KPRG

ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG and Associates, Inc.

TRANSMITTAL LETTER

May 29, 2020

Ms. Jennifer Dorman
Wisconsin Department of Natural Resources
2300 N. Dr. Martin Luther King Drive
Milwaukee, WI 53212

VIA FEDEX KPRG Project No. 11717

Re: Technical Memorandum – Southwest Parking Lot Remedial Action Options / Interim Remedial Action Plan
Former Navistar/RMG Foundry - 1401 Perkins Avenue, Waukesha, WI
BRRTS # 02-68-098404

Dear Ms. Dorman:

On behalf of our client, Navistar, Inc., enclosed please find the following:

- Technical Memorandum – Southwest Parking Lot Remedial Action Options / Interim Remedial Action Plan (Hard Copy and Electronic on Disc)

- A check for $1,050 to cover a Technical Assistance Review.

If there are any questions, please call me at 630-325-1300 or Richard Gnat of KPRG at 262-781-0475.

Sincerely,
KPRG and Associates, Inc.

Timothy J. Stohner, P.E.
Senior Project Manager

cc: Mr. Ferdinand Alido, Navistar

14665 West Lisbon Road, Suite 2B Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

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ENVIRONMENTAL CONSULTATION & REMEDIATION

KPRG and Associates, Inc.

SOUTHWEST PARKING LOT/STORM SEWER MEMORANDUM

May 29, 2020

To: Mr. Mark Drews, P.G., Wisconsin Department of Natural Resources
141 NW Barstow Street, Room 180
Waukesha, WI 53188

From: Tim Stohner, Rich Gnat, KPRG and Associates, Inc. (KPRG)

VIA E-MAIL and FEDEX KPRG Project No. 11717

Re: Technical Memorandum – Southwest Parking Lot Remedial Action Options / Interim Remedial Action Plan
Former Navistar/RMG Foundry - 1401 Perkins Avenue, Waukesha, WI
BRRTS # 02-68-098404

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KPRG and Associates, Inc. (KPRG) in support of our client Navistar, Inc. (Navistar) is pleased to present this Technical Memorandum to summarize Remedial Action Options for the Southwest Parking Lot and Storm Sewer-related impacts on the foundry property and to outline the Interim Remedial Action Plan to implement the selected remedial action options.

The purpose of this memorandum is as follows: to inform WDNR of the remedial action options that Navistar and KPRG have developed and evaluated to address potential soil vapors from the historical shallow soil chlorinated volatile organic compound (CVOC) impacts, specifically trichloroethene (TCE), beneath the southwest parking lot located on the north side of Perkins Avenue and to repair the compromised on-site storm sewer in that area. This memorandum then provides the preferred remedial action option for this area and requests WDNR's concurrence with the selected approach prior to Navistar initiating bidding and scheduling the work later this year.

Background Information

Site investigation work prior to KPRG's project involvement identified a TCE concentration of 2,720 micrograms per kilogram (µg/kg) in the 2-4 feet below ground surface (ft bgs) interval of soil boring GP-18 near monitoring well NMW-3R located on the east side of the southwest parking lot (Figure 1). This result was the first documented indication of an alleged historical spill/release or presence of TCE-impacted fill material in this parking lot area, which had no known historical operational or chemical storage function. In fact, KPRG's review of historical Sanborn fire insurance maps and aerial photographs indicated that 11 single-family residences and six associated garages were present in this area at least through 1950. (It should be noted that the far western portion of the parking lot was undeveloped until the 1949-1970 period when it was utilized as a used car lot; however, there are no TCE impacts in that area of the parking lot.) If fill was placed within this area as part of parking lot development, the TCE may have been within that fill material at time of placement (i.e., originating from a different source area).

In September 2017, KPRG advanced geoprobe borings GP-30 through GP-33 in locations surrounding boring GP-18 and NMW-3R to define the extent of impacts in that area. Analytical results indicated no detectable TCE concentrations in borings GP-30 to the south and GP-33 to the north but did indicate elevated TCE concentrations in GP-31 to the west and in GP-32 adjacent to GP-18. (Historical borings GP-16 and GP-17 had delineated TCE concentrations to the east.) Additional delineation borings in the western portion of the parking lot were advanced in August 2018 (GP-55 and GP-56), with elevated TCE concentrations in both, and January 2019 (GP-57 through GP-61).

A review of the January 2019 data indicated elevated levels of TCE in soil samples collected from two of the geoprobe locations (GP-57 and GP-61) on the southern property boundary. Borings located near the western side of the property (GP-58 and GP-59) and one of the three borings located on the southern property boundary (GP-60) indicated TCE concentrations below laboratory detection limits. To complete definition of the TCE impacts beneath the southwest parking lot, two soil borings (GP-62 and GP-63) were drilled to the north and west of geoprobe location GP-55, respectively, in May 2019.

Borings GP-62 and GP-63 indicated TCE concentrations above the soil to groundwater standard of 3.6 µg/kg but decreased relative to other parking lot impacts. Three additional soil borings (GP-64 through GP-66/HA-1) were drilled in May and June 2019 within the right-of-way on the south side of Perkins Avenue. The analytical data indicated no detections of any CVOCs including TCE on the south side of Perkins Avenue. These sampling locations are presented on Figure 1 and demonstrated the completion of definition of the extent of TCE impacts in the southwest parking lot area. Figure 1 illustrates a TCE soil plume in excess of the 3.6 µg/kg TCE soil-to-groundwater standard with an area of approximately 26,000 square feet (0.6 acres) and also an estimated TCE soil plume in excess of the non-industrial direct contact standard of 1,300 µg/kg (approximately 3,400 square feet). Generally, elevated concentrations were noted within the range of 1-6 ft bgs (only at GP-31 and GP-57 were exceedances noted at 0-2 ft bgs, only at GP-32 and GP-62 were exceedances noted at 6-8 ft bgs, and only at GP-55 at 5-7 ft bgs). Based on this data, it is estimated that approximately 5,800 cubic yards (CY) of soil requiring remediation may be present in the parking lot. At an estimated soil bulk density of 1.45 tons per cubic yard, this yields approximately 8,400 tons of soils that are potentially above the soil-to-groundwater standard of 3.6 µg/kg.

As additional background, it is noted that the RMG facility, an iron foundry, is built over a natural surface water drainage creek that flows to the west and discharges into the Fox River. The creek was routed through a storm sewer at the time of construction of the foundry. As part of implementing the work plan, in December 2017, KPRG began collecting surface water samples from a downstream creek location in Frame Park (west of RMG) and from a natural spring identified as "Hobo Spring" which daylights in Frame Park. The proposed upstream sample location was dry at that time. The surface water samples were analyzed for VOCs and monitored natural attenuation (MNA) parameters. The data indicated low level detections of trichloroethane (TCA) and TCE along with degradation products of DCE (cis, trans and 1,1) and dichloroethane (DCA) in both the downstream and Hobo Spring samples. Although the detections were below WDNR NR 105 applicable surface water comparison criteria, the TCE concentrations in both surface water samples exceeded the NR 140 drinking water enforcement standard (ES) of 5 μg /l.

As part of site investigation work, a camera study was completed of the storm sewer that conveys the creek. The eastern portion of the storm sewer beneath the foundry operations is old brick construction. This portion of the storm sewer was found to be in relatively good condition with some minor mortar deterioration. The western third of that storm sewer, however, is made of corrugated metal. There are two sections of the corrugated metal storm sewer, totaling approximately 190 lineal feet of pipe, that were found to be in poor condition, with some portions disintegrated to the point that the camera could not pass through it (see Figure 1). Repair of this storm sewer must be considered as it is within the area that has TCE shallow soil impacts.

It is also noted that a soil vapor intrusion study was performed (and is ongoing) as part of the site investigation work. The residential neighborhood to the south of Perkins Avenue was found to have TCE vapor intrusion impacts, which have been initially addressed, as necessary, via the installation and operation of sub-slab depressurization systems (SSDSs). CVOC vapor impacts were also measured significantly to the south and east into another neighborhood as well. However, considering the historical industrial use of the properties to the south of Perkins Avenue prior to construction of what is referred to as the Phoenix Heights subdivision, the overall distribution of vapor intrusion impacts within those areas, the distribution of TCE groundwater impacts beneath those areas and associated off-site sources of those impacts, the overall vapor intrusion issue is not sourced from the subject RMG foundry property. However, preventing potential migration of CVOC vapors from the southwest parking lot area to the south must also be considered as part of interim remedial action objectives.

Initial Remedial Action Option Evaluation

In considering remedial options for the shallow soil southwest parking lot TCE impacts, initial discussions focused on soil vapor extraction (SVE) as a possible means to prevent vapor migration off site and to treat the source contamination. Based on the above soil results, KPRG completed two SVE pilot tests on shallow extraction wells EW-1 and EW-2. EW-1 and EW-2 were installed at locations on the west and east sides of the parking lot adjacent to soil borings GP-55 and GP-32, respectively, which had the highest TCE concentrations of any of the parking lot borings advanced by KPRG. EW-2 was also in close proximity to the location of the highest overall TCE concentration in parking lot soils at GP-18. The pilot testing was completed in June and July 2019.

The goals of KPRG's SVE pilot testing were the following:

- To evaluate the potential effectiveness of SVE as a means to remove vapor phase TCE from the vadose zone;
- To estimate approximate SVE radius of influence (ROI) to remove vapor phase TCE across the parking lot;
- To assess potential SVE levels of vacuum and flow rates given existing soil conditions; and
- To provide data on the vapor phase concentrations in the vacuum-driven vapors.

The purpose of the extraction well induced vacuum variable rate pilot tests was to define the pressure/flow characteristics of sub-surface soils around each extraction well and to estimate potential conditions for an operational SVE system design. Starting the test with lower variable rates of vacuum and flow allowed the extraction well and outer wells sufficient time to adjust and stabilize and minimized the risk of developing preferential pathways within the subsurface or short-circuiting to the ground surface. This methodology also assisted the development of newly installed extraction wells. Overall, the SVE pilot tests indicated that SVE is a viable remedial technology for the parking lot TCE soil concentrations, but the test results also indicate the potential for variable operational performance and results across the parking lot site. This variability may be attributable to the presence of heterogeneous fill materials from the former home foundations and other potential imported fill materials used to construct the parking lot. In summary, extraction well EW-1 yielded a maximum induced well vacuum of 25 inches of water and a maximum vapor flow of 28.68 standard cubic feet per minute (scfm), while EW-2 yielded respective values of 8 inches of water and 47.45 scfm.

Over the course of each approximately 8-hour pilot test, the system vacuum was increased at approximately 2-hour time periods and the flow rate recalculated. Measurements were taken at observation wells surrounding each extraction well to record observed vacuum. The measurements recorded over the course of each test were used to calculate 1 percent (%) and 3% ROI. Thus, 1% and 3% ROI with an average vacuum of 17 inches of water at EW-1 correspond to vacuums of 0.17 and 0.51 inches of water, respectively. It is assumed that beyond these points, the pressure gradient (driving force) of the system would be negligible to effectively transport vaporized contaminants to the extraction well. Under continuous operation, it is expected that vacuum and ROI would likely continue to increase horizontally and vertically. Although vacuum and flow were different on the western and eastern portions of the parking lot, the 1% and 3% ROI were similar. Specifically, at EW-1 the 1% and 3% ROI were approximately 15 feet and 13 feet, while at EW-2 they were 16.4 feet and 14.4 feet, respectively. However, it should be noted that one of the observation wells installed to the east of EW-2 and adjacent to historic hot spot GP-18 exhibited minimal vacuum response, indicating a possible physical obstruction such as a former building foundation between the extraction and observation wells.

As part of the pilot testing, KPRG also collected vapor Summa canister "grab" samples for VOC analysis according to Method TO-15 at time periods representing the approximate beginning, middle, and end of each of the two pilot tests. These results are summarized below in micrograms per cubic meter ($\mu g/m^3$).

West Side		East Side	
Extraction Well #1	TCE (µg/m^3)	Extraction Well #2	TCE (µg/m^3)
EW-1 Start	87,300	EW-2 Start	7,340
EW-1 Mid	95,900	EW-2 Mid	5,380
EW-1 End	145,000	EW-2 End	5,320

The west side EW-1 results indicate increasing TCE concentrations as vacuum and flow rates were increased over the course of the test, while EW-2 results indicate steady to decreasing concentrations over the test period. It is noted that the higher soil vapor concentrations were found on the west side of the parking lot, which has TCE soil concentrations that are an order of magnitude lower than that observed in soils on the east side. These results again point to possible heterogeneities in subsurface materials across the parking lot site. Another site feature that would need to be incorporated into an SVE system design is a sanitary sewer line running roughly north-south across the approximate center portion of the parking lot. This sewer would need to be bridged as part of a single system design or used as a dividing line for a multi-system design. Regardless, the SVE system would need to intercept the sewer backfill to prevent it from potentially acting as a preferential migration pathway for TCE.

As mentioned in the background discussion above, KPRG implemented an on-site storm sewer camera study to gain an understanding of the current condition of the sewer lines to help evaluate the potential distribution of impacts and provide the necessary information to support the evaluation of remedial options. Further, KPRG completed a comprehensive storm sewer water sampling program both on and off site. The intent of this sampling was to gain an understanding of the potential presence of CVOCs in storm water within the regional storm water system at a specific point in time. The camera investigation of the old storm sewer beneath the southwest parking lot area occurred on July 16, 2019. The results specific to the storm sewer (culvertized creek) within the southwest parking lot indicates two separate portions of sewer line, totaling approximately 190 lineal feet of corrugated metal pipe, that needs to be repaired/replaced on the northwest and northeast portions of the parking lot. It was noted that this damage was severe enough that there were locations through which the camera could not pass. Given these results, the assumed remedial solution would be to remove approximately 190 feet of the existing storm sewer and replace with new 48-inch diameter storm sewer pipe (same as current storm sewer) with the removed backfill being disposed of off-site at a non-hazardous waste landfill. KPRG's June 24, 2019 Data Transmittal Letter of the Storm Sewer Water Data showed no detected concentrations of any CVOCs on the RMG site including upstream of the locations in the southwest parking lot requiring repairs/relining.

<u>Interim Remedial Action Options</u>

Given the above background information on environmental conditions in the southwest parking lot, the identified likely remedial action options are summarized in detail below and evaluated in accordance with the following criteria established in NR 722.07(4):

- Technical Feasibility
    - Long-Term Effectiveness
    - Short-Term Effectiveness
    - Relative Timeframe
    - Implementability

- Economic Feasibility

A narrative discussion of the identified remedial action options follows below, while the technical and economic feasibility and timeframes of each option are further explored in the attached Table 1.

<u>*Southwest Parking Lot CVOCs in Soils*</u>

<u>*SVE*</u>

Upon review of the SVE pilot test results, KPRG has determined that the method is a technologically viable option to address southwest parking lot shallow TCE soil concentrations. However, given that there are site conditions that may complicate system design and add cost and time to the completion of remediation in this area, KPRG believed it was warranted to consider other remedial action option alternatives. Further, it was also warranted to establish the cleanup objective for this area. Unencumbered future site usage would require cleanup to the soil-to-groundwater standard of 3.6 µg/kg. However, as stated previously, the estimated footprint of the 3.6 µg/kg plume in conjunction with noted possible site heterogeneities will make achieving this goal using SVE challenging. Further, it is likely that the parking lot area will remain part of a commercial or industrial property for the foreseeable future. In that regard, it was noted that there were no exceedances of the industrial direct contact TCE standard of 8,410 µg/kg and only two exceedances of the non-industrial direct contact TCE standard of 1,300 µg/kg. Given the presence of nearby residences and the likely ongoing future use of this area as a paved parking lot (i.e., an engineered barrier), the 1,300 µg/kg standard is recommended as an alternative remedial objective. The remedial option selected will be based on the assumptions that the relevant portion of the parking lot is maintained as an engineered barrier (continuing obligation) and that a non-residential usage of the property will be included as an institutional control.

The results of the two pilot tests indicate that if SVE were the selected alternative, the design would include two individual SVE systems focused on the east and west sides of the parking lot, respectively, and using the aforementioned sanitary sewer as a dividing line between the systems. Based on the locations of the observed “hot spots”, the sanitary sewer, and the proximity of electrical service via the transformer yard to the east, one of the SVE systems would be located on the east side of the parking lot in the vicinity of GP-18 and GP-32, and the second system would be located adjacent to the west of the sanitary sewer. System 1, addressing west-side soils, would include an approximately 150-foot long horizontal slotted header pipe running approximately due west from the system adjacent to the west of the sanitary sewer to 50 feet west of GP-55 to capture the approximate western extent of the TCE plume. The eastern extent of this header pipe will end within the backfill of the noted sanitary sewer. System 2, addressing east-side soils, would include an approximately 125-foot long horizontal slotted header pipe running approximately due west from the system adjacent to GP-32 and GP-18. The western extent of this header would also be set within the backfill of the sanitary sewer so that the system will eliminate the possibility of this utility backfill acting as a vapor migration pathway. The two header pipes would be offset by approximately 25-30 feet in the north-south direction so that the ROI intersect but do not entirely coincide. A series of vertical extraction wells would be placed at approximate 30-foot intervals and connected to the header pipes with five vertical wells for System 1 and 4 wells for System 2. System 1 would include an approximately 150 scfm blower at 30 inches of water, while System 2 would include an estimated 240 scfm blower at 15 inches of water. These systems will require site power at 240 volts, 3 phase, 60 Hertz. Each system would include a water separator for capturing condensate. Each system would be enclosed in an eight-foot square shed with pressure treated plywood flooring, lighting, and a 600-watt heater. The systems as designed are intended to collect identified elevated TCE concentrations along an approximately 275-foot long by 30-foot wide roughly east-west corridor from west of GP-55 to east of GP-32 and operate until the 3.6 µg/kg objective is met. Sharp turns and lateral piping were avoided in this design so as to maximize efficiency of the blowers.

KPRG evaluated setting the header pipe using trenching or horizontal drilling and found that trenching was preferred for cost, availability of local contractors, ease of setting pipe at desired depths, and ability to reuse most excavated material as backfill. A rubber liner is proposed as a top layer prior to sub-base and fresh asphalt to prevent short-circuiting of fresh air into the system during operation.

The operating timeframe of the system would depend upon system effectiveness. System monitoring by KPRG field personnel would occur on a monthly basis during the first year and quarterly thereafter. KPRG would also be on call for any system-related outages, which would be signaled by a flashing strobe light on the control panels so that RMG can contact KPRG. (System telemetry was considered to be a cost that could be avoided.) For remedial action comparison purposes, KPRG included quarterly sample effluent VOC analysis and annual progress reports over a 5-year timeframe.

The projected installation and operating cost for the two systems over a 5-year timeframe including a 15% engineering contingency is $970,000. This cost has assumed normal system maintenance and repairs and assumes that the system electrical service is paid by RMG.

<u>*Chemical Oxidation*</u>

In-situ chemical oxidation (ISCO) represents another strategy to address soil impacts in place without incurring significant disposal costs. ISCO involves the introduction of a chemical oxidizing agent, such as potassium/sodium permanganate or catalyzed sodium persulfate, into the subsurface soil. The oxidizing agent reacts chemically with the organics within the soil (including the contaminants) resulting in non-hazardous by-products such as chlorine, carbon dioxide and manganese oxide in the case of potassium/sodium permanganate treatment. Typically, when ISCO is considered, source samples of impacted soils are collected to be used in bench-scale testing to determine total oxidant demand and treatability of site soils and impacts. This testing is used to determine which oxidant and catalyzing agent will be most effective with site soils and known site concentrations and also to calculate the approximate dose level and quantity of oxidants and agents. For purposes of this remedial option comparison and based on KPRG's experiences with this remedial technology on other sites, assumptions have been made concerning dosing and chemical quantities. However, were this remedial technology selected, KPRG would recommend conducting a bench test in order to select the most appropriate oxidant/agent and the recommended dosage/quantity for site conditions.

Based on KPRG's experiences on other sites and given the relatively low concentrations of TCE at shallow depths potentially present across approximately 0.5 acres of parking lot, KPRG would recommend in-situ soil mixing rather than use of a grid of geoprobe-installed injection points for treating to the most conservative remediation objective of 3.6 µg/kg.

Given the calculated dosage of treatment chemicals, a per square foot quantity of chemicals would be determined to be applied during soil mixing. This method will involve the removal and recycling of the existing top cover of deteriorated asphalt and associated granular sub base to expose the underlying impacted soils. Once impacted soils are exposed, the remediation area would be divided into smaller, more manageable treatment grid zones. A hydraulic excavator or backhoe would be used to expose soils in each treatment zone while chemicals are applied. This process would continue iteratively across the treatment area. Assuming sufficient mixing to allow oxidant contact with impacted soils, the reaction would proceed rapidly. Therefore, in order to determine sufficient concentration reductions are taking place and that a second round of treatment is not required, KPRG would collect representative documentary samples from a limited grid area (likely the area with highest concentrations near GP-16/GP-32) for expedited chlorinated VOC analysis while treatment and mixing are continuing. This process would allow rapid evaluation of analytical data and determination of whether additional treatment is required. Further, it would alleviate the potential need for a second mobilization of personnel, equipment, and chemicals. This gridded in-situ mixing and confirmation soil sampling practice has been used by KPRG successfully on other projects with WDNR approval including Western Industries (BRRTS #02-68-543967).

It should be noted that ISCO can have a detrimental effect on the strength properties of the soils due to the oxidants reacting with the natural organic soil components. Therefore, upon completion of remediation, it is recommended that the treated soils be left unpaved for several months to allow for drying and settling. Further, machine compaction and proof-rolling would be required and recommended prior to repaving. Amendment with engineered backfill in place of treated soils may be necessary prior to application of paving materials. Structural adjustments to site soils are not included in this estimate.

The projected cost of this estimated 20-day field treatment approach to treat the parking lot area to the most conservative objective of 3.6 µg/kg including a 15% engineering contingency is $1,300,000.

Excavation/Disposal

Soil excavation and disposal is an option for remediation by physically removing the source soils from the site and disposing of them properly at a regulated solid waste disposal facility. This option has assumed that the soils are considered a non-hazardous waste and can be profiled for disposal at a local landfill such as the Advanced Disposal Emerald Park Landfill in Muskego or the Waste Management Orchard Ridge Disposal facility in Menomonee Falls. As indicated above, 8,000 tons of soils are estimated to be present within the 3.6 µg/kg plume. This quantity assumes that the overlying asphalt is removed and recycled and that the overlying one foot of un-impacted soils and sub base can be set aside and replaced.

It should be noted that a small portion of these soils may be impractical to excavate and remove safely. These include soils along the southern portion of the impacted area along the sidewalk and soils beneath and immediately adjacent to the north-south sanitary sewer to prevent these features from being structurally undermined. KPRG has assumed that the excavation can be accomplished in approximately 10 days using 12 trucks per day with each truck making three trips to the landfill per day. When possible, trucks would return to the site with loads of virgin stone for backfill. An exception to the stone backfill would be along the aforementioned southern sidewalk where clay backfill would be placed as a means to block any potential vapor migration from any minimal remaining soil impacts. Site restoration would include machine compaction and repaving of the affected area with asphalt upon completion of remediation. Documentary bottom and sidewall verification soil samples would be collected at a spacing of approximately one for every 20 linear feet for CVOC analysis to document successful remediation.

The projected cost of this 10-day field excavation treatment approach including a 15% engineering contingency is $1,200,000.

Focused Excavation/Active Venting

Recognizing that the overall RMG property will likely remain industrial and that the subject area will likely remain used as parking for the foreseeable future, significant cost savings can be achieved through using a combination of technologies to achieve the soil non-industrial direct contact cleanup objective of 1,300 µg/kg.

Using existing soil data, it is assumed that approximately 1,000 tons of soils in excess of this objective are present at depths of up to 6 feet below ground in the vicinity of GP-32/GP-18 and GP-55 (the high concentration at GP-55 is below this objective but for purposes of this estimate, soils in this area are assumed to include concentrations that are above). These soils are proposed to be excavated for proper disposal as non-hazardous waste as described above. Clean stone backfill will be replaced in the excavation and removed/recycled pavement will be replaced. Similar excavation type documentary bottom and sidewall soil samples will be collected only from the two hot spot excavations for VOC analysis to document successful remediation along approximate 20-linear foot spacing. This analysis would be expedited to prevent the need for an additional equipment mobilization if some limited further excavation is required.

To address the potential soil vapor migration from the lower concentration residually impacted soils to be left in place, a vapor interceptor trench will be constructed. This approximately 300-foot (the east-west distance of the soils with TCE concentration that may be above the non-industrial direct contact standard) approximately 3-feet wide trench will be dug to a depth of up to 8-feet running approximately east-west along the northern sidewalk, as shown on Figure 1. These soils comprising an additional approximately 750 tons will also be removed for proper landfill disposal. The top, bottom, and southern face of the trench will be lined with Bentomat CL, a reinforced geosynthetic clay liner (specifications provided in Attachment 1). The trench will be backfilled with a uniform graded stone to create a more porous active vapor vent. A four-inch diameter slotted horizontal pipe will be located within the backfill with two terminating vertical headers placed in protective locations that will receive prevailing winds. This eastern terminating vertical header at a height of 15 to 20 feet will utilize a radon-type electric motor with manometer to provide a continuous negative pressure (i.e., vacuum) within the horizontal trench pipe. The western terminating vertical header will be topped with a roof-type “pinwheel” vent to provide backup passive venting in the event of power outage or motor maintenance event. The stone will be topped with the geosynthetic clay liner as noted to prevent short circuiting with ambient air and topped with gravel sub base prior to asphalt surface. Bollards will be placed to protect the turbine vents from vehicle damage.

Backfill of the southern flowing six-inch sanitary sewer line near the northern sidewalk will utilize compacted clay as a clay “check” plug as shown on Figure 1. This will be used as an additional control to prevent potential off-site CVOC vapor migration to the south through sewer backfill.

The projected cost of this 10-day field treatment approach, which will require maintenance of the parking lot as an engineered barrier, including a 15% engineering contingency is $460,000.

<u>Storm Sewer Pipe</u>

KPRG’s video camera study of the southern on-site storm sewer revealed two sections of pipe, totaling approximately 190 lineal feet of pipe, beneath the west side of the southwest parking lot that are damaged. KPRG’s corresponding storm water sampling study also revealed from up-gradient and down-gradient storm sewer water samples that the water passing through the pipe is not impacted by CVOCs. It is suspected that down-gradient surface water detections of CVOCs in Frame Park may be from CVOC impacts moving within down-gradient pipe backfill or from near surface groundwater discharge to the creek and not from the southwest parking lot.

Nevertheless, this damaged infrastructure maintenance item is to be addressed as part of overall site remediation efforts due to its location within an area with known shallow soil CVOC impacts. Therefore, KPRG has identified the following potential remedial action options.

Pipe Rerouting and Abandonment

The creek that traverses Frame Park to the west of the site before emptying in the Fox River has an up-gradient location across Cleveland Avenue to the east of the foundry. KPRG has noted from regularly collecting surface water samples at this location that the creek flow at this up-gradient location has been manipulated for storm water controls using a series of weirs. These weirs preferentially send the primary flow through a storm sewer that cuts across Cleveland Avenue before proceeding down Perkins Avenue and through a newer storm sewer that generally parallels the northern property boundary and flows west before connecting with the aforementioned central storm sewer pipe that has a damaged portion within the southwest parking lot. This connection point between the two sewers is downstream (west) of the section that is damaged. This flow is shown on Figure 1.

One means of addressing the damaged portion of the storm sewer that is present in the southwest parking lot that was considered was abandoning this section of pipe. If this section were abandoned, the potential leaching ingress of CVOCs through this damaged pipe would be eliminated. The pipe would need to be plugged at an upstream location in the vicinity of manhole STMH-11 and a pumping lift station and piping would be required to connect this upstream pipe section to the storm sewer that runs along the northern property boundary.

This option does introduce the use of pump(s) to manage water flow, which will require regular inspection and maintenance, into a system that previously worked exclusively via gravity. This aspect is manageable although it adds ongoing costs and responsibilities on the facility. However, there is concern that the northern on-site storm sewer may be overloaded and overflow in the event of a significant storm water event if it is handling water flow formerly served by two storm sewers. Further, it is possible that the City of Waukesha's Public Works Department may not approve of abandoning the southern of the two on-site storm sewers for that reason.

Therefore, due to these potential regulatory and long-term maintenance concerns, rather than technical or economic concerns, this option has been deemed to be infeasible. Since this option was determined to be infeasible, an estimated timeframe was also not determined.

Pipe Relining

Cured in place pipe (CIPP) repair generally involves using a resin impregnated felt tube made of polyester or fiberglass that is inverted and pulled through a damaged pipe from an up-gradient access point to a down-gradient egress point whereupon steam is used to seal the lining in place. CIPP requires the pipe subject to relining to be dry. Thus, it would need to be temporarily bypassed and dewatered. Further, prior to relining, worker entry will be required to assess those locations where the camera could not pass. It is possible that those locations may not be able to be relined and may require excavation and replacement. This means of pipe repair is advantageous for the two western sections totaling approximately 190 feet in that little to no excavation may be required, based on the results of the above-mentioned assessment, when existing manholes can be utilized as entry and exit points. A nearby exit point is present at the manhole identified on Figure 1 as STMH-12; however, unfortunately all up-gradient entry points are all located within the "alley" that traverses the plant and that is a major area of foundry operational traffic of trucks and other equipment. These locations, STMH-11 and other up-gradient entry points, are impractical due to the disruption they would cause to ongoing foundry operations. Also, such a distant entry point would mean that approximately 530 feet of pipe would be relined rather than the approximately 190 feet that actually need relining.

This option also includes the installation of clay "check" plugs prior to the storm sewer pipe exiting the western property boundary and prior to the sanitary sewer pipe exiting the southern property boundary as previously noted. It is assumed that the approximately 1,600 tons of removed backfill will be disposed of locally off-site at a non-hazardous waste landfill.

The projected cost of this 10-day field treatment approach including a 15% engineering contingency is approximately $275,000 plus the difficult to currently quantify potential additional cost to later replace pipe sections that are determined to be conditionally unsuitable for relining. The project cost of the two sewer plug installations including a 15% engineering contingency is approximately $70,000.

Pipe Replacement & Pipe Backfill Plugs

This option calls for the direct excavation, removal, and replacement of the two sections of sewer pipe, totaling approximately 190 feet that is damaged (and limited replacement of the spot corrosion hole on the east side of the parking lot). The 48-inch diameter corrugated metal pipe will be replaced with an equal diameter, likely HDPE pipe.

This option also includes the installation of clay "check" plugs prior to the storm sewer pipe exiting the western property boundary and prior to the sanitary sewer pipe exiting the southern property boundary as previously noted. It is assumed that the approximately 1,600 tons of removed backfill will be disposed of locally off-site at a non-hazardous waste landfill.

The projected cost of the 12-day pipe replacement approach including a 15% engineering contingency is approximately $300,000. The project cost of the two sewer plug installations including a 15% engineering contingency is approximately $70,000.

Summary Table

The attached summary Table 1 provides brief summaries of the potential remedial options discussed above and the relative technical and economic feasibilities of each.

Conclusions/Recommendations

Navistar/KPRG has evaluated all presented remedial options in general accord with NR 722.13(2)(e) as outlined below. Although all of the presented remedial options are generally technically feasible, the time horizons and potential costs to complete remedial action, particularly if the soil-to-groundwater TCE standard of 3.6 µg/kg were the clean-up objective, are wide ranging. Thus, in consideration of these potential long-term treatment windows and high cost per weight of impacted soil, Navistar/KPRG select focused "hot spot" excavation in conjunction with active vapor venting as the most expedient, technically sound, and cost effective means to address the shallow residual soil TCE impacts in the southwest parking lot. Due to potential technical and logistical challenges of the other evaluated options, Navistar/KPRG select replacement of damaged portions of the storm sewer and clay "check" plugs around sewer crossings of property boundaries as the preferred means of addressing potential sewer backfill contributions to off-site surface water and vapor impacts.

Navistar/KPRG propose to begin planning the implementation of the selected remedial options upon written approval of this document by WDNR. This process will include preparation of bid documents, contractor site walk, bid opening and review, preparation of waste profiles, scheduling, and planning with the facility. It is expected that this pre-construction planning phase may take up to 10 weeks. The construction phase of the selected remedial options is expected to be completed within four weeks. The timing of this construction phase, whether it occurs during the 2020 construction season or whether it occurs during spring 2021, will depend in part on the timing of the approval of this document. The combined cost of the two selected remedial measures is estimated to be $830,000. Compliance with the WDNR non-industrial direct contact standard of 1,300 µg/kg is expected to be achieved immediately upon completion of excavation of the two noted "hot spots". Other areas of excavation (the vapor trench, storm sewer repairs, and clay "check" plug installations) will achieve immediate incidental improvements in soil conditions though there are no documented exceedances in these areas. As previously noted, the excavated soils and debris are expected to be profiled for disposal at a nearby landfill as a non-hazardous waste. Galvanized storm sewer pipe removed for repair will be recycled/scrapped. Soil vapor improvement standards will be monitored by regular vacuum gauge inspection to document proper operation of the electric vacuum blower motor and passive wind-driven vent. Potential surface water quality improvements from the clay "check" plug and sewer repairs will be monitored through continued routine monitoring of surface water chemistry in Frame Park.

It is noted that the selected remedial options area believed to be the most sustainable of all of the options evaluated. By conducting only focused "hot spot" excavations and only those trenches needed for storm sewer repairs, vapor piping, and clay "check" plugs, significant reductions in emissions from trucks transporting soils to the landfill and heavy equipment moving soils on site are achieved. Further, this approach greatly reduces the amount of soils placed in a landfill. In addition, this approach does not result in any noteworthy wasted water usage or impact on water resources. Also, the use of a small vacuum blower motor with wind-driven passive backup will result in significant savings on electrical power usage over time when compared to that of the SVE option. Other sustainable practices to be implemented as feasible will include recycling of scrap storm sewer pipe and overlying asphalt and reuse of underlying pavement sub base (if deemed suitable).

Below is presented the general steps to implement these interim remedial actions.

<u>INTERIM REMEDIAL ACTION IMPLEMENTATION</u>

This section provides the proposed implementation plan for the preferred remedial alternative identified above for soil, soil vapors, and surface water (i.e., the storm water pipe). The Interim Remedial Action Plan (IRAP) phase includes the following tasks:

- Task 1 – Direct Excavation of Hot Spot Soils/Off-Site Disposal/Vapor Trench/Storm Sewer Repair
    - 1a. Hot spot excavation/disposal
    - 1b. Storm sewer pipe replacement/spot repair
    - 1c. Soil vapor trench/liner/pipe installation
    - 1d. Clay "check" installations
    - 1f. Repaving/site restoration

- Task 2 – Soil Vapor Interceptor Trench Operation and Condition Monitoring

- Task 3 – Interim Response Action Summary Report

Each task is discussed separately below.

<u>Task 1 – Direct Excavation of Hot Spot Soils/Off-Site Disposal/Vapor Trench/Storm Sewer Repair</u>

This task will include the following:

- Complete a Waste Profile for submittal and approval to the Advanced Disposal Emerald Park Landfill in Muskego or the Waste Management Orchard Ridge Disposal facility in Menomonee Falls for disposal. At this time, it is believed that the soil data obtained as part of the focused site investigation will be sufficient for completing the required Waste Profile documentation.

- Contact Diggers Hotline and a private locate contractor to mark public and private underground utilities within the excavation area in conjunction with knowledgeable RMG personnel.

- Revise the existing site health and safety plan to include the proposed interim remedial actions.

- Sawcut an estimated 500 linear feet of asphalt pavement for the storm sewer and soil vapor distinct trenches and approximately 3,400 square feet from the two hot spots. Remove and recycle the existing asphalt. Segregate reusable sub-base gravel if acceptable.

- Excavate and load an estimated 3,350 tons of residually impacted soils to a depth of eight to up to 13 feet from the two hot spots, the vapor trench, storm sewer, and storm and sanitary clay "check" locations. Some hand excavation will likely be required in close proximity of utility piping, etc.

- Transport and dispose of the impacted soils to the selected local landfill.

- Collect verification soil samples from the sidewalls of the two identified "hot spot" excavations at approximate 20-foot intervals (up to 12 samples are expected). Have the soil samples analyzed for CVOCs on an expedited basis (24-hour turn around). Perform additional soil excavation and verification sampling in specific areas, if necessary, based on the results of the initial verification samples.

- The storm sewer excavation will extend up to approximately 13 feet below grade. Replacement pipe will be similar 48-inch diameter ribbed galvanized steel or HDPE equivalent. Pipe bedding will be six inches of 0.5 to 0.75-inch loose crushed stone. Trench backfill will be 1.5-inch crushed stone machine compacted.

- The soil vapor trench will extend to eight feet below grade. The top, bottom, and southern face of the trench will be lined with Bentomat CL or equivalent. The trench will have a bedding material of 0.5 to 0.75-inch loose crushed stone overlying the Bentomat CL and upon which is placed four-inch diameter PVC Screen 0.030-slot Schedule 40 piping with enclosing filter sock (to prevent silting/clogging of vapor piping). Two forty-five degree pipe elbows will be used at the eastern and western terminus of the piping and solid Schedule 40 four-inch PVC piping to stub above grade. A suitably sized inline electric blower motor will be installed on the eastern vertical header to draw a vacuum over the length of the piping to exhaust at a point at least 15 feet above grade. The western pipe stack will include a wind turbine vent to allow continued passive operation in the event of a power outage or electric motor repair/replacement. Overlying excavation backfill with 1.5-inch crushed stone. Top excavation with the liner as noted. Atop the liner is a gravel sub-base followed by three-inch binder/two-inch asphalt surface coat. Four bollards will be placed around each vertical header.

- Clay "check" plugs will be installed at the south flowing six-inch sanitary line and the western end of the replacement section of the 48-inch storm sewer pipe that ultimately drains towards Frame Park to the west. Each plug location will include the entire excavation cross section with a width of four feet. Due to the plug presence around a pipe, some hand backfilling and hand tamping will be done in the vicinity of the pipe with the entire profile filled with clean clay placed in six-inch lifts that are plate compacted.

- Upon completion of all subsurface work in the southwest parking lot, each excavation location will have surrounding asphalt sawcut to create clean boundaries for site restoration with clean/recycled gravel road sub base, three-inch asphalt binder, and a two-inch asphalt surface course.

Construction cross sections are presented in Figure 2. A vertical vapor header detail is presented in Figure 3. The implementation should also include a water management plan if the excavation needs to be dewatered due to rains or an unexpectedly high water table. The water pumped from the excavation would need to be stored temporarily, sampled and sent for proper off-site disposal or permitted sanitary sewer discharge.

<u>Task 2 – Operational and Condition Monitoring of the Soil Vapor Interceptor Trench</u>

The "hot spot" excavations to achieve the soil non-industrial direct contact cleanup objective of 1,300 µg/kg and the additional soil removals for storm sewer replacements/repairs, clay plugs, soil vapor trench will result in a significant CVOC source removal action that will also have incidental source volatilization during the construction process when the pavement is removed. Further source removal will occur over time through the continuous operation of the active soil vapor interceptor trench. In order to verify this ongoing source reduction, the following procedures will be used:

- Thereafter, KPRG will conduct a quarterly inspection of the exhaust vacuum motor operation, record the manometer readings at the two headers, and note general parking lot condition in the trench location. At the conclusion of the two years, KPRG will provide WDNR with an annual progress report summarizing the results.

<u>Task 3 – Response Action Summary Report</u>

Upon completion of Task 1 activities and the initial Task 2 activities, a Response Action Summary Report will be issued. The report will include, but not be limited to, the following:

- Background and Response Objective(s)
- Documentation of soil and soil vapor remediation activities. This will include a narrative describing the field activities and all associated transport and disposal documentation.
- Verification soil sampling results documenting achievement of soil remediation goals.
- Analysis of the first round of soil vapor monitoring.
- Summary/Conclusions

CERTIFICATION

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

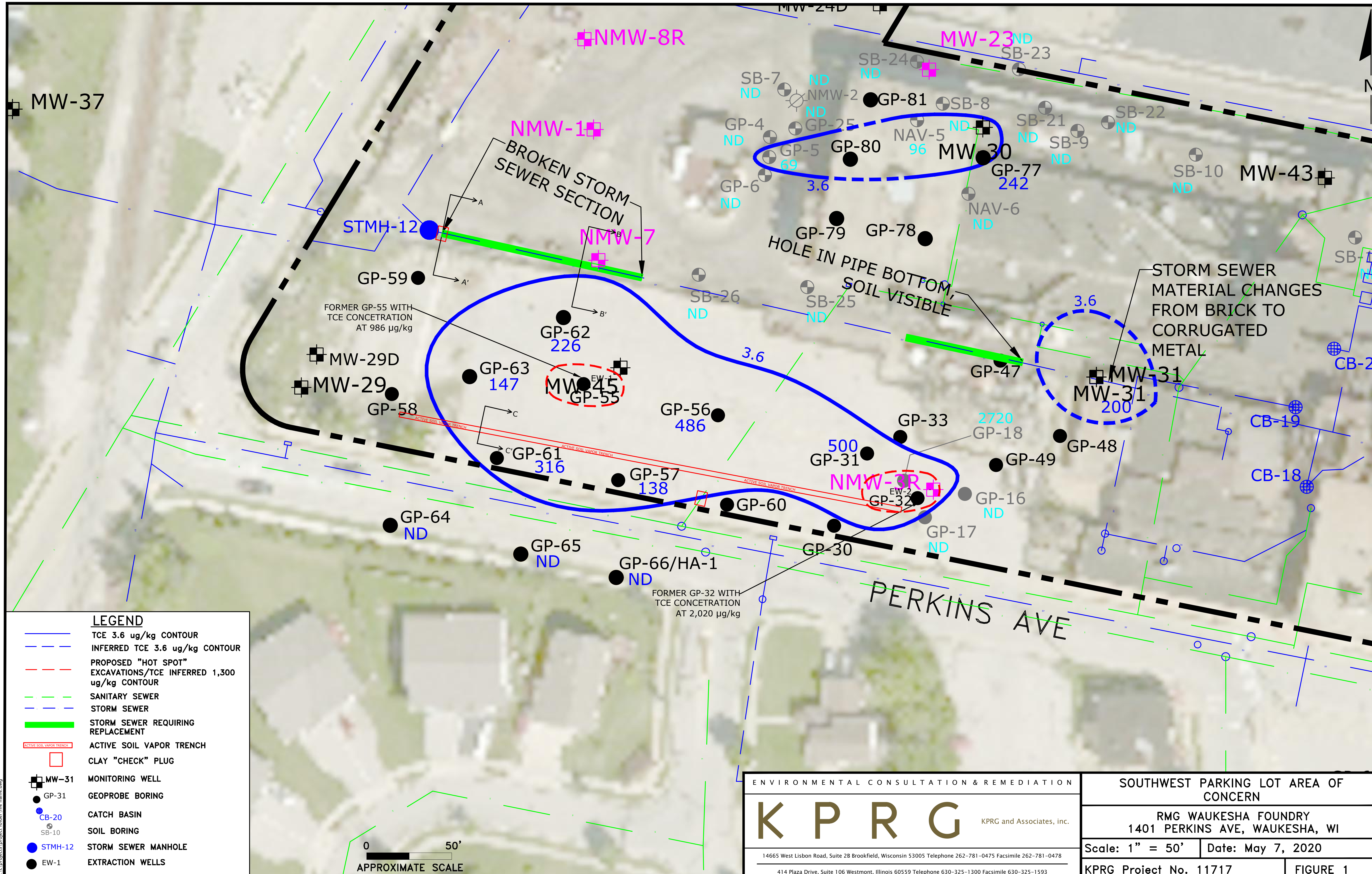
WISCONSIN
JOSHUA D.
DAVENPORT
PE #40131-006
HARTLAND,
WI
PROFESSIONAL ENGINEER

5-29-2020

Joshua Davenport, Senior Engineer, 40131-006

P.E. stamp

Figures



E N V I R O N M E N T A L C O N S U L T A T I O N & R E M E D I A T I O N

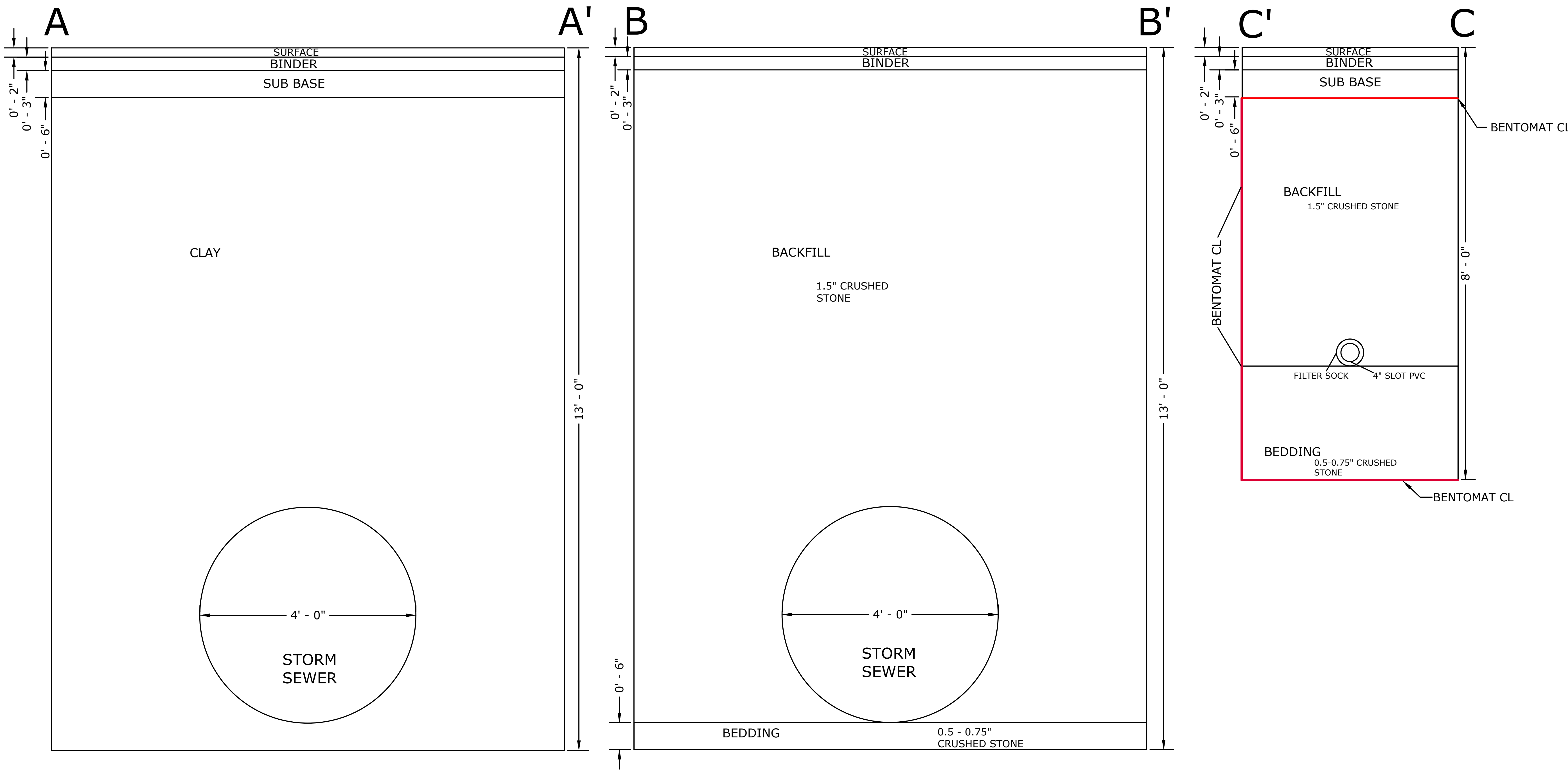
KPRG

KPRG and Associates, inc.

14665 West Lisbon Road, Suite 2B Brookfield, Wisconsin 53005 Telephone 262-781-0475 Facsimile 262-781-0478

414 Plaza Drive, Suite 106 Westmont, Illinois 60559 Telephone 630-325-1300 Facsimile 630-325-1593

SOUTHWEST PARKING LOT AREA OF CONCERN	
RMG WAUKESHA FOUNDRY 1401 PERKINS AVE, WAUKESHA, WI	
Scale: 1" = 50'	Date: May 7, 2020
KPRG Project No. 11717	FIGURE 1



LEGEND

BENTOMAT CL

0 2'

APPROXIMATE SCALE

ENVIRONMENTAL CONSULTATION & REMEDIATION

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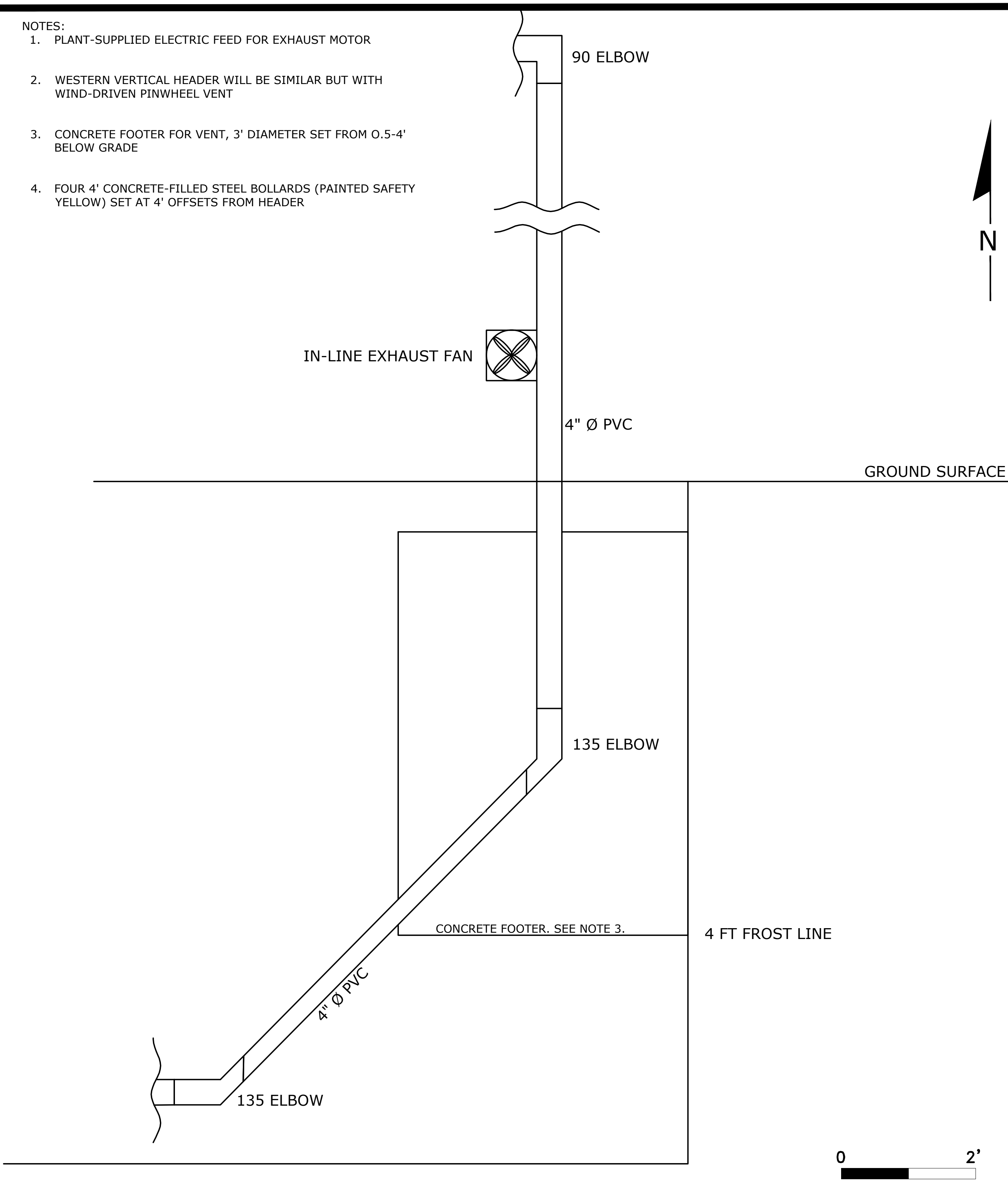
CROSS SECTIONAL VIEWS A–A', B–B', C–C'

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1" = 2'	Date: May 8, 2020
KPRG Project No. 11717	FIGURE 2

NOTES:
1. PLANT-SUPPLIED ELECTRIC FEED FOR EXHAUST MOTOR
2. WESTERN VERTICAL HEADER WILL BE SIMILAR BUT WITH WIND-DRIVEN PINWHEEL VENT
3. CONCRETE FOOTER FOR VENT, 3' DIAMETER SET FROM O.5-4' BELOW GRADE
4. FOUR 4' CONCRETE-FILLED STEEL BOLLARDS (PAINTED SAFETY YELLOW) SET AT 4' OFFSETS FROM HEADER



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ENVIRONMENTAL CONSULTATION & REMEDIATION

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EASTERN VERTICAL VAPOR HEADER DETAIL

RMG WAUKESHA FOUNDRY
1401 PERKINS AVE, WAUKESHA, WI

Scale: 1” = 2’	Date: May 28, 2020
KPRG Project No. 11717	FIGURE 3

<u>Table</u>

Table 1. Evaluation of Remedial Options, Southwest Parking Lot, RMG, 1401 Perkins Avenue, Waukesha, WI 53186

KPRG

Soil/Vapor Remedy Options	Technology Description	Technical Feasibility	Economic Feasibility	Relative Timeframe	Remedy Cost including 15% Engineering Contingency
No Action	This option assumes there is a no action alternative for the southwest parking lot soils. Use natural biodegradation and volatilization processes to reduce contaminant mass over time.	There is documentation of soil impacts above soil screening levels for TCE. This alternative would only be feasible in conjunction with engineered barriers and/or institutional controls (see discussion of barrier below). Due to regional soil vapor intrusion concerns, this option alone is unlikely to be acceptable to regulators.	No substantive additional cost.	The use of engineered barriers/institutional controls represents an ongoing obligation. This obligation would be ongoing unless the property owner elected reopen the site and pursue a different remedial option.	**$0.00**
Soil Vapor Extraction (SVE)	This option includes: The installation of two SVE systems to address identified impacted shallow TCE-impacted soils on the west and east sides of the southwest on-site parking lot. Approximately 275 feet of trenching on a roughly east-west trajectory to install slotted horizontal tied to east/west extraction wells. Systems would intercept the backfill of an approximately north-south sanitary sewer line near the center of the parking lot. System specs include approximately 240 and 150 scfm blowers using 240-volt, 3 phase electrical service.	This option is technically feasible. Pilot test results indicated that potential subsurface heterogeneities may impact the ability to reach soils at the calculated radii of influence, which would negatively impact the *time* required to complete treatment. If the remediation objective is 3.6 ug/kg and the maximum detected concentration is 2,720 ug/kg, then a maximum 99.9% reduction must be achieved, which will be a challenging SVE goal even with ideal soil conditions.	Regular system performance monitoring will be conducted (monthly the first year and quarterly thereafter). Site investigation to be performed at the five-year operating point to determine progress at contaminant mass reduction. Project budget assumes a five-year operating window; however, additional costs would be incurred if operation is required to continue. Budget cost is over an estimated *five years*.	The timeframe for this option has initially been set at 5 years based on the relative levels of TCE present, the limits of the remediation technology, and the heterogeneities of the subsurface conditions. At 5 years, remedial progress would be evaluated and the project timeframe revisited. Based on experience at other sites, this timeframe will be extended past the 5 years.	**$970,000.00**
In-Situ Treatment w/ Chemical Oxidation	This option generally involves: Introduction of a chemical oxidizing agent into the subsurface soil via direct mixing or injection points. Oxidizing agent would react chemically with the organics within the soil (including the contaminants) resulting in non-hazardous by-products such as chlorine, carbon dioxide, water, oxygen and manganese oxide depending upon the oxidant used in treatment. In theory no soils would be excavated with this option, so soil handling/disposal issues would be minimized or eliminated. Due to the size of the area potentially encompassing soils with TCE in excess of 3.6 ug/kg & deteriorated condition of existing pavement, KPRG would propose using a hydraulic excavator to mechanically mix soils and oxidant iteratively across the treatment area. This process would more quickly, economically, and completely introduce oxidant to the contaminant mass than multiple injection points.	Chemical oxidation technology has evolved over the last several years. Oxidant selection is also important. This option generally requires a treatability study to determine the proper chemical and dosage to use. Since the oxidant chemically reacts with the contaminant to physically breakdown the chemical to non-hazardous by-products and the reaction occurs quickly, this treatment option is effective on both the short and long term basis relative to meeting cleanup objectives and risk reduction. In general, cleanup objectives are not always met with only one reaction and that based on verification sampling, a "polishing" second mixing over a portion of the treatment area may be needed to meet final goals. One downside of the reaction of the oxidant with the natural organic components of the soil is the potential negative effect on the structural properties of the soil, which may effect its strength as an underlying material for the parking lot in the future.	The economic feasibility of this option is driven by: The mass of contaminant that needs to be treated (and thus the quantity of oxidant required), the natural oxidant demand of the soil, the size of the treatment area, the permeability of the soils and the levels of treatment that need to be achieved. Based on the data available, the estimated costs include $15,000 to collect a representative sample and conduct a treatability study. The mixing process would include expedited confirmation sample analysis over a small area to determine treatment effectiveness and whether further additions of oxidant were warranted to complete treatment. For budgetary purposes, a second smaller round of mixing is assumed for approximately one third of the treatment area.	The timeframe for this option assumed that 300 cubic yards of impacted soils could be treated each day, which would require 20 days of treatment.	**$1,300,000.00**
Soil Excavation and Off-Site Disposal	This option includes: Excavation of the primary impacted source soils exceeding the soil-to-groundwater residual contaminant level of 3.6 ug/kg TCE and transport of the soils for proper off-site disposal. Based on data collected to date, KPRG estimates that approximately 8,000 tons of TCE-impacted soil exists to a depth of 7 feet bgs beneath the site at 1.45 tons per cubic yard conversion. Excavation would include temporarily restricting access to the parking lot, removing and recycling overlying asphalt, setting aside the top un-impacted sub base material if suitable for reuse, excavating the impacted soils, backfilling the excavation with virgin stone, machine compacting the work area, and replacing the asphalt pavement. Based on the observed TCE concentrations, the soil is assumed to be suitable for disposal as a non-hazardous waste.	This option is technically feasible and would cause only short-term disruption of the parking lot area use. Excavation of source material provides a good *short and long term* solution to eliminating the potential vapor migration pathway. Documentary sampling during the course of the excavation would be used to document successfully reaching the 3.6 ug/kg cleanup standard. This result would eliminate the need for any further remediation in this area and subsequent engineering and institutional controls.	This analysis assumes that 8,000 tons of soils are present across approximately 0.6 acres at concentrations in excess of the 3.6 ug/kg soil-to-groundwater standard. This conservative approach will eliminate shallow soil TCE concentrations that have the potential to contribute to vapor migration.	The timeframe for this option has been estimated at 10 days. However, this is dependent upon the number of dump trucks that can be utilized each day, the number of trips each truck can make to the landfill each day, and the number of truckloads of clean stone backfill that each truck can return with each day.	**$1,200,000.00**
Focused Excavation and Active Soil Vent (Pavement as Engineered Barrier)	This remedial alternative uses a focused excavation of those soils with TCE concentrations in excess of the direct contact-non industrial standard of 1,300 ug/kg. This limited cleanup would be done in conjunction with the installation of a geosynthetic clay lined active vapor vent trench along the southern property boundary. This option assumes that 650 cubic yards of potentially impacted soils and approximately 600 cubic yards of trench soils will be removed and disposed of at a non-hazardous solid waste landfill. This cleanup strategy would require maintenance of the asphalt parking lot pavement as an engineered barrier to manage the risks associated with the site and to eliminate direct contact hazards and minimize potential leaching associated with the infiltration of precipitation.	The known lateral distribution of impacted soils on the subject property above the 1,300 ug/kg objective are clustered around borings GP-32 and GP-18 to the east (however, for purposes of this estimate, soils in the vicinity of GP-55 to the west are also assumed to require excavation). The excavation of the trench along the southern property boundary will also contribute indirectly to the remediation of this parking lot area (although no TCE concentrations above 1,300 ug/kg are known to be present in this area). The installation of a very low permeability geosynthetic clay liner as a vapor barrier will act to prevent any remaining lower TCE concentrations from potentially migrating off site in the southern direction. This feature will be combined with a high permeability, high porosity stone backfilled vapor evacuation trench that will also include piping and riser that will be connected to an electric exhaust fan (with wind-driven backup) to enhance outward vapor flow through diffusion and advection.	This option eliminates the potential vapor migration pathway. It is the most economical and practical in that some low concentrations of TCE are allowed to remain in place beneath an asphalt parking lot engineered barrier. Most of the site is already under an engineered barrier type material consisting of either building structure, concrete or asphalt. Some replacement/upgrade and maintenance of the existing asphalt may be necessary. Further, this option represents one of the *fastest* means to address potential vapor migration in this area.	This remedial option has been estimated at 10 days. This option is also dependent on trucking considerations. This option also considers the productivity of several trades involved in installing the trench lining, vapor trench piping, stacks, bollards, motor and electrical service, and pavement restoration. The option also uses engineered barriers/institutional controls (a continuing obligation). This obligation would be ongoing unless the property owner elected reopen the site and pursue a different remedial option.	**$460,000.00**

Storm Sewer Remedy Options	Technology Description	Technical Feasibility	Economic Feasibility	Relative Timeframe	Remedy Cost including 15% Engineering Contingency
No Action	This option assumes there is a no action alternative for addressing the identified damage to the storm sewer pipe and the related potential (not proven) for this damage to allow CVOC concentrations in southwest parking lot soils to potentially leach into waters in the pipe and ultimately impact surface water conditions in down-gradient Frame Park.	Although the potential CVOC transportation mechanism discussed under Technology has not been proven, the camera study has identified damage to the pipe that will require a response. Further, by not replacing/repairing this pipe section, further corrosion will occur which would ultimately undermine the structural integrity of the overlying parking lot. Thus, this option is unlikely to be acceptable to regulators.	No substantive additional cost.	This timeframe is unknown and essentially represents the continued use of the storm sewer without maintenance or replacement until it fails and the pipe becomes blocked and backs up.	**$0.00**
Pipe Rerouting and Abandonment	This remedial option considered the abandonment of the damaged portion of the storm sewer pipe within the southwest parking lot. Abandonment of this section would require rerouting of the upgradient flow from an area around STMH-11 to the other existing storm water pipe on the north side of the site. This reroute would be accomplished using pump(s) at a lift station to reroute the flow.	Although this option is technically feasible, there are several reasons why it may not be a practical option: The existing storm water system on site is exclusively gravity driven. The introduction of pumps via a lift station will result in ongoing maintenance concerns and costs for the facility. The existing system has redundancies that are useful in flood prevention during significant storm water events. Thus, the City of Waukesha may be resistant to abandoning this pipe and relying upon the other northern on-site storm pipe exclusively during normal and increased flow storm events.	Since this option was ruled out due to potential regulatory and long-term maintenance concerns, its economic feasibility was not quantified.	Since this remedial option was ruled out, its cost and timeframe to complete were not fully evaluated.	**Not determined**
Pipe Relining and Pipe Backfill Plugs	This remedial option uses cured in place pipe (CIPP) repair as an alternative to excavation and replacement. This option generally requires an up-gradient ingress point and a down-gradient egress point often through existing manholes. A nearby egress point is available at STMH-12; however, up-gradient entry points are all within a foundry operational alley road at STMH-11 and further away.	This option is technically feasible. The lack of a nearby available entry point means that approximately 530 feet of pipe will be relined unnecessarily at greater cost rather than the 190 feet that require maintenance. Further, the location of the available entry points within operational areas of the foundry will cause significant disruptions. This option has a relatively *short-term* implementation schedule (*approximately 2 weeks* with project management and mobilization) with an estimated long-term effectiveness of approximately 50 years. This option also assumes that the pipe damage/blockage is not so severe that the relining would fail and spot excavation/repair would not be necessary later.	This option essentially represents an infrastructure repair that has a potential positive environmental side effect in that it *may* result in a long-term positive effect on down-gradient surface water quality in Frame Park. There is a temporary negative economic impact on foundry operations that is difficult to quantify. However, this option is economically feasible. The cost and contingency assumes the relining does not fail due to blockages that prevent a sound relining. The costs include approximately $70,000 for the clay "check" plugs. The cost to estimate addressing a partial relining failure due to blockages and other severe instances of deterioration cannot be estimated at this time and is thus not included.	This remedial option was estimated to take approximately 10 days to complete. That timeframe assumes that the relining was successful and that follow-up spot excavation/repairs are not necessary later.	**$345,000**
Pipe Replacement and Pipe Backfill Plugs	This remedial option calls for the direct excavation, removal, and replacement of approximately 190 feet of damaged storm sewer pipe (and limited replacement of a spot corrosion hole on the east side). The 48-inch diameter corrugated metal pipe will be replaced with equal diameter pipe. This option also includes the installation of clay "check" plugs prior to the storm sewer pipe exiting the western property boundary and prior to the sanitary sewer pipe exiting the southern property boundary. Approximately 1,600 tons of removed backfill will be disposed of locally off-site at a non-hazardous waste landfill.	This option is technically feasible. There are no documented elevated CVOC concentrations in the excavation locations slated for replacement, repairs, or clay plugs. However, this infrastructure repair/upgrade will likely result in incidental remediation of soils with low levels of CVOCs, which will lessen the long-term potential for CVOC vapor migration off site and for potential CVOC soil concentrations to leach into water that could reach down-gradient surface water locations. This *short-term* construction project will be conducted entirely in outdoor areas of the facility with minimal operational impacts.	This option essentially represents an infrastructure repair that has a potential positive environmental side effect in that it *may* result in a *long-term positive effect* on down-gradient surface water quality in Frame Park. Further, this option is economically feasible. The costs include an estimated $300,000 for sewer replacement/repair and approximately $70,000 for the clay "check" plugs.	This remedial option was estimated to take approximately 12 days to complete. It is noted that some productivity gains may be possible by undertaking this option simultaneously with the selected focused remediation option above.	**$370,000**

Attachment 1

BENTOMAT® CL CERTIFIED PROPERTIES

CETCO® Bentomat® CL is a reinforced geosynthetic clay liner (GCL) consisting of a layer of sodium bentonite between a polypropylene woven geotextile and a polypropylene nonwoven geotextile, which are needle-punched together and laminated to a polyethylene geofilm.

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY	CERTIFIED VALUES
Bentonite Moisture Content[2]	ASTM D2216	1 per 50 tonnes	12% max.
Bentonite Swell Index[2]	ASTM D5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[2]	ASTM D5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[3]	ASTM D5993	40,000 ft^2 (4,000 m^2)	0.75 lb/ft^2 (3.7 kg/m^2) min.
Geofilm Density[1]	ASTM D1505	200,000 ft^2 (20,000 m^2)	0.92 g/cm^3
Geofilm Thickness[1]	ASTM D5199	200,000 ft^2 (20,000 m^2)	5 mil (0.12 mm) min.
Geofilm Break Strength[1,4]	ASTM D882	200,000 ft^2 (20,000 m^2)	14 lbs/in (2.5 kN/m) min.
Total Mass/Area[3]	ASTM D5993	40,000 ft^2 (4,000 m^2)	0.84 lb/ft^2 (4.1 kg/m^2) min.
GCL Moisture Content	ASTM D5993	40,000 ft^2 (4,000 m^2)	35% max.
GCL Grab Strength[5]	ASTM D6768	200,000 ft^2 (20,000 m^2)	30 lbs/in (5.3 kN/m) min.
GCL Peel Strength	ASTM D6496	40,000 ft^2 (4,000 m^2)	3.5 lbs/in (610 N/m) min.
GCL Hydraulic Conductivity[6]	ASTM D5887	250,000 ft^2 (25,000 m^2)	5 x 10^{-12} m/s max.
GCL Index Flux[6]	ASTM D5887	250,000 ft^2 (25,000 m^2)	1 x 10^{-9} $m^3/m^2/s$ max.
GCL Hydrated Internal Shear Strength[7]	ASTM D6243	1,000,000 ft^2 (100,000 m^2)	500 psf (24 kPa) typ.@ 200 psf (9.6 kPa)

Notes:

1 Geosynthetic property tests performed on the geosynthetic components before they are incorporated into the finished GCL product.

2 Bentonite property tests performed before the bentonite is incorporated into the finished GCL product.

3 Reported at 0% moisture content.

4 Geofilm tensile break strength performed in the machine and cross-machine directions using ASTM D882.

5 GCL tensile strength testing is performed in the machine direction using ASTM D6768.

6 ASTM D5887 is modified to include the laminated thin flexible membrane on the test specimen. Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (550 kPa) cell pressure, 77 psi (530 kPa) headwater pressure and 75 psi (515 kPa) tailwater pressure. ASTM D5887 (modified) testing is performed only on a periodic basis because the thin flexible membrane is essentially impermeable. The Bentomat® GCL core (without the flexible membrane) has a maximum hydraulic conductivity of 5 x 10^{-11} m/s with deaired distilled/deionized water. For more information, see CETCO® Technical Reference (TR) Nos. 111 and 112.

7 Peak values measured at 200 psf (9.6 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

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