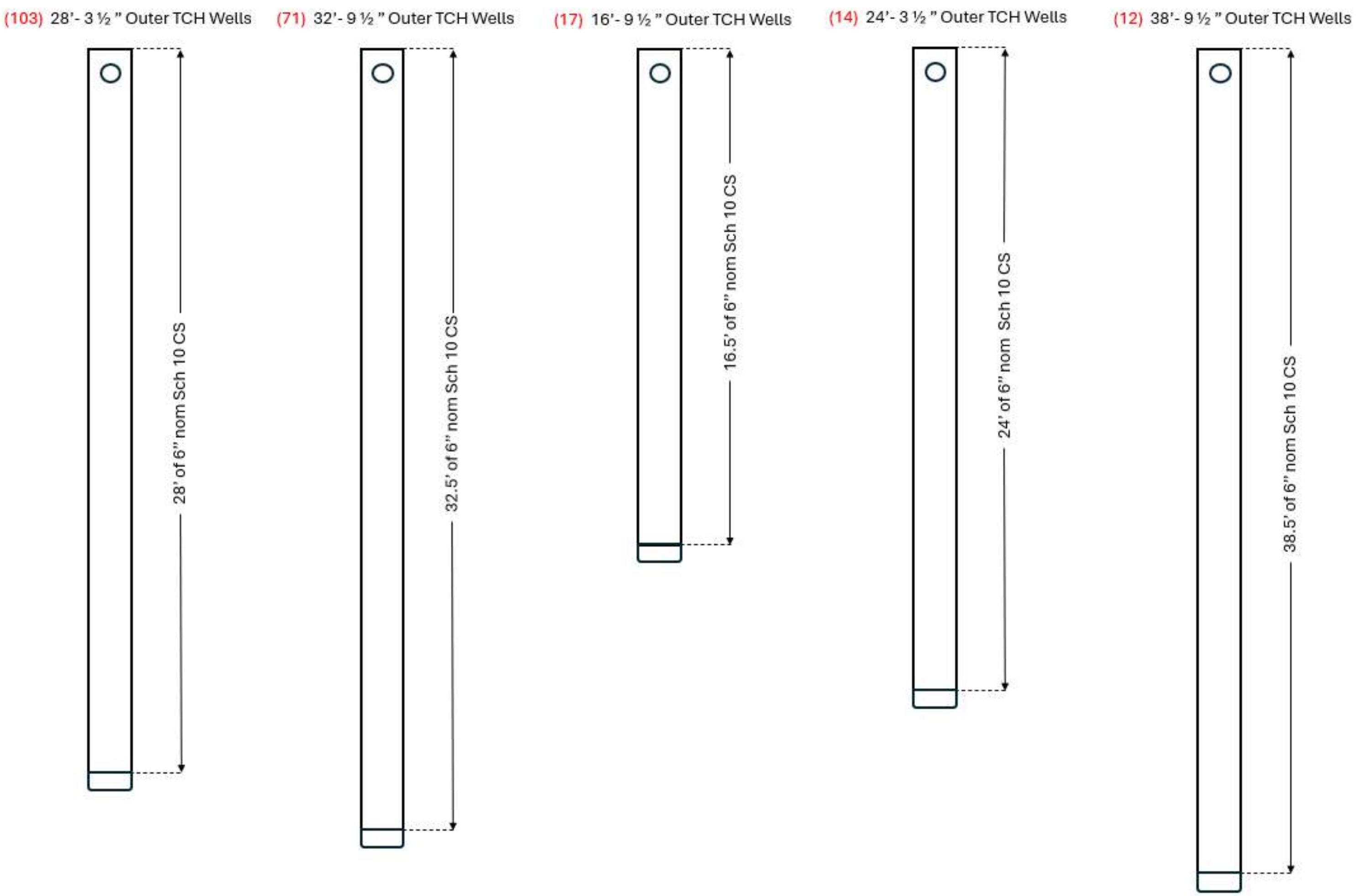


Fully composed Well (in Field)



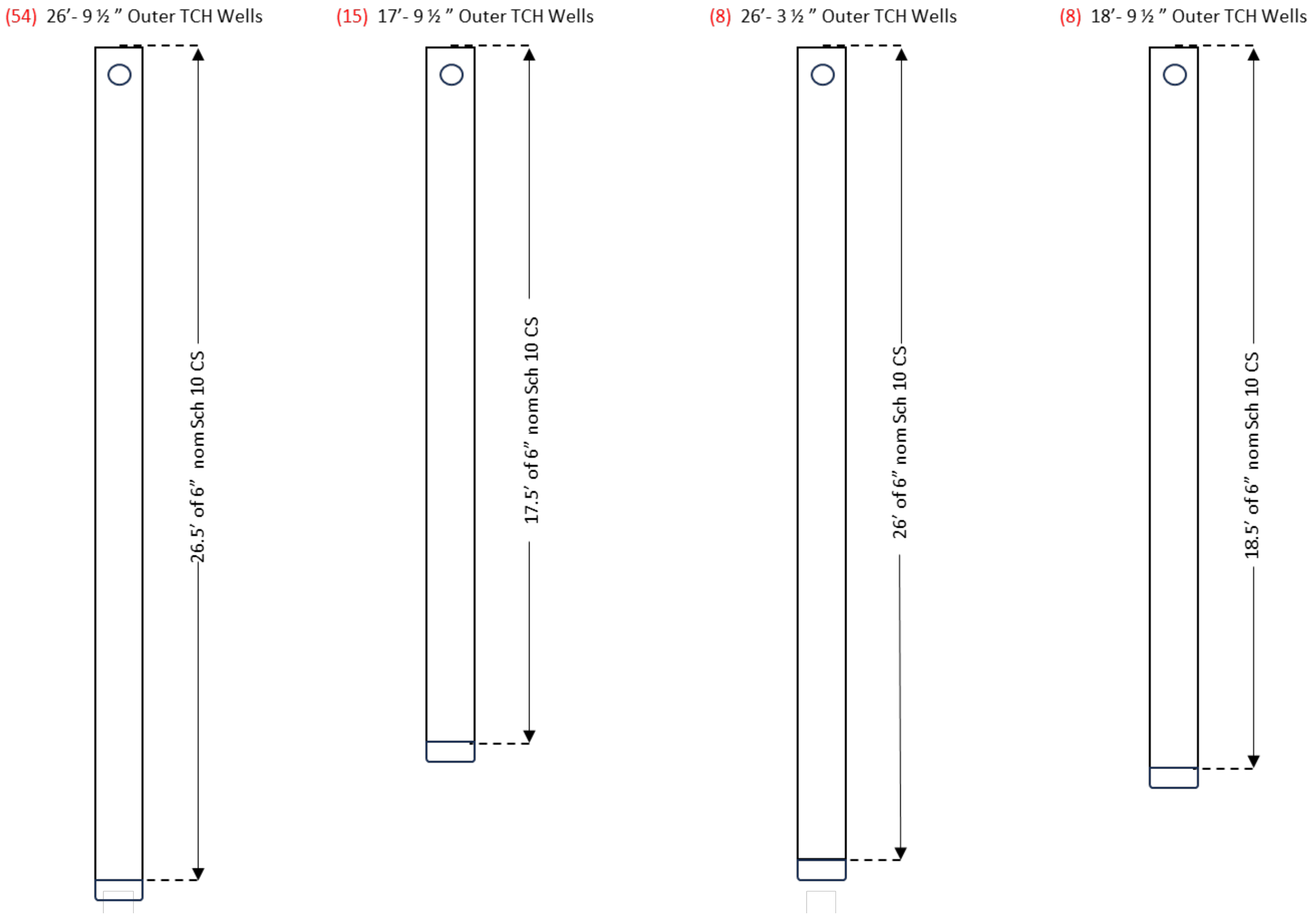
Wellfield Design – Well Counts & Details

TCH Outer Well Designs & Quantities



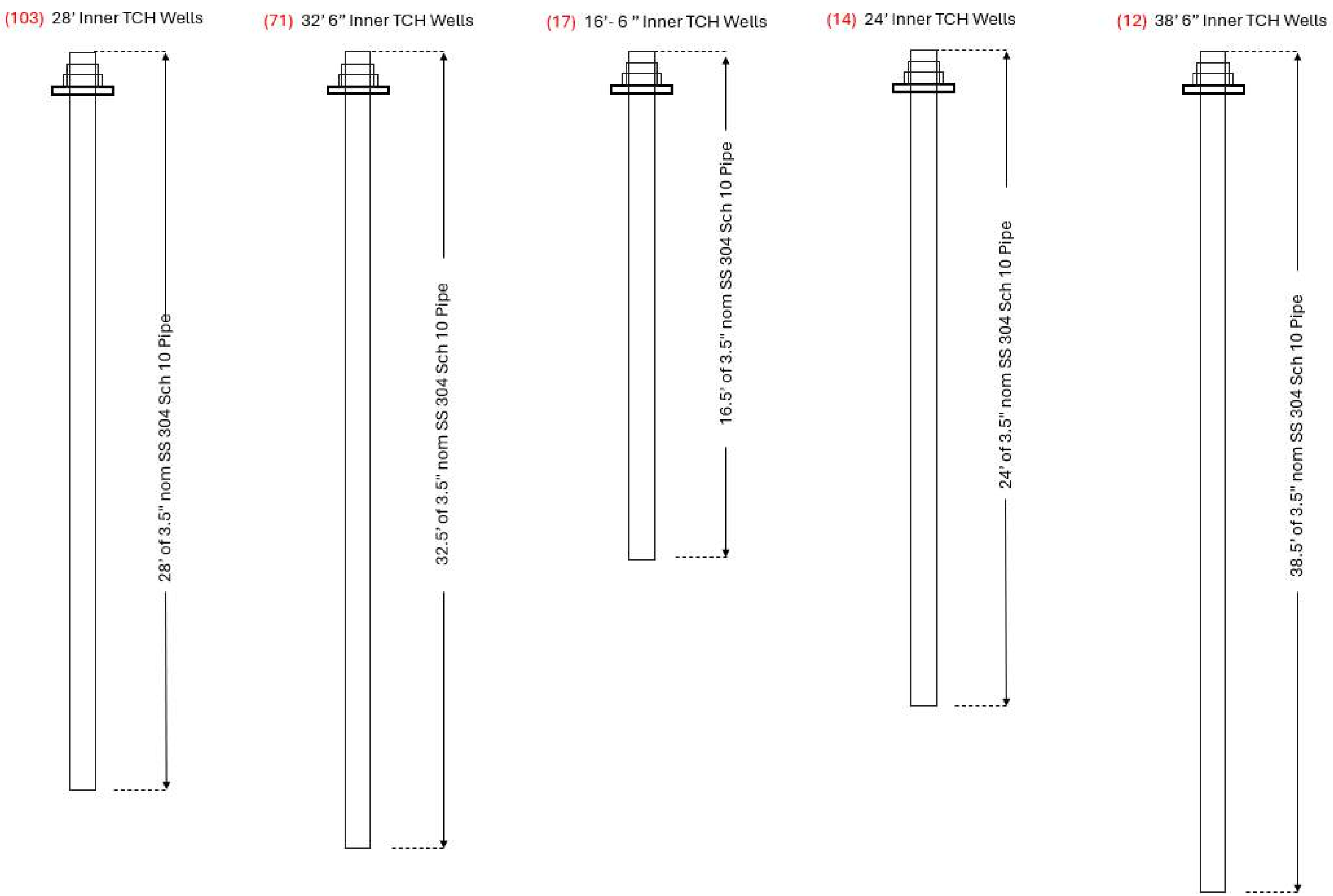
Wellfield Design – Well Counts & Details

TCH Outer Well Designs & Quantities



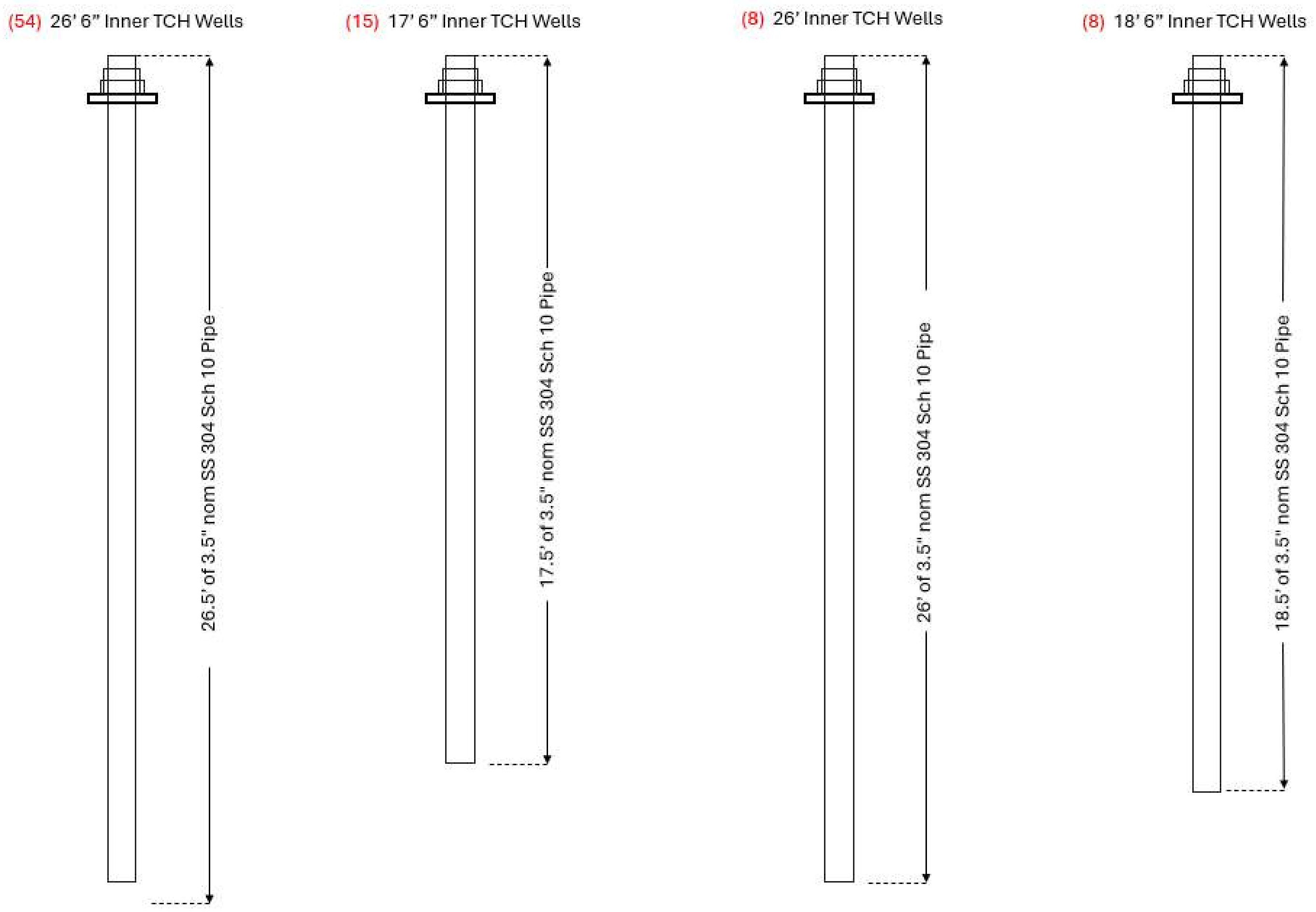
Wellfield Design – Well Counts & Details

TCH Inner Well Designs & Quantities



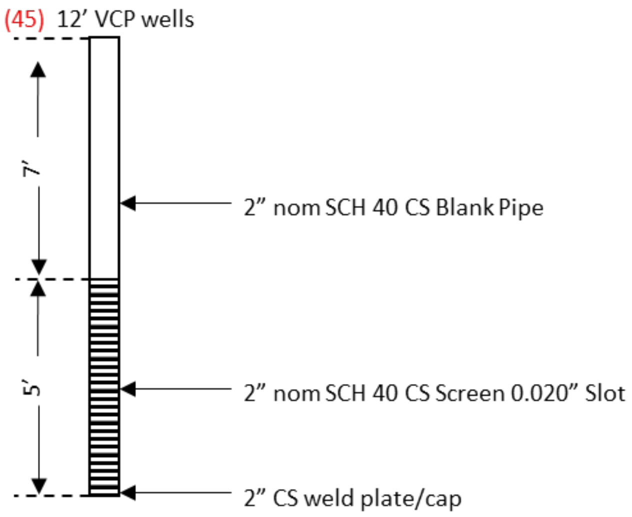
Wellfield Design – Well Counts & Details

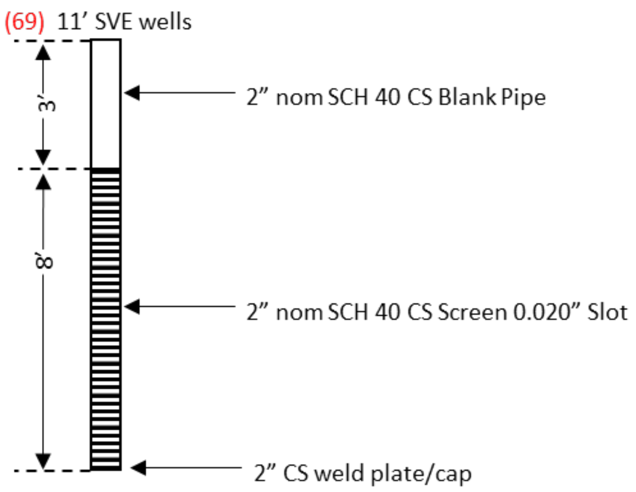
TCH Inner Well Designs & Quantities



Wellfield Design – Well Counts & Details

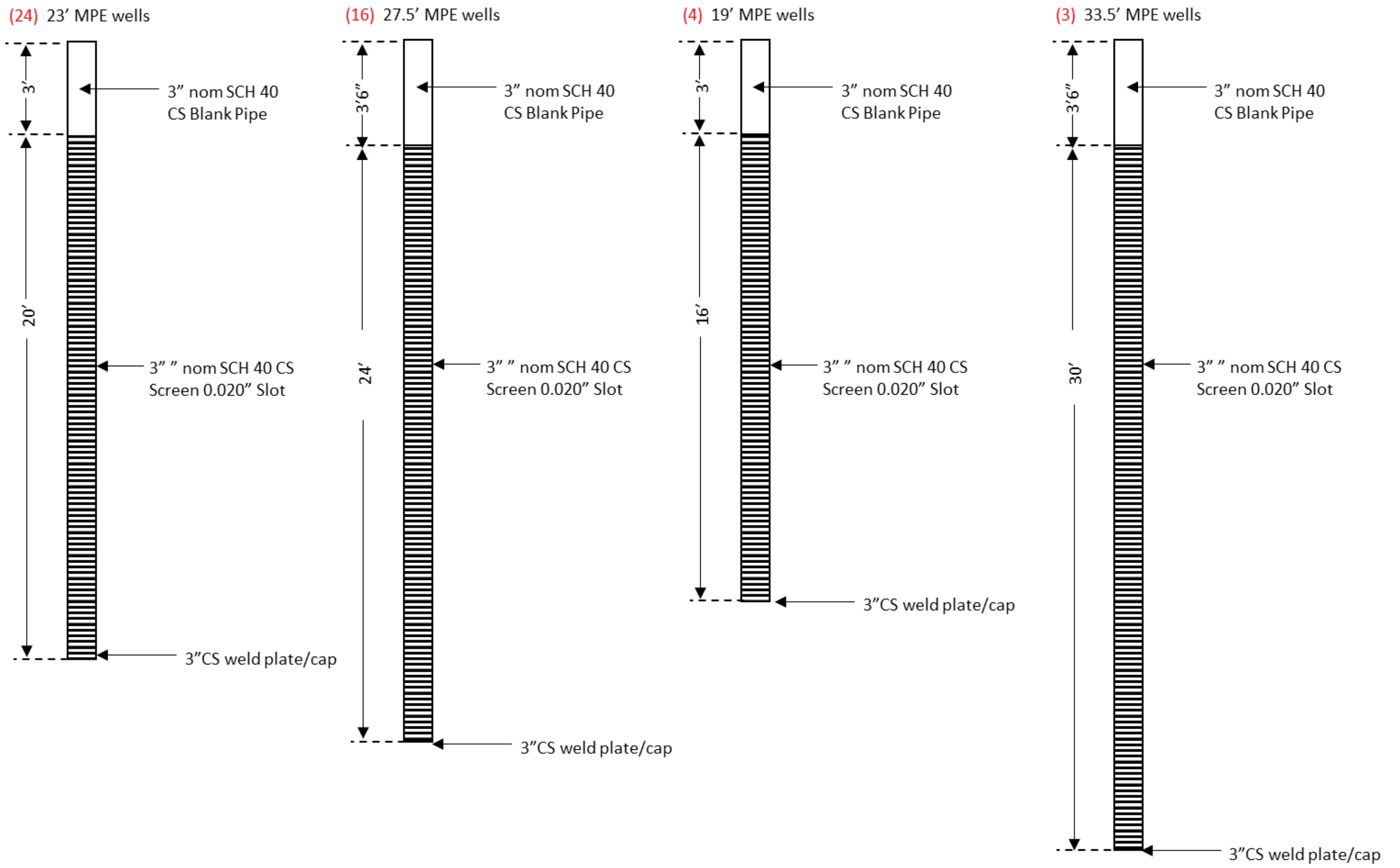
VCP & SVE Well Designs & Quantities





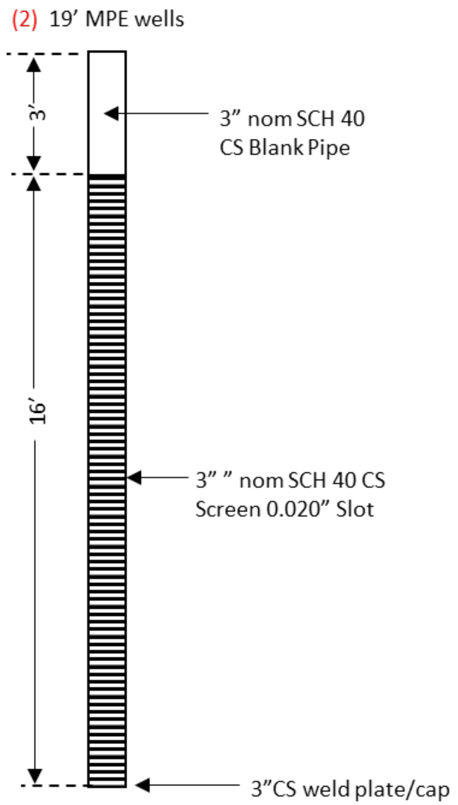
Wellfield Design – Well Counts & Details

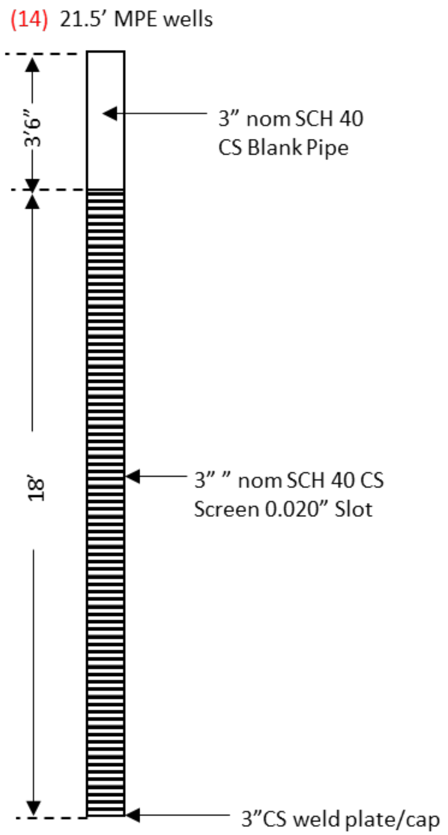
MPE Well Designs & Quantities



Wellfield Design – Well Counts & Details

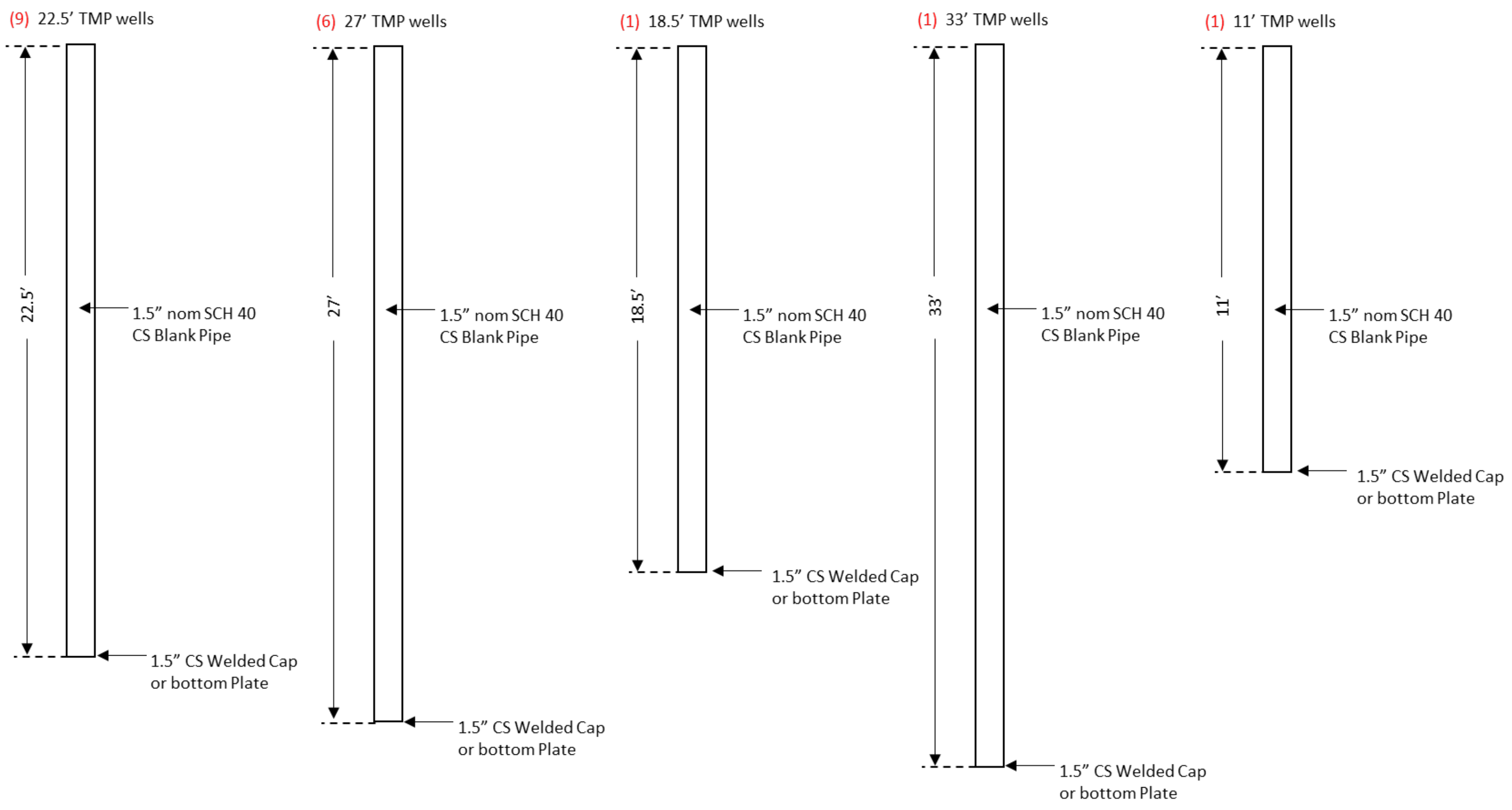
MPE Well Designs & Quantities





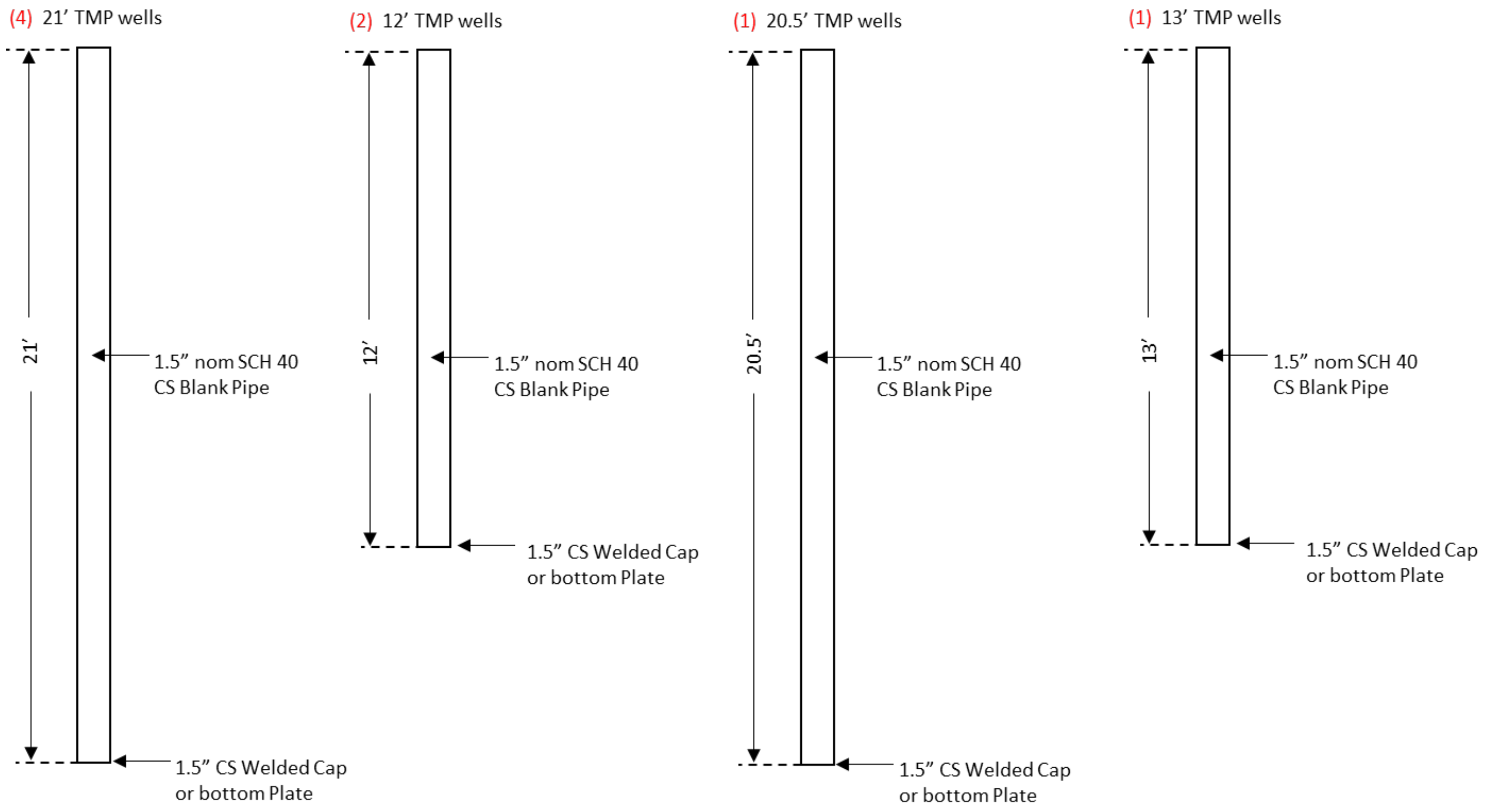
Wellfield Design – Well Counts & Details

TMP Well Designs & Quantities



Wellfield Design – Well Counts & Details

TMP Well Designs & Quantities

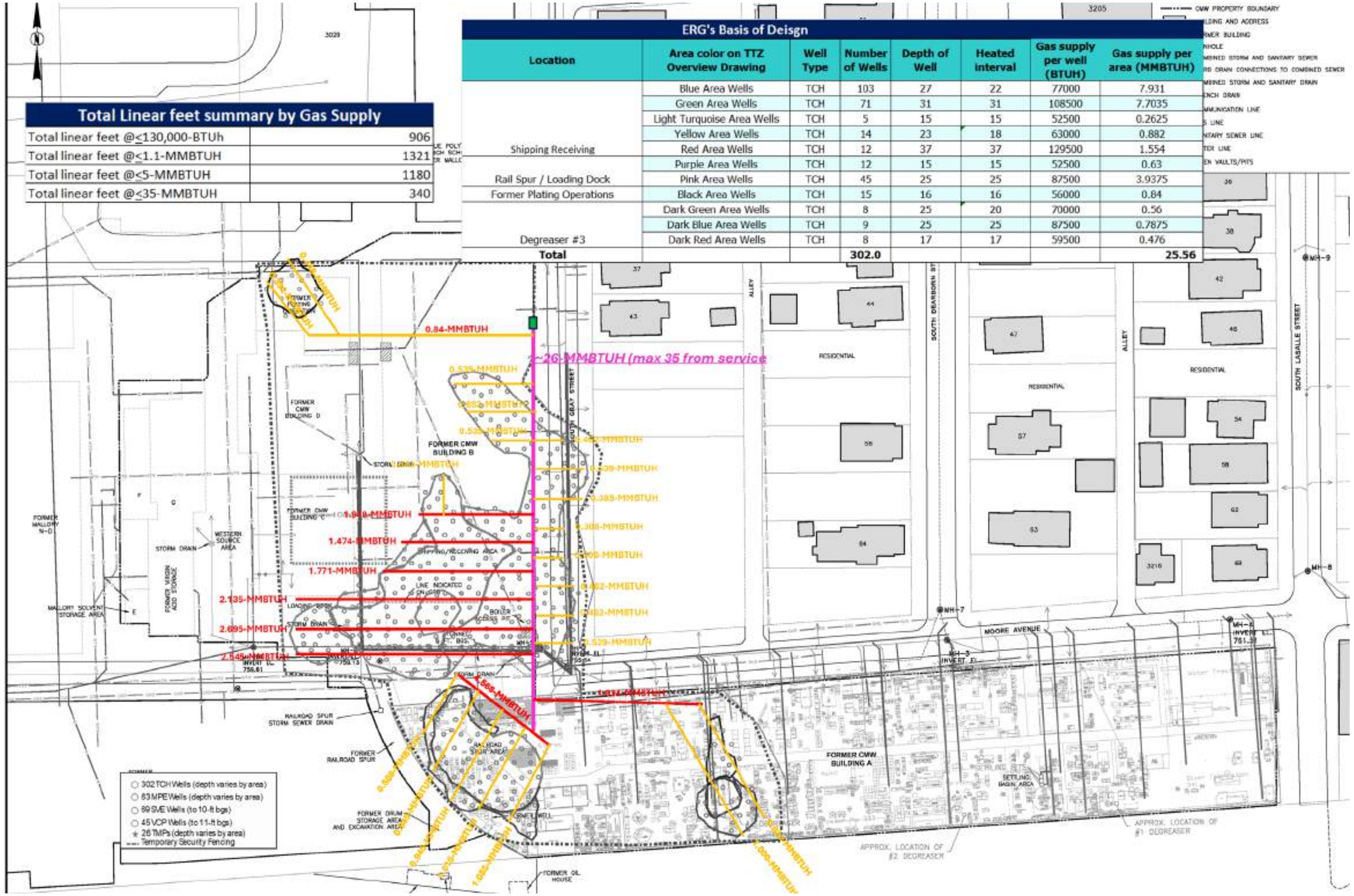


Wellfield Design – Well Layout

Wellfield Design –Gas Distribution System

Total Linear feet summary by Gas Supply	
Total linear feet @≤130,000-BTUh	906
Total linear feet @≤1.1-MMBTUH	1321
Total linear feet @≤5-MMBTUH	1180
Total linear feet @≤35-MMBTUH	340

ERG's Basis of Deisgn							
Location	Area color on TTZ Overview Drawing	Well Type	Number of Wells	Depth of Well	Heated interval	Gas supply per well (BTUH)	Gas supply per area (MMBTUH)
	Blue Area Wells	TCH	103	27	22	77000	7.931
	Green Area Wells	TCH	71	31	31	108500	7.7035
	Light Turquoise Area Wells	TCH	5	15	15	52500	0.2625
	Yellow Area Wells	TCH	14	23	18	63000	0.882
Shipping Receiving	Red Area Wells	TCH	12	37	37	129500	1.554
	Purple Area Wells	TCH	12	15	15	52500	0.63
Rail Spur / Loading Dock	Pink Area Wells	TCH	45	25	25	87500	3.9375
Former Plating Operations	Black Area Wells	TCH	15	16	16	56000	0.84
	Dark Green Area Wells	TCH	8	25	20	70000	0.56
	Dark Blue Area Wells	TCH	9	25	25	87500	0.7875
Degreaser #3	Dark Red Area Wells	TCH	8	17	17	59500	0.476
Total			302.0				25.56

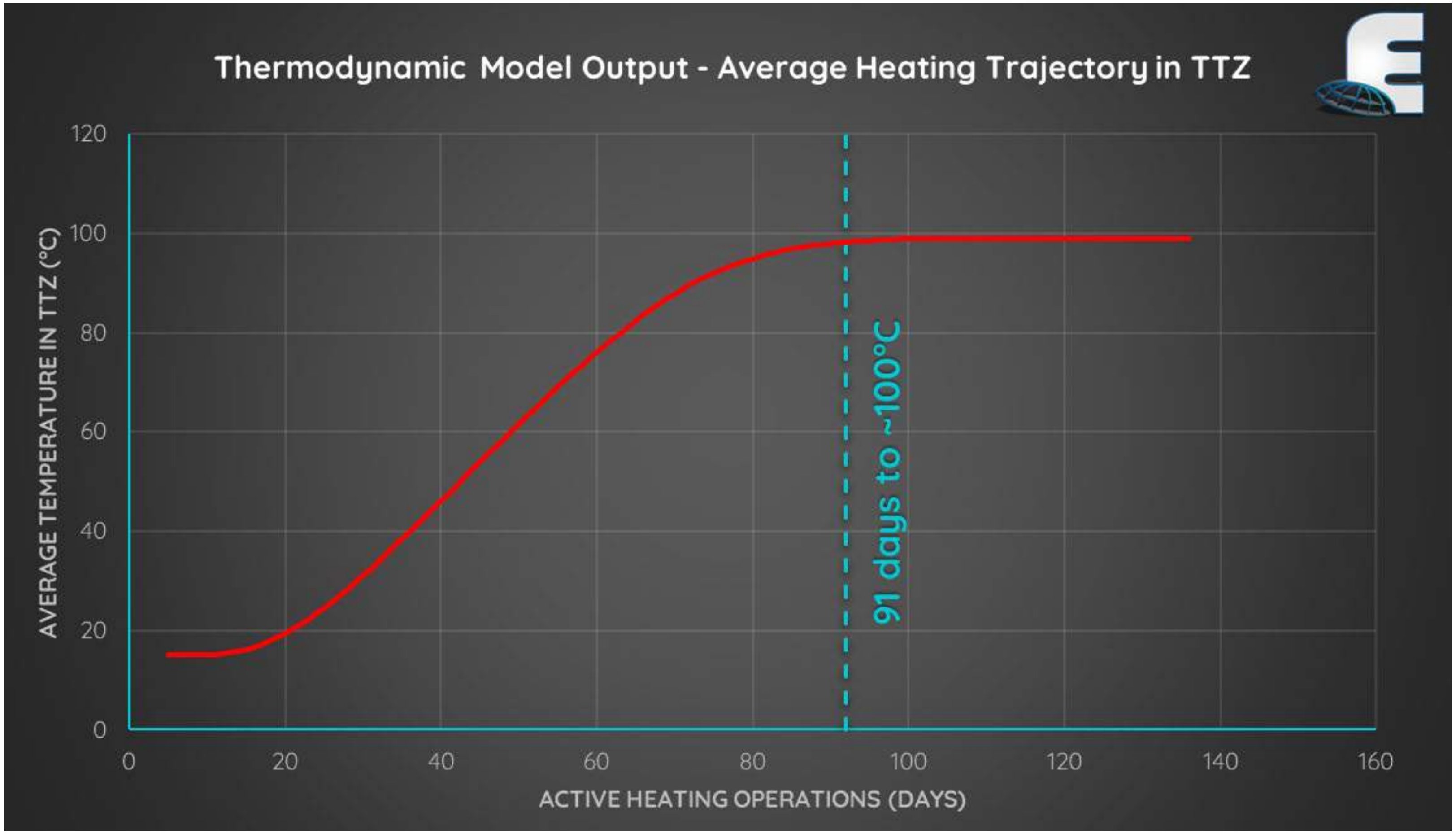


Wellfield Design

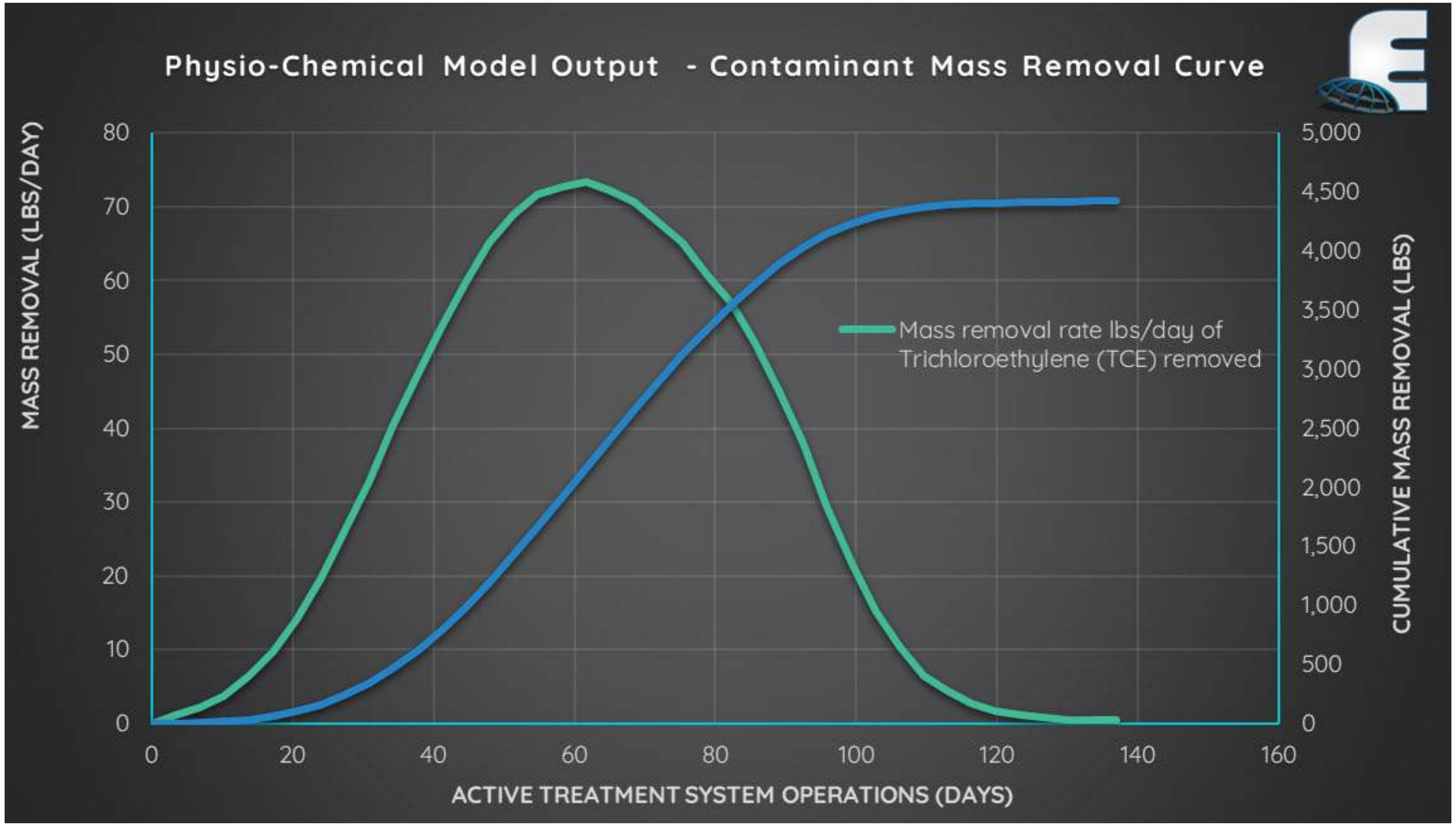
Contact Metals Welding (CMW) Site - Final Detailed FFPGR		
Summary of TTZ - Project Totals		
Characteristics	TTZ	Unit
Treatment area	39,630.0	ft^2
Upper depth of treatment	0.0	ft bgs
Avg. Lower depth of treatment	21.2	ft bgs
Total Heated Volume	38,397.1	yd^3
Solids volume	23,293.6	yd^3
Porosity	0.25	-
Porosity volume	7,764.5	yd^3
Initial saturation	85.8	percent
Soil weight	104,013,256	lbs soil
Water weight	11,244,071	lbs water
Soil heat capacity	26,003,314	BTU/F
Water heat capacity	11,244,071	BTU/F
Total heat capacity, whole TTZ	37,247,385	BTU/F

Contact Metals Welding (CMW) Site - Final Detailed FFPGR		
Energy balance		
Parameter	TTZ	Unit
HETR Power Input Rate	637	MMBTU/Day
Energy flux into TTZ	17,897,751.1	BTU/hr
Energy Losses (Sum)	5,796,953.5	BTU/hr
Net energy flux into treatment volume	11,829,991.9	BTU/hr
Heating per day	0.89	°C/Day
Start temperature	15.0	°C
Target temperature	100.0	°C
Estimated heat loss, worst case	33.90%	%

Heating Trajectory

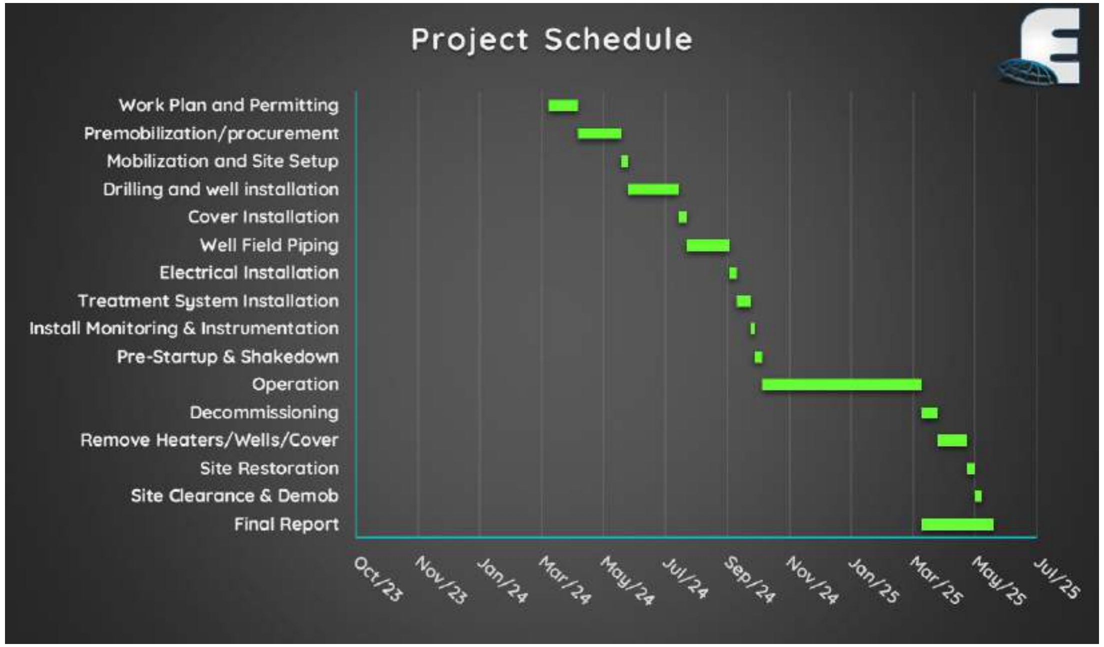


Mass Removal Trajectory



Proposed Project Schedule

Contact Metals Welding (CMW) Site - Final Detailed FFPGR			SMA, A Terracon Company
Preliminary Project Schedule			
Task	Start	Duration (Days)	End
Work Plan and Permitting	4/5/2024	28	5/3/2024
Premobilization/procurement	5/3/2024	42	6/14/2024
Mobilization and Site Setup	6/14/2024	7	6/21/2024
Drilling and well installation	6/21/2024	49	8/9/2024
Cover Installation	8/9/2024	7	8/16/2024
Well Field Piping	8/16/2024	42	9/27/2024
Electrical Installation	9/27/2024	7	10/4/2024
Treatment System Installation	10/4/2024	14	10/18/2024
Install Monitoring & Instrumentation	10/18/2024	4	10/21/2024
Pre-Startup & Shakedown	10/21/2024	7	10/28/2024
ISTR Operations	10/28/2024	155	4/1/2025
Decommissioning	4/1/2025	16	4/17/2025
Remove Heaters/Wells/Cover	4/17/2025	28	5/15/2025
Site Restoration	5/15/2025	7	5/22/2025
Site Clearance & Demob	5/22/2025	7	5/29/2025
Final Report	4/1/2025	70	6/10/2025



Treatment System

Contact Metals Welding (CMW) Site - Final Detailed FFPGR		SMA, A Terracon Company
Utilities and Consumables - Project Total		
Utility estimates	Value	Unit
Power usage, treatment system	1,289,472.0	kWh
Gas usage, total	83,500.7	MM BTU
Discharge water, total	3,002,726.0	gallons

Contact Metals Welding (CMW) Site - Final Detailed FFPGR		SMA, A Terracon Company
Treatment System Design Summary Per 1 Phase of 1 Phases		
Process equipment	Value	Unit
HETR-TCH Fuel Supply	33.0	MMBTU/H @ 5-15 PSI
Treatment system power supply	300.0	kW
Total power need to site	350.0	kW
Estimated total electric load	440.0	kVA
Estimated Electric current	529.2	Amps @ 480-v, 3-phase
Vapor extraction rate, total	2,099.86	scfm
Non-condensable vapor	1,049.93	scfm
Estimated steam extraction	1,049.93	scfm
Condensed liquid rate	11.4	gpm
Water treatment rate	20.0	gpm
Vapor treatment type	GAC w/ gas conditioning	-
Dominant contaminant of concern	Trichloroethylene (TCE)	-
Estimated COC mass	4,886.7	lbs
Estimated COC mass treated by vapor system	4,780.0	lbs
Estimated COC mass treated by water system	385.7	lbs
Estimated max mass removal rate, vapor system	76.7	lbs/day

Treatment System (Continued)

				Design Parameters	
3/28/2024			Mass	4400 pounds TCE +	63 MPE wells
REV 0			Extraction	2160 SCFM total combined flow	69 SVE wells
	70 South Gray Street, Indianapolis, IN			2000 SCFM @ 10-12" hg	45 sewer line VCP
				1800 SCFM @ 15-16" hg	73 PPD max at Day 62
				1079 SCFM Condensable	Duration:~5 Months,
				1079 SCFM non Condensable	
				11 GPM condensate	
				20.3 GPM liquid treatment rate	

Equip. No.	Equipment Description	HP	KW		Capacity	Material
KO90	Knock out tank					
HE101A	air -air heat exchanger	5	3.7			Stainless Steel
HE101B	air -air heat exchanger	5.00	3.7			Stainless Steel
HE101C	air -air heat exchanger	5.00	3.7			Stainless Steel
HE101D	air -air heat exchanger	5.00	3.7			Stainless Steel
HE102A	air -air heat exchangers, VFD and temperature control	5.00	3.7			
HE102B	air -air heat exchangers, VFD and temperature control	5.00	3.7			
HE281	Shell and tube heat exchanger					Stainless Steel
HE282	Shell and tube heat exchanger					Stainless Steel
KO95	Knock out tank					
CT310	refrigerated chiller	10.00	7.5			
CT310	refrigerated chiller	10.00	7.5			
P212	transfer pump	1.50	1.1			
P2227	transfer pump	1.50	1.1			
B104	VACUUM BLOWER QX6015	75.00	55.9			
B105	VACUUM BLOWER QX6015	75.00	55.9			
B106	VACUUM BLOWER QX6015	75.00	55.9			
HE120A	air -air heat exchanger	2.00	1.5			
HE120B	air -air heat exchanger	2.00	1.5			
HE120C	air -air heat exchanger	2.00	1.5			
B150	Booster Blower with VFD control	20.00	14.9			
VGAC 220	Vapor Carbon Tank, 72" Dia, 10" fittings, with initial fill				4500 Pounds	
VGAC 221	Vapor Carbon Tank, 72" Dia, 10" fittings, with initial fill				4500 Pounds	
VGAC 222	Vapor Carbon Tank, 72" Dia, 10" fittings, with initial fill				4500 Pounds	
T190	HOLDING TANK					
P201	Transfer pump	5.00	3.7			
	(3) Bag Filters					
BF209	(3) Bag Filters					Stainless Steel
LGAC220	Liquid Phase carbon vessels, with initial fill				2000 Pounds	
LGAC221	Liquid Phase carbon vessels, with initial fill				2000 Pounds	
LGAC222	Liquid Phase carbon vessels, with initial fill				2000 Pounds	
T225	backwash tank					
	Containment berm					
AC400	Air compressor	5.00	3.7			
FDG-HETR-150X	HETR wellhead Fans (302 x)	0.10	22.5			
	control panel		7.3			
	instruments		0.0			
	Total Power (kW)	263.9				

Treatment System (Continued)