REMEDIAL ACTION OPTIONS REPORT

MARTINO'S MASTER DRY CLEANERS
3917 52ND STREET
KENOSHA, WISCONSIN 53144
WDNR BRRTS# 02-30-552186

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Prepared For:

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EXECUTIVE SUMMARY

Environmental Forensic Investigations, Inc. (EnviroForensics) has prepared this Remedial Action Options Report for Martino's Master Dry Cleaners located at 3917 52nd Street in Kenosha, Wisconsin (Site). The Site building housed a plant-on-premises dry cleaning facility from approximately 1966 until 2005, utilizing tetrachloroethene (PCE) in the dry cleaning process. From 2005 to present, the Site building has operated as a drop-off location for clothes dry cleaned elsewhere. Past releases of PCE from facility operations has caused subsurface soil and zones of groundwater to become contaminated with PCE and its products of natural degradation including: trichloroethene (TCE); cis- and trans-dichloroethene (DCE); and vinyl chloride. These are collectively known as chlorinated volatile organic compounds (CVOC).

It appears that the main source of subsurface impacts are periodic spills of solvent around the former dry cleaning machine because the bulk of soil impacts lies directly beneath and adjacent to the former location of the machine. Secondary sources may include areas outside the building on the south end where spills could have occurred due to solvent handling and past disposal of spent filters.

The Site stratigraphy is comprised of glacially deposited silt and clay, with some discontinuous clayey sand lenses. An alleyway adjacent to the building on the south side has up to 3-5 feet of fill material. Two separate water bearing intervals are encountered: a perched zone that is present in the fill material and a more consistent water table located at a depth of between 11 and 12 feet bgs.

The bulk of PCE impacts has infiltrated the unsaturated silt and clay soil beneath the former dry cleaning machine and caused impacts to the water table which is encountered at a depth of between 11-12 feet at this location. Soil and groundwater impacts extend into the alley along the south Site boundary, and onto two (2) adjacent residential properties. Groundwater impacts are greatest in the perched zone of the alleyway and have migrated vertically to the slightly deeper water table. Impacts in the perched zone have also migrated laterally to the west along utilities in the alleyway. Sub-slab vapor impacts were identified beneath the eastern part of the Site building, and two (2) vapor mitigation systems were installed to address potential vapor intrusion risks.

Likely remedial actions were identified through an initial screening of technologies. Likely actions were further evaluated considering technical and economic feasibility to develop three (3) potential remedial options for the Site. The recommended option would rely on a combination of risk management strategies and remediation, including excavation and potentially multi-phase extraction (MPE), to bring the Site to regulatory closure.

Excavation of the highly contaminated silt and clay soil would be completed beneath the former dry cleaning machine within the southern half of the building. This excavation area encompass the majority of the CVOC impacts in the vadose zone, and is considered the source area for continued generation of vapor and residual impacts to groundwater. The excavated soil would be hauled off-site for disposal in a permitted facility.

The recommended remedial option minimizes Site disruptions, potentially eliminates the need for long-term operation and maintenance of the vapor mitigation systems, and provides the most benefit with respect to overall costs of implementation. The need for additional excavation in the alley and installation of the MPE system will be implemented as needed. The results of periodic groundwater monitoring will be evaluated to determine whether additional actions are needed to achieve remediation goals.

1.0 BACKGROUND

Environmental Forensic Investigations, Inc. (EnviroForensics) has prepared this Remedial Action Options Report (RAOR) on behalf of Dan Martino, Sr., d/b/a Martino's Master Dry Cleaners for the Martino Master Dry Cleaners (Martino's) facility located at 3917 52nd Street in Kenosha, Wisconsin (Site). This RAOR follows guidelines for selecting remedial actions set forth in the Wisconsin Administrative Code (WAC) Chapter NR 722 and other associated Chapter NR 700 series rules. This Report is being submitted subsequent to the Site Investigation Report dated September 15, 2015.

The Site is located at 3917 52nd Street in Kenosha, Kenosha County, Wisconsin. The location of the Site is depicted in **Figure 1**. The Site encompasses approximately 0.19 acres within a larger retail development owned by Mr. Martino. The property is developed with a slab-on-grade building occupied by Martino's and other retail businesses. Current tenants include restaurants, a grocery store, and a nail salon. The Site occupies 2,096 square feet of the building.

The general layout of the Site and surrounding area, including Site features, is depicted on **Figure 2**. Utilities noted during the Site reconnaissance include water, sewer, natural gas, telephone, and overhead electrical lines. Asphalt driveway and parking areas surround the building, and no vegetation or unpaved areas are present at the property. The Site is bounded by 52nd Street to the north, a residence to the south, and commercial land (part of the overall development between 39th and 40th Avenue) to the east and west. Land use surrounding the Site consists of mixed residential and commercial properties.

The Site building was reportedly constructed in 1966 and originally operated as Better Cleaners. Mr. Martino purchased the business in 1970. The building housed a plant-on-premises dry cleaning facility until 2005. Tetrachloroethene (PCE) has historically been utilized in the cleaning process. However, since 2005 the building has served as a drop-off location for clothes dry cleaned elsewhere. The dry cleaning machine was located in the southeast part of the Site building as illustrated on **Figure 2**.

1.1 Site Hydrogeology

The Site stratigraphy is comprised of glacially deposited silt and clay, with some discontinuous clayey sand lenses. An alleyway adjacent to the building on the south side has up to four (4) feet of fill material followed by an upper zone of silty clay to silty clayey sand, which extends to an approximate depth of 5.5 to 8 feet below ground surface (bgs). This upper zone is underlain by clay which extends to a depth of approximately 20 to 24 feet bgs. Two separate water bearing intervals are encountered: a perched zone that is present in the fill material and a more consistentwater table located at a depth of between 11 and 12 feet bgs. Neither water bearing zone is used as a resource, nor are these waters considered viable for productive use.

The direction of groundwater flow in the deeper water table appears to be toward the east/northeast; however, groundwater movement in the perched zone along utility conduits has distributed impacts to the west of the source area, as well. A downward vertical gradient exists at the on-Site well nest (MW-5T/PZ-5).

1.2 Nature and Extent of Contamination

The nature and extent of contamination associated with release(s) at the Site was detailed in the Site Investigation Report. A summary is provided herein for reference. The compounds of concern are PCE and associated daughter products.

As shown on **Figure 2**, the soil impacts extend into the alley along the south Site boundary, and onto two (2) adjacent residential properties. The northeastern corner of 5231 40^{th} Avenue and the northwestern corner of the undeveloped parcel to the southeast are affected. The undeveloped parcel is owned by Mr. Martino. The apparent source of release is the former dry cleaning machine located on the south side of the Martino's space in the Site building and possible surface spillage outside along the southeast portion of the building The greatest concentrations of chlorinated solvents are in silt and clay soil beneath the floor slab. Cross-sections depicting volatile organic compound (VOC) impacts to soil are presented on **Figures 3** through **5**.

The migration of impacts has occurred within the perched zone of groundwater that is moving through shallow fill, along utility corridors in the alley south of the building, and through discontinuous sand layers and seams and other more permeable zones within the overall clay matrix. Direct-contact exposure to soil within Site boundaries is currently prevented by surface cover materials (i.e. asphalt, concrete, and buildings). At off-Site locations, the concentrations of CVOC in soil are less than direct contact residual contaminant levels (RCLs).

Groundwater contamination is present under the Site building, the alley, and residential properties to the south and southeast. The deeper groundwater contaminant plume extends approximately 110 feet downgradient to the east. Groundwater monitoring data indicate a stable plume, and PCE degradation products in groundwater samples demonstrate that reductive de-chlorination processes are naturally occurring. The extent of contamination in groundwater is depicted on **Figure 6**.

Sub-slab vapor impacts were identified beneath the eastern part of the Site building, and two (2) sub-slab depressurization (SSD) systems were installed to address potential vapor intrusion exposure. The results of vapor intrusion assessments conducted at two (2) neighboring residential properties indicated that the concentrations of PCE and trichloroethene (TCE) in sub-slab vapor were below screening levels.

2.0 IDENTIFICATION OF REMEDIAL ACTION OPTIONS

This section presents the remedial action options identified for control, removal, containment, and/or treatment of impacted media at the Site. The initial identification and screening of remedial action options is based on information generated during site investigation activities, including the nature and extent of contamination and the hydrogeological conditions at the Site and surrounding areas. Remediation of contaminants in soil and groundwater to levels that no longer migrate or pose a risk of vapor intrusion to nearby occupied structures drives the remedial options evaluation. Initial screening for remedial technologies under general remedial response actions was completed as discussed below.

The following general responses were considered:

1. No Action,
2. Risk Management,
3. Removal Action, and
4. Treatment Action.

2.1 Screening of Remedial Action Options

An initial screening of remedial actions options was completed as summarized in **Tables 1** and **2**. The technologies were screened against the conceptual site model to identify whether they would be: 1) protective of human health and the environment; and 2) are appropriate for the Site, considering applicability for Site conditions, reasonably anticipated future land uses, and other factors which would pre-emptively preclude the alternative from further evaluation, as well as relevance to site-specific exposure pathways. Institutional controls such as land use or groundwater use restrictions are not evaluated separately in this report because it is assumed that the Site will be added to the GIS Registry at closure due to residual contamination. Institutional controls are inherent for all sites included in the GIS Registry.

Alternatives which passed both of the initial screening criteria were carried forward for further evaluation. The following remedial technologies were removed from further evaluation:

- Soil
  - No Action – Natural Attenuation
  - Engineering Controls – Structural Vapor Barrier

- In-Situ Remediation – Injection (flooding): In-Situ Chemical Oxidation
- In-Situ Remediation – Soil Mixing: Solidification and Stabilization

- Groundwater
  - No Action – No response
  - Engineering Controls – Structural Vapor Barrier
  - Containment – Physical Barrier
  - Containment – Permeable Reactive Barrier
  - Removal – Pump-and-Treat
  - Removal – Excavation
  - In-Situ Remediation - Bioaugmentation
  - In-Situ Remediation – Injection: Air Sparging
  - In-Situ Remediation – Injection: Ozone Sparging
  - In-Situ Remediation – Soil Mixing: Solidification and Stabilization
  - In-Situ Remediation – Enhanced Aerobic Bioremediation
  - In-Situ Remediation – Phytoremediation

2.2 Likely Remedial Action Options

Under the response action scenarios, the following remedial technologies were considered likely for the Site and selected for further evaluation:

- Soil
  - Engineering Controls – Soil Cover (used in conjunction with other options)
  - Removal - Excavation
  - In-Situ Remediation – Soil Vapor Extraction (alley fill only)
  - In-Situ Remediation – Thermal Treatment
  - In-Situ Remediation – Soil Mixing: In-Situ Chemical Oxidation

- Groundwater
  - Monitoring - Natural Attenuation (used in conjunction with other options)
  - In-Situ Remediation – Multi-Phase Extraction
  - In-Situ Remediation - Thermal Treatment
  - In-Situ Remediation – Injection: Enhanced Reductive Dechlorination
  - In-Situ Remediation – Injection: In-Situ Chemical Oxidation
  - In-Situ Remediation – Injection: In-Situ Chemical Reduction

3.0 EVALUATION OF REMEDIAL ACTION OPTIONS

The potentially feasible remedial technologies were evaluated according to specific actions associated with each technology. The evaluation was documented and quantified using a ranking matrix (**Table 3**) to identify the most suitable technology or combination of technologies for remediation at the Site.

Each remedial action was evaluated for the following performance metrics:

- Technical Feasibility
    - Short-Term Effectiveness,
    - Long-Term Effectiveness,
    - Ability to Implement, and
    - Restoration Time Frame.

- Economic Feasibility
    - Capital Costs,
    - Initial Cost,
    - Annual Operation and Maintenance, and
    - Future Liability.

Additionally, the need for continuing obligations after completion of a remedial action, such as maintenance of an engineering control, was considered.

As described in Section 1.2, contamination extends onto the northwest quadrant of the undeveloped parcel southeast of the Site. The soil impacts on this parcel are well below direct contact RCLs, and groundwater impacts are minimal. The parcel is owned by Mr. Martino, and there are no plans for development or future use. Therefore, the impacts identified on this parcel are not specifically considered in the evaluation of remedial actions. The only realistic options for remediation of this parcel are limited excavation or an engineered soil cover.

Given the Site setting, hydrogeology, and distribution of impacts, and future plans for the Site, each remedial action was evaluated against the above criteria and relative points were assigned. The scores were summed across all categories for each remedial action. Those remedial actions with greater than 20 accumulated points were selected for further evaluation to develop conceptual costs.

The detailed evaluation of remedial actions considered for soil and groundwater is presented in the attached **Table 3**. The table below summarizes the ranking system utilized:

RANKING SYSTEM		
Relative Weight	**All Criteria but Cost**	**Cost**
High	5	0
Moderate to high	4	1
Moderate	3	2
Low to moderate	2	3
Low	1	4
Very low to none	0	5
Total available points	30	
Remedial options selected	≥ 20 points	
Remedial options rejected	< 20 points, high cost, difficult to implement	

The evaluation criteria are discussed in more detail below.

3.1 Technical Feasibility

The feasibility of a technology to remediate impacted areas at any specific site is evaluated with regard to the following specific considerations:

- Proven technology: when a technology is fully developed and historical success case histories are available;
- Emerging technology: when a technology is not fully developed and may not be reliable;
- Inappropriate technology: when Site conditions are not technically suitable for the application of the technology; and
- Potential additional liability: whether the treatment technology may add additional liability.

3.1.1 Effectiveness

The key aspect of the technical feasibility evaluation is the effectiveness of each remedial action in protecting human health and the environment. Each potential remedial action is evaluated as to its effectiveness in providing protection and the reductions in toxicity, mobility, or volume of contamination that it would achieve. Both short- and long-term components of effectiveness are evaluated; short-term referring to the construction and implementation period until case closure, and long-term referring to the period after remediation is complete. Reduction of toxicity, mobility, or volume refers to changes in one or more characteristics of the contaminated media by the use of treatment that decreases the inherent risks. Any remedial action option under consideration should minimize adverse impacts to Site workers, visitors, the surrounding population, and the environment. Community impact is also important and the technology is considered a disadvantage if the application of the technology could be perceived as negatively impacting the local community or environment.

3.1.2 Ability to Implement

The ability to implement is a measure of both the technical and administrative feasibility of constructing, operating, and maintaining a remedial action option, and is used to evaluate combinations of remedial actions with respect to conditions at a specific site. The determination that an option is not readily implementable would usually preclude it from further consideration unless steps can be taken to change the conditions responsible for the determination.

The technical aspects related to the ability to implement refers to the ability to construct, reliably operate, and meet technology-specific regulations for remedial actions until remediation is complete; it also includes operation, maintenance, replacement, and monitoring of technical components of an action, if required, into the future after the remedial action is complete. Administrative feasibility considers the ability to obtain approvals and permitting from other offices and agencies, the availability of treatment, storage, and disposal services and capacity, and the requirements for, and availability of, specific equipment and technical specialists.

3.1.3 Restoration Time Frame

The estimated time for completion of a remedial action and restoration of the environment is based on the information available from vendor(s) with experience in remediating similar sites, and EnviroForensics' past experience using technologies in similar settings. Contaminant degradation rates, both naturally and under treatment conditions, are assumed based on experience to estimate the duration of remedial actions. If necessary, the time frame for continuing obligations is also considered.

3.2 Economic Feasibility

The cost to implement various options is not an exact cost, but represents a combination of typical contractor costs and consultant efforts coupled with the estimated time to achieve remedial endpoints. This is inherent because uncertainties associated with the definition of options often remain, and it may not be possible or practical to collect all of the data needed to refine costs better than a reliability level of +50% to -30%.

The focus is on comparative estimates of costs between options so that if costs go up or down during the remedial process, that they remain relative. The following cost factors are considered during the evaluation of options:

- Initial costs: those costs incurred for design and testing of the remedial action;
- Capital costs: the cost to construct, install, or otherwise implement the remedial action;
- Operation and maintenance (O&M) costs: the costs to operate and maintain the remedial system or technology. The evaluation includes those O&M costs that would be incurred for as long as necessary, even after the initial remedial action is complete; and
- Future liability: includes potential additional remedial action costs and costs for property re-development are considered during evaluation to the extent they can be estimated.

3.3 Continuing Obligations

The involvement of continuing obligations in the closure strategy is considered in the evaluation process. Post-closure obligations may include activities such as annual cover inspections and operation, maintenance, and inspections of vapor mitigation systems. These activities may be required for an indefinite period of time following case closure. A remedial action is considered more advantageous if the resulting need for continuing obligations is limited or eliminated.

3.4 Remedial Action Options Selected

Selected remedial actions are identified in the remedial action options evaluation matrix (**Table 3**). Remedial options were developed combining selected remedial actions for soil and groundwater. The following remedial technologies were carried forward in the evaluation process:

- Soil
    - Engineered Soil Cover;
    - Excavation and Disposal in a Permitted Facility; and
    - Soil Vapor Extraction (alley fill).

- Groundwater
  - Multi-Phase Extraction (perched zone);
  - In-Situ Chemical Reduction (deeper zone); and
  - Monitored Natural Attenuation.

The first (Option 1) is a risk management approach which would rely on engineering controls to prevent exposure to Site contamination. No remediation would be completed as part of this option. The second and third option (Option 2 and Option 3) would rely on a combination of risk management strategies and remediation to bring the Site to regulatory closure. All three (3) options are discussed in further detail below.

3.4.1 Option 1 – Risk Management

Option 1 would manage exposure risk with engineering controls. Engineering controls would physically limit contact with contamination and would be achieved through maintenance of the existing asphalt and building floor to prevent direct contact with the underlying soil and the operation and maintenance of the vapor mitigation systems at the Site.

This option would require long-term continuing obligations consisting of periodic maintenance of the sub-slab vapor mitigation systems, annual cover inspections and repair as needed, groundwater monitoring to ensure that the plume is not continuing to migrate, and vapor monitoring to confirm exposure pathways do not become complete. There is considerable uncertainty in the costs, timeframe, and regulatory acceptance of the risk management approach. It is not expected that the contaminants would naturally attenuate in 50 years and the monitoring obligations may continue indefinitely.

3.4.2 Option 2 – Excavation, In-Situ Chemical Reduction, and Risk Management

Option 2 would rely on a combination of risk management strategies and remediation to bring the Site to regulatory closure. Remedial actions would consist of excavating the heavily contaminated unsaturated soil under the building slab and along utility corridors in the alley, and zero-valent iron (ZVI) injections to treat the near-source groundwater plume. For the purpose of this document, "ZVI" is used in lieu of a specific product. The product selected will utilize the ZVI in-situ chemical reduction (ISCR) technology most likely in combination with enhanced reductive de-chlorination (ERD). The primary remediation objectives would be to remove source material that continually supports dissolved and vapor phase impacts, and reduce groundwater concentrations near the source area in the deeper groundwater zone.

Excavation would be completed under the southern half of the building, and in the north half of the alley for nearly the entire length of the building. These excavation areas encompass the majority of the CVOC impacts in the vadose zone. The excavation under the building would be advanced to 10-12 feet or the depth to groundwater; however, the depth of excavation may be limited to approximately 8-9 feet due to tight equipment operating space and ceiling height restrictions. An impermeable liner will be placed in the bottom of the excavation prior to backfilling to limit upward migration of vapors. The excavated soil would be transported off-site for disposal in a permitted facility.

The ZVI injections would target the alley and east side of the Site building. A remedial design characterization phase would be performed to evaluate the viability of injections in the low permeability Site soils, and to determine mass of contamination as a function of depth in the source area and alley. This step would allow an appropriate injection design to be developed, including injection point spacing and product volumes required to treat each interval. Up to 102 injection points are anticipated, installed in a triangular grid pattern across the treatment area. Injections would occur through direct-push tooling on 2-foot depth intervals between 5 and 20 feet. Shallower injections are impractical due to concerns with product "daylighting" around the tooling. One repeat injection event is anticipated to achieve remediation goals.

It is anticipated that inclusion on the WDNR GIS Registry will be necessary for residual groundwater contamination at downgradient locations. The ongoing monitoring costs would be much less with Option 2 than with Option 1 due to a shorter monitoring period. The long-term liability would be reduced significantly with Option 2, with post-remediation costs projected over a 2 to 3-year period instead of 50-years. Option 2 is expected to provide more certainty regarding the timeframe to reach remedial end-points than would Option 1.

3.4.3 Option 3 – Excavation, Multi-Phase Extraction, and Risk Management

Option 3 would also rely on a combination of risk management strategies and remediation to bring the Site to regulatory closure. Option 3 retains the same excavation approach for soil remediation, and adds a multi-phase extraction (MPE) system to further remediate soil and contaminated groundwater in the perched zone. The primary remediation objectives would be to remove source material, reduce vapor intrusion risk, and reduce off-site migration of contaminated water.

The MPE system would consist of a horizontal extraction well placed in the alley trench excavation at approximately 5 feet bgs, and a horizontal extraction well within the source area to treat residual impacts on the south side of the excavation. The extraction wells would be connected to trailer-mounted mechanical components. The system would include a blower capable of extracting both groundwater and vapor within the perched water zone. The groundwater and vapor removed by the system would be treated prior to discharge to meet permit and/or regulatory standards.

Option 3 is focused on reducing or eliminating vapor intrusion risk, which is the most likely potential exposure pathway. The long-term liability would be approximately the same as Option 2, with post-remediation costs projected over an estimated 2 to 3 year period. The required duration of post-remediation groundwater monitoring may be longer than with Option 2, but vapor intrusion monitoring would be reduced.

TABLE 1

REMEDIAL ACTION OPTIONS SCREENING - SOIL

Martino's Master Dry Cleaners

3917 52nd Street, Kenosha, Wisconsin

General Response	Remedial Approach	Description	Protective of Human Health and the Environment?	Appropriate Response?	Further Evaluation Warranted?
No Action	Natural Attenuation	Monitor to confirm natural degradation of contaminants is occurring and screen for potential changes in exposure potential.	No	No	No
Engineering Controls	Structural Vapor Barrier	Construction of vapor barrier to mitigate vapor intrusion concerns in structures.	Yes	No	No
	Soil Cover	Installation and/or maintenance of a cover to prevent potential direct contact with subsurface impacts.	Yes, in conjunction with other options	Yes	Yes, in conjunction with other options
Removal	Excavation	Removal of contaminated soil using excavation equipment.	Yes	Yes	Yes
In-Situ Remediation	Soil Vapor Extraction	Volatilization of contaminant mass in unsaturated zone and removal via vacuum extraction.	Yes	Yes	Yes
	Thermal Treatment	Removal of contaminants in aqueous, liquid, and sorbed phases by heating and volatilization, with subsequent vacuum extraction.	Yes	Yes	Yes
	Injection: In-Situ Chemical Reduction	Injection of chemically reductive additives such as zero-valent iron to promote degradation of contaminants via reductive processes. Requires displacement of pore-air content with injection product in vadose zone.	Yes	No	No
	Injection: Ozone Sparging	Combines air sparging with in-situ chemical oxidation. Ozone is added to air sparging injection stream to facilitate oxidative destruction of contaminants.	Yes	No	No
	Soil Mixing: In-Situ Chemical Oxidation	Involves the addition of oxidation reagents to a contaminated material (e.g. soil or sludge) to facilitate oxidative destruction of contaminants.	Yes	Yes	Yes
	Soil Mixing: Solidification and Stabilization	Stabilization involves the addition of reagents to a contaminated material (e.g. soil or sludge) to produce more chemically stable constituents. Solidification involves the addition of reagents to a contaminated material to impart physical/dimensional stability to contain contaminants in a solid product and reduce access by external agents (e.g. air, rainfall).	Yes	No	No
	Phytoremediation	Use of plants to remove, contain, degrade, and/or eliminate contaminants.	Yes	No	No

Highlighted boxes indicate that this technology will move forward in the screening process

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4.0 RECOMMENDED CLOSURE STRATEGY

4.1 Rationale

Option 3 is the recommended closure strategy. In summary, Options 2 and 3 are preferred over Option 1, and Option 3 is selected over Option 2 for the following reasons:

- More benefit with respect to overall costs of implementation (the estimated total cost for Option 3 is approximately 30% less than Option 2);
- There is low confidence in the ability to implement the injection component of Option 2 due to the low permeability soil present at the Site;
- There is no potential need for continual re-application of injectable substrates; and
- Operating time for the existing SSD systems may decrease if the soil source is rapidly removed.

It is expected that cap maintenance as an engineering control will be utilized to prevent infiltration of rainwater and monitoring of natural attenuation will be performed for two (2) years after active remediation to evaluate the ability of natural microbial populations to further degrade residual impacts. The stable groundwater plume is an indication of a disrupted contribution of source material (i.e., discontinued use of PCE). The removal of the source area is likely to yield a shrinking plume. GIS Registration for the Site and impact notifications for off-Site properties are also anticipated.

4.2 Preliminary Design

The results of soil samples collected near the dry cleaning machine indicate that soil excavated from under the building will contain PCE at concentrations exceeding hazardous waste thresholds. However, the extent of the hazardous PCE concentrations in soil has not been defined. In order to constrain waste disposal costs, soil within the pre-defined limits of the excavation will be characterized by sampling and analysis before excavation begins. Characterization sampling will allow waste profiles and disposal facilities to be arranged in advance. For costing purposes, we are assuming that 140 tons of soil will need to be disposed of as hazardous waste.

Initially, the source area excavation component of the selected remedial option will be performed. The excavation in the alley and installation of the MPE system will be implemented as needed. The results of periodic groundwater monitoring will be evaluated to determine whether any additional actions are needed to achieve remediation goals.

The anticipated extent of excavation under the building is depicted on **Figure 7**. Near surface soil will be excavated and transported to an appropriate disposal facility. The proposed source area excavation under the building measures approximately 26 feet by 32 feet with a depth of 8-12 feet bgs. Temporary modifications to the building will be needed to access the source area, including the relocation of equipment and supplies, removal of interior partitions, and removal of a portion of the concrete floor.

If needed, the MPE system will be installed following excavation in the utility trench and source areas. The potential layout of the MPE system is shown on **Figure 7**. If installed, the system will be comprised of one (1) horizontal extraction pipe within the utility trench, and one (1) horizontal extraction pipe along the south sidewall of the source area excavation. The piping will be connected to temperature controlled, trailer-mounted MPE equipment staged outside the east wall of the Martino's building. MPE equipment will include a liquid ring blower, air/water separator with transfer pump, air stripper, in-line bag filters, carbon vessels for liquid phase polishing prior to discharge, electrical controls, telemetry system, and enhanced sound absorption materials. Treated water would be discharged to the storm sewer under permit. Exhaust will be sent directly to the atmosphere or through carbon treatment, if needed, so that contaminant concentrations are below permitting thresholds.

4.3 Schedule

Waste characterization sampling has been completed. The source area excavation will take approximately one (1) month to complete, including building modifications. Actions to be completed after the excavation include the following:

- Groundwater monitoring (two years remediation, three years post remedy and closure);
- Sub-slab vapor and indoor air monitoring;
- Confirmation soil sampling;
- Remediation Completion Report; and
- Well abandonment and Site restoration.

4.4 Restoration Time Frame

The estimated duration of the recommended remedial actions for soil and groundwater is 2 to 3 years, followed by post-remediation sampling/monitoring to confirm that state environmental standards have been met. The post-remediation monitoring timeframe for groundwater will depend on remediation effectiveness but is anticipated to be at least two years in accordance with standard closure requirements.

4.5 Performance Monitoring

The performance of the remedial action would be measured via a monitoring program that includes:

- Quarterly monitoring of the effluent from the existing SSD systems to evaluate changes in concentration following excavation.
- Two (2) post-remedial sub-slab sampling events to confirm elimination of vapor intrusion risk to the Site building and tenant spaces; and
- Quarterly groundwater monitoring for a minimum of two (2) years following remediation as required for closure consideration, followed by additional monitoring during the closure process as needed. Specific wells to be included in the monitoring program will be discussed with WDNR and listed in the remedial design documents.

If the MPE system is installed, performance monitoring will also include:

- The collection of liquid and vapor phase discharge samples to comply with anticipated permit requirements and to calculate mass removal. The sampling schedule would follow the testing requirements under Wisconsin Administrative Code (WAC) chapter NR 419.07(6);
- Soil sampling to confirm the effectiveness of MPE prior to ceasing system operation;

4.6 Sustainability

Hazardous waste generation will be minimized via the pre-remediation characterization sampling described in Section 4.2. Disposal of special waste in local landfills requires much less transportation and associated fuel consumption than disposal of hazardous waste in more distant facilities.

The shallow water bearing units at the Site are neither used regionally as a potable resource by local water utilities or individuals, nor are these waters considered a viable resource for productive use, and the groundwater plume does not reach any surface water features. As such, the recommended remedial actions will not impact water use in the area. The following sustainable practices will be considered during remedial design, implementation, and long-term monitoring:

- Using local contractors to the extent possible; and
- Combining mobilizations with work at other sites to minimize vehicle use.

TABLES

TABLE 2
REMEDIAL ACTION OPTIONS SCREENING - GROUNDWATER
Martino's Master Dry Cleaners
3917 52nd Street, Kenosha, Wisconsin

General Response	Remedial Approach	Description	Protective of Human Health and the Environment?	Appropriate Response?	Further Evaluation Warranted?
No Action	None	No further action	No	No	No
Monitoring	Natural Attenuation	Monitor to confirm natural degradation of contaminants is occurring and screen for potential changes in exposure potential.	Yes, in conjunction with other options	No	Yes, in conjunction with other options
Containment	Physical Barrier	Installation of a sheet pile or slurry wall to prevent migration of contaminated groundwater.	Yes	No	No
	Permeable Reactive Barrier	Installation of granular zero-valent iron (ZVI) or other permeable reactive media in a trench perpendicular to flow to treat contaminated groundwater.	Yes	No	No
Removal	Pump-and-Treat	Removal of contaminated groundwater via pumping and subsequent treatment.	Yes	No	No
	Excavation	Removal of contaminated soil in the saturated zone using excavation equipment. May require dewatering of excavation area and disposal of purged groundwater.	Yes	No	No
In-Situ Remediation	Multi-Phase Extraction	Removal of contaminants in aqueous and liquid phases via vacuum extraction, combined with soil vapor extraction.	Yes	Yes	Yes
	Thermal Treatment	Removal of contaminants in aqueous, liquid, and sorbed phases by heating and volatilization, with subsequent vacuum extraction.	Yes	Yes	Yes
	Injection: Enhanced Reductive Dechlorination	Injection of an organic substrate to stimulate the growth of dehalogenating bacteria and, by extension, stimulate the degradation of chlorinated compounds via reductive dechlorination.	Yes	Yes	Yes
	Injection: In-Situ Chemical Oxidation	Injection of an oxidation reagent such as permangate to facilitate oxidative destruction of contaminants.	Yes	Yes	Yes
	Injection: In-Situ Chemical Reduction	Injection of chemically reductive additives such as zero-valent iron to promote degradation of contaminants via reductive processes.	Yes	Yes	Yes
	Injection: Bioaugmentation	Injection of microorganisms to promote degradation of contaminants through direct or indirect biological processes.	Yes	No	No
	Injection: Air Sparging	Injection of air into the subsurface to promote volatilization and subsequent removal of contaminants via vapor extraction.	Yes	No	No
	Injection: Ozone Sparging	Combines air sparging with in-situ chemical oxidation. Ozone is added to air sparging injection stream to facilitate oxidative destruction of contaminants.	Yes	No	No
	Soil Mixing: In-Situ Chemical Oxidation	Involves the addition of oxidation reagents to a contaminated material (e.g. soil or sludge) to facilitate oxidative destruction of contaminants. Mixing of is performed using heavy equipment such as augers or specialized soil mixing tools.	Yes	No	No
	Enhanced Aerobic Bioremediation	Application of nutrients and/or oxygen to the subsurface to accelerate naturally-occurring breakdown of contaminants via aerobic bacteria.	Yes	No	No
	Phytoremediation	Use of plants to remove, contain, degrade, and/or eliminate contaminants.	Yes	No	No

Highlighted boxes indicate that this technology will move forward in the screening process

TABLE 3
REMEDIAL ACTION OPTIONS EVALUATION MATRIX
Martino's Master Dry Cleaners
3917 52nd Street, Kenosha, Wisconsin

				Technical Feasibility								Economic Feasibility					
General Response	**Remedial Technology**	**Remedial Action**	**Description**	**Short-Term Effectiveness**	**Relative Ranking**	**Long-Term Effectiveness**	**Relative Ranking**	**Ability to Implement**	**Relative Ranking**	**Restoration Time Frame**	**Relative Ranking**	**Initial and Capital Costs**	**Relative Ranking**	**Annual O&M and Future Liability**	**Relative Ranking**	**Cumulative Points**	**Comments**
SOIL																	
Risk Management	**Engineering Control**	**Cover**	Maintain existing building and pavement in good condition to prevent exposure to soil.	Minimizes exposure to subsurface soil and limits construction worker contact. Also limits water infiltration.	4	Reduces future exposure to human health risks. Inherent continuing obligation.	3	Readily implementable. Utilizes existing building/ pavement - no construction needed.	5	> 50 years	0	Minimal. No construction.	5	Annual inspections of cover condition and repair/ replacement as necessary. Long-term monitoring of indoor air quality and OM&M on SSD systems.	3	20	Selected
Removal	**Excavation**	**Excavation and Disposal**	Use of construction equipment, such as backhoes and bulldozers, to remove impacted soils. Transport soil for proper disposal.	Immediate mass removal. Client is willing to modify building to allow access to source material under building slab.	4	Soil containing the highest concentrations will be removed, which will reduce vapor intrusion concerns and continued loading to perched groundwater. Deeper impacts will remain.	3	The building can be modified to permit limited excavation under the slab. Alleyway and off-site properties are readily accessible to excavation equipment.	4	<6 months including all logistics.	5	Relatively high landfill disposal costs.	2	Engineering control with routine inspections may be required after remediation due to deeper residuals. No equipment O&M.	4	22	Selected
In-Situ Treatment	**Physical**	**Soil Vapor Extraction (SVE)**	Volatilizes contaminants from saturated and unsaturated soil particles by pulling air through extraction wells.	Mass removal rate is highest within the first few months after system startup. Limited adverse effects during construction.	4	High degree of contaminant reduction in shallow soil. May eliminate vapor intrusion risk to the site building.	4	Favorable subsurface conditions. Horizontal extraction wells can be placed in excavations prior to backfill. Proven technology with readil available equipment and installation contractors.	4	2-4 years	4	Moderate design and construction cost.	3	Intermittent exhaust sampling and general maintenance on system. Moderate energy cost to operate. Minimizes continuing obligations.	3	22	Selected
		Thermal Treatment	Removal of contaminants in aqueous, liquid, and sorbed phases by heating and volatilization, with subsequent vacuum extraction.	Expected to be highly effective within one year. Increased potential for vapor intrusion needs to be mitigated with soil vapor extraction system.	4	Expected to be highly effective in the long term with excellent mass removal capability.	5	Favorable subsurface conditions. May be difficult to implement due to physical constraints and administrative hurdles.	2	< 2 years	5	Very high design and construction cost	0	Very high energy cost to operate. Minimizes continuing obligations. Relatively short duration.	3	19	Not selected
	Chemical	**Chemical Oxidation**	Soil mixing with oxidants such as hydrogen peroxide or potassium permanganate to oxidize/destroy organic contaminants.	Mixing exposes workers to chemical oxidants. Source area under building slab not accessible to soil mixing equipment due to limited vertical clearance.	3	High degree of contaminant reduction in accessible areas by mixing to maximize contact with oxidant.	3	Suitable for depth and type of contaminants. Readily implementable only in accessible areas outside building.	3	1 year	4	Moderate chemical and equipment costs.	3	No equipment to maintain. Confirmation soil sampling required. Possible soil stabilization needed befor re-paving or construction on undeveloped parcel.	3	19	Not selected
GROUNDWATER																	
Risk Management	**Monitoring**	**Monitored Natural Attenuation**	In-place reduction of VOCs in ground water over the long-term by biological an abiotic attenuation processes.	Not effective in reducing source concentrations or adverse impacts.	1	Slow reduction of toxicity, mobility and volume. Monitoring data indicates moderate attenuation to date.	2	Readily implementable.	5	> 50 years; shorter duration when combined with other actions.	0	Minimal costs to design monitoring plan.	5	Moderate long-term monitoring cost, n O&M.	4	17	Selected only in conjuction with other option(s)
In-situ Treatment	**Physical**	**Multi-Phase Extraction (MPE)**	Removes contaminated perched groundwater by pulling water through vacuum extraction wells.	Limited adverse effects during construction.	3	Prevents contaminant migration in perched groundwater and potential contribution to deeper groundwater zone. May eliminate vapor intrusio risk to the site building.	4	Favorable subsurface conditions. Horizontal extraction wells can be placed in excavations prior to backfill. Proven technology with readil available equipment and installation contractors.	4	2-3 years	4	Moderate design and construction cost.	3	General maintenance on system. Wate treatment/ discharge permit needed. Moderate energy cost to operate. Minimizes continuing obligations.	3	21	Selected
		Thermal Treatment	Removal of contaminants in aqueous, liquid, and sorbed phases by heating and volatilization, with subsequent vacuum extraction.	Expected to be highly effective within one year. Increased potential for vapor intrusion needs to be mitigated with soil vapor extraction system.	4	Expected to be highly effective in the long term.	5	Favorable subsurface conditions. Will be difficult to implement due to both physical constraints and administrative hurdles.	2	< 2 years	5	Very high design and construction cost	0	Very high energy cost to operate but relatively short duration. Maintenance on required vapor collection system.	3	19	Not selected
	Biological	**Enhanced Reductive Dechlorination (ERD)**	Injection of carbon source to the aquifer t enhance anaerobic biological degradation of VOCs by indigenous and/or engineere microbes.	Utilizes non-hazardous materials only. Slow process and will not immediately reduce contaminants.	2	May need to augment with chemical reduction to get complete degradation.	3	Injection in perched zone difficult due to shallow depth. Injection points need to be tightly spaced to treat deeper zone. Simple to obtain injection approval.	3	6-10 years	3	Moderate chemical and equipment costs. Potential need for multiple injections.	3	No O&M costs. Extended long-term monitoring cost to confirm effectiveness.	3	17	Not selected
	Chemical	**In-Situ Chemical Oxidation (ISCO)**	Injection of oxidants to oxidize contaminants due to high oxidation potential.	Unanticipated migration possible along preferential pathways.	3	Likely effective based on contaminants and geologic conditions. Bench-scale and pilot testing needed to fully evaluate.	3	Readily implementible outside; however, injection in perched zone would be challenging Not suitable inside building due to unacceptable risk of exposure to chemicals.	2	3-4 years	4	Moderate chemical and equipment costs. Likely need for multiple injections.	2	No O&M costs. Long-term monitoring cost to confirm effectiveness.	3	17	Not selected
		In-situ Chemical Reduction (ISCR)	In-situ injection of zero-valent iron (ZVI)	Relatively rapid reduction of contaminants. Non-hazardous material does not migrate in the subsurface.	4	Aggressive technology. Effectiveness depends in subsurface distribution in accessible areas.	4	Injection difficult due to shallow depth of contaminants and source area under site building housing active business. Outside areas readily accessible.	3	2-3 years	4	Moderate chemical and equipment costs.	3	No O&M costs. Long-term monitoring cost to confirm effectiveness.	3	21	Selected

Relative Ranking (all criteria but cost): 0 = Very low to none; 1 = Low; 2 = Low to moderate; 3 = Moderate; 4 = Moderate to high; 5 = High
Relative Ranking for Cost: 0 = High; 1 = Moderate to high; 2 = Moderate; 3 = Low to moderate; 4 = Low; 5 = Very low to none

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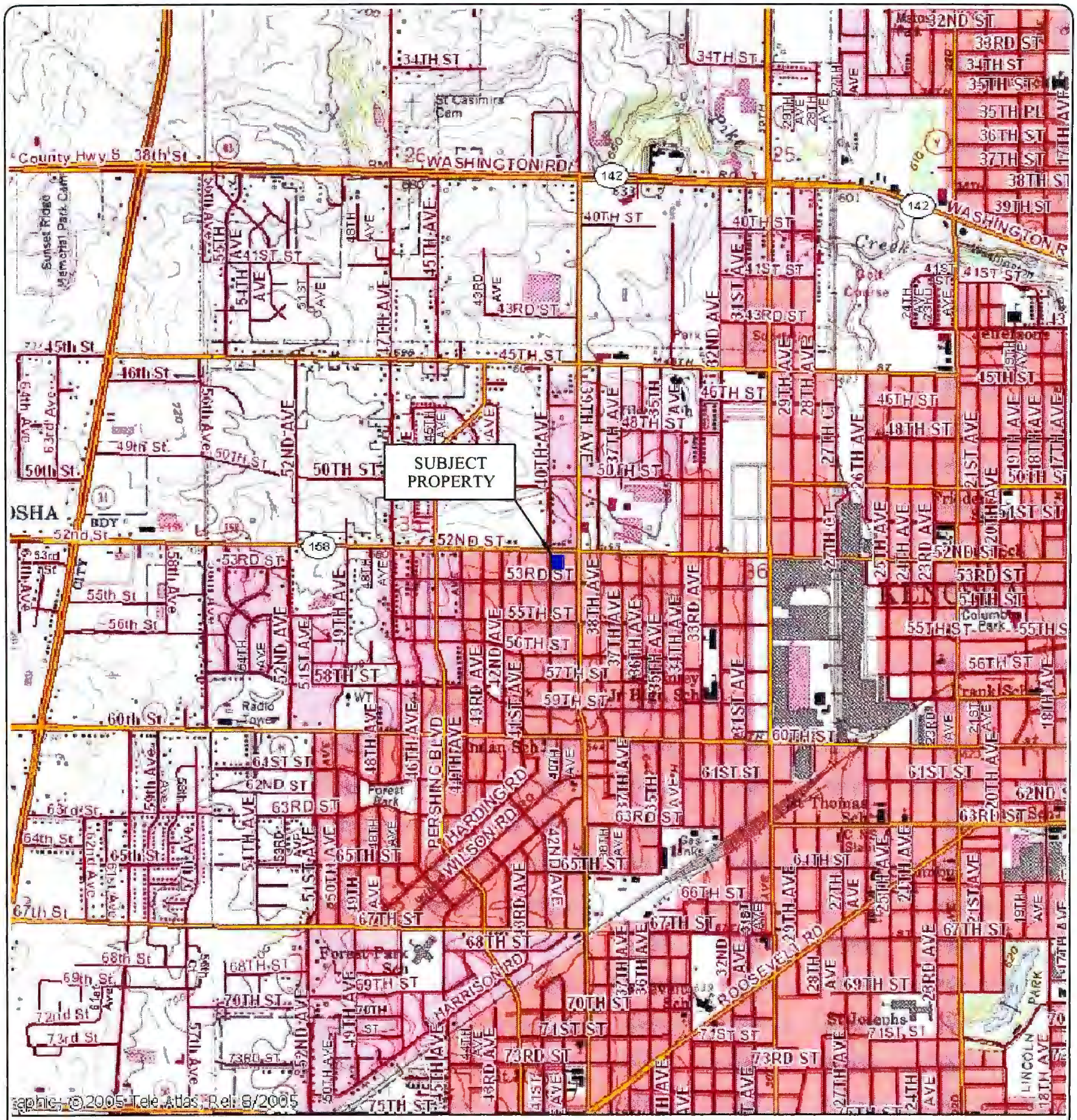
FIGURES



Scale 1:24,000

1 — 1/2 — 0 — 1 Mile

1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 Feet

1 — .5 — 0 — 1 Kilometer

N

Source: US Geological Survey, Kenosha, Wisconsin 7.5 Minute Quadrangle, 2007

No.	Date	Revision	Approved

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602 N. Capitol Ave., Ste 210 • Indianapolis, IN 46204
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Date:	12/13/11
Designed:	SP
Drawn:	SP
Checked:	BK
DWG file:	66376-11

SITE LOCATION MAP
Martino's Cleaners
3917 52nd Street
Kenosha, WI

Figure 1

Project 6190

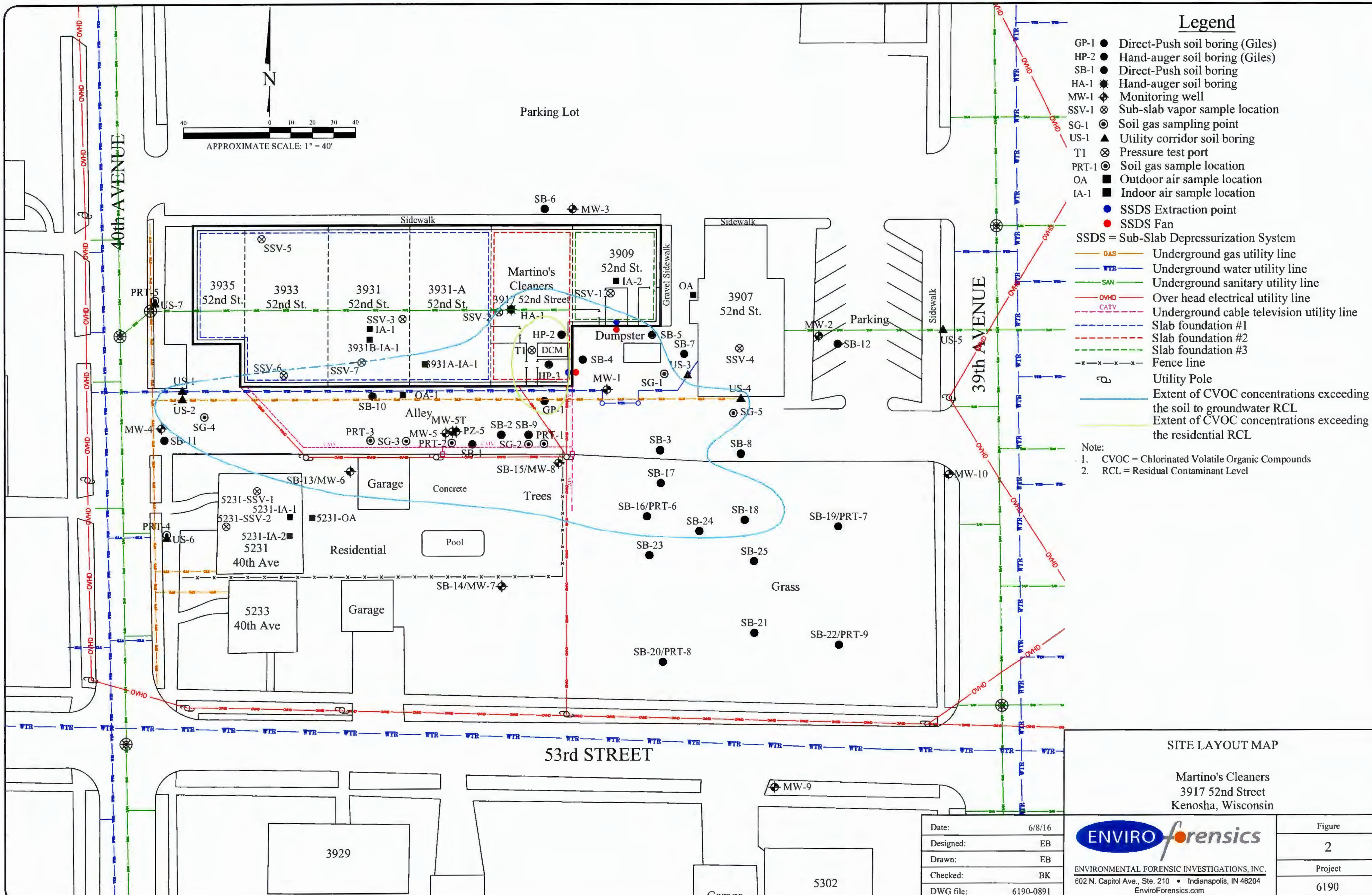
N
APPROXIMATE SCALE: 1" = 40'
Parking Lot
40th AVENUE
39th AVENUE
53rd STREET
Sidewalk
Gravel Sidewalk
3935 52nd St.
3933 52nd St.
3931 52nd St.
3931-A 52nd St.
Martino's Cleaners 3917 52nd Street
3909 52nd St.
3907 52nd St.
Dumpster
DCM
Parking
Alley
Garage
Concrete
Trees
Pool
Residential
5231 40th Ave
5233 40th Ave
Grass
3929
5302
SB-6
MW-3
SSV-5
SSV-3
IA-1
3931B-IA-1
3931A-IA-1
SSV-6
SSV-7
SSV-2
HA-1
HP-2
HP-3
T1
SSV-1
IA-2
OA
SB-4
SB-5
SB-7
US-3
SSV-4
MW-1
SG-1
US-4
SG-5
MW-2
SB-12
US-5
PRT-5
US-7
US-1
US-2
SG-4
MW-4
SB-11
SB-10
OA-1
MW-5T
PRT-3
SG-3
MW-5
PRT-2
PZ-5
SB-2
SB-9
SG-2
PRT-1
SB-1
GP-1
SB-3
SB-8
SB-13/MW-6
SB-15/MW-8
SB-17
MW-10
5231-SSV-1
5231-IA-1
5231-SSV-2
5231-OA
5231-IA-2
PRT-4
US-6
SB-16/PRT-6
SB-24
SB-18
SB-19/PRT-7
SB-23
SB-25
SB-14/MW-7
SB-21
SB-22/PRT-9
SB-20/PRT-8
MW-9
Legend
GP-1 Direct-Push soil boring (Giles)
HP-2 Hand-auger soil boring (Giles)
SB-1 Direct-Push soil boring
HA-1 Hand-auger soil boring
MW-1 Monitoring well
SSV-1 Sub-slab vapor sample location
SG-1 Soil gas sampling point
US-1 Utility corridor soil boring
T1 Pressure test port
PRT-1 Soil gas sample location
OA Outdoor air sample location
IA-1 Indoor air sample location
SSDS Extraction point
SSDS Fan
SSDS = Sub-Slab Depressurization System
GAS Underground gas utility line
WTR Underground water utility line
SAN Underground sanitary utility line
OVHD Over head electrical utility line
CATV Underground cable television utility line
Slab foundation #1
Slab foundation #2
Slab foundation #3
Fence line
Utility Pole
Extent of CVOC concentrations exceeding the soil to groundwater RCL
Extent of CVOC concentrations exceeding the residential RCL
Note:
1. CVOC = Chlorinated Volatile Organic Compounds
2. RCL = Residual Contaminant Level
SITE LAYOUT MAP
Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin
Date: 6/8/16
Designed: EB
Drawn: EB
Checked: BK
DWG file: 6190-0891
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Figure
2
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6190

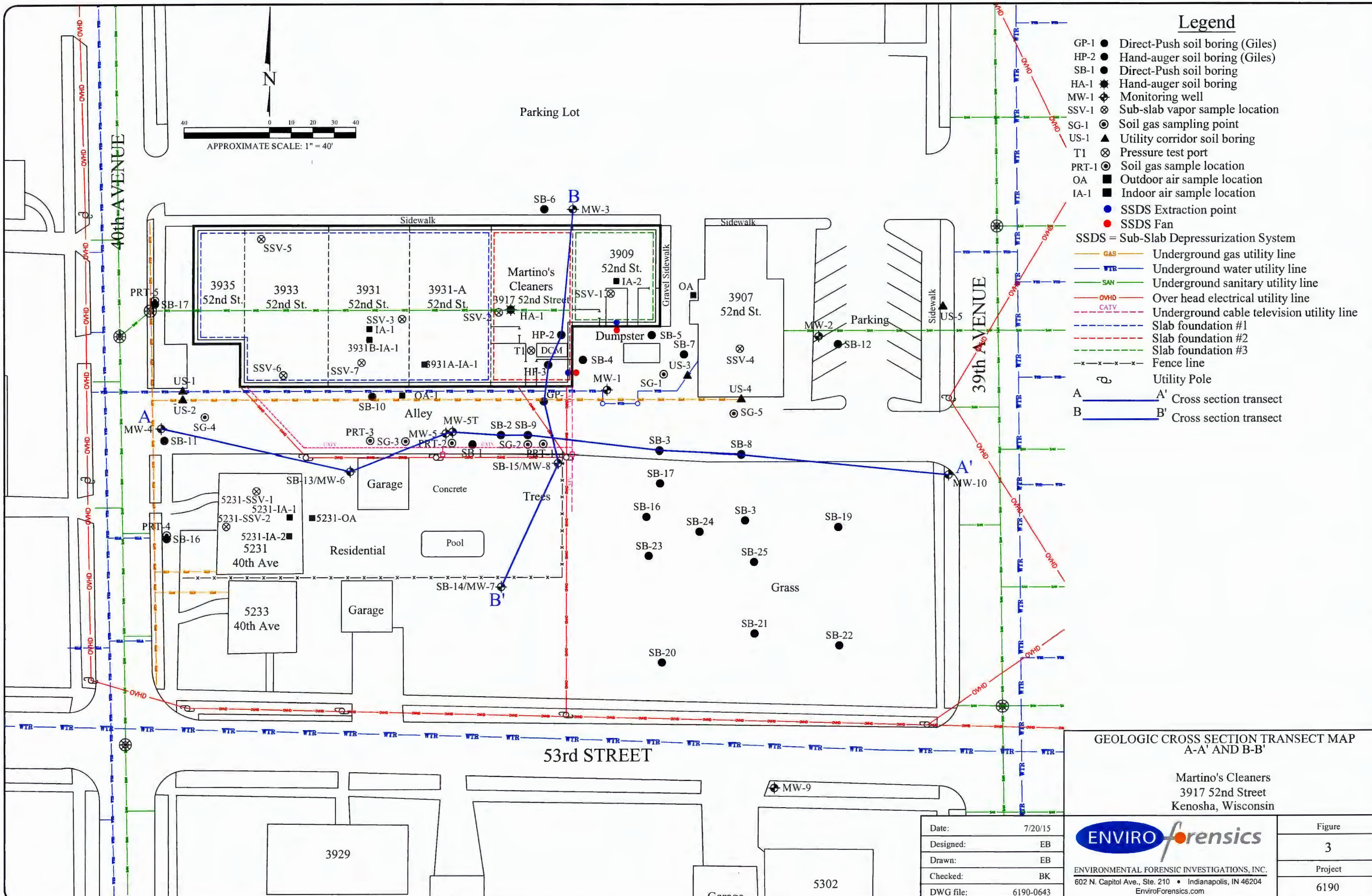
Legend
GP-1 Direct-Push soil boring (Giles)
HP-2 Hand-auger soil boring (Giles)
SB-1 Direct-Push soil boring
HA-1 Hand-auger soil boring
MW-1 Monitoring well
SSV-1 Sub-slab vapor sample location
SG-1 Soil gas sampling point
US-1 Utility corridor soil boring
T1 Pressure test port
PRT-1 Soil gas sample location
OA Outdoor air sample location
IA-1 Indoor air sample location
SSDS Extraction point
SSDS Fan
SSDS = Sub-Slab Depressurization System
Underground gas utility line
Underground water utility line
Underground sanitary utility line
Over head electrical utility line
Underground cable television utility line
Slab foundation #1
Slab foundation #2
Slab foundation #3
Fence line
Utility Pole
A A' Cross section transect
B B' Cross section transect
APPROXIMATE SCALE: 1" = 40'
N
Parking Lot
40th AVENUE
39th AVENUE
53rd STREET
Sidewalk
Gravel Sidewalk
3935 52nd St.
3933 52nd St.
3931 52nd St.
3931-A 52nd St.
Martino's Cleaners 3917 52nd Street
3909 52nd St.
3907 52nd St.
Dumpster
Parking
Alley
Garage
Concrete
Trees
Pool
Residential
5231 40th Ave
5233 40th Ave
Grass
3929
5302
GEOLOGIC CROSS SECTION TRANSECT MAP
A-A' AND B-B'
Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin
Date: 7/20/15
Designed: EB
Drawn: EB
Checked: BK
DWG file: 6190-0643
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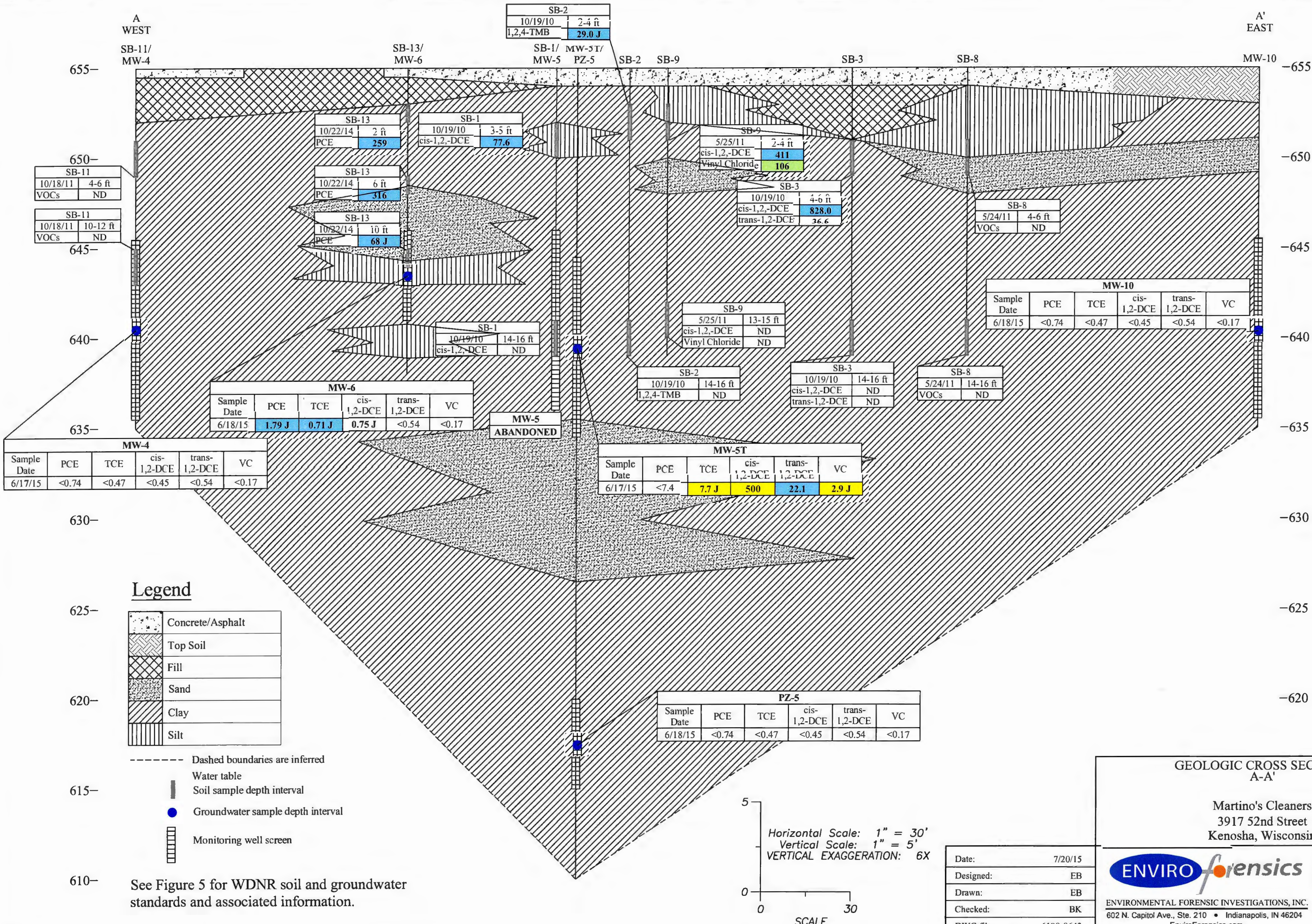
Figure
3
Project
6190



GEOLOGIC CROSS SECTION A-A'

Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin

Date:	7/20/15
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6190-0643

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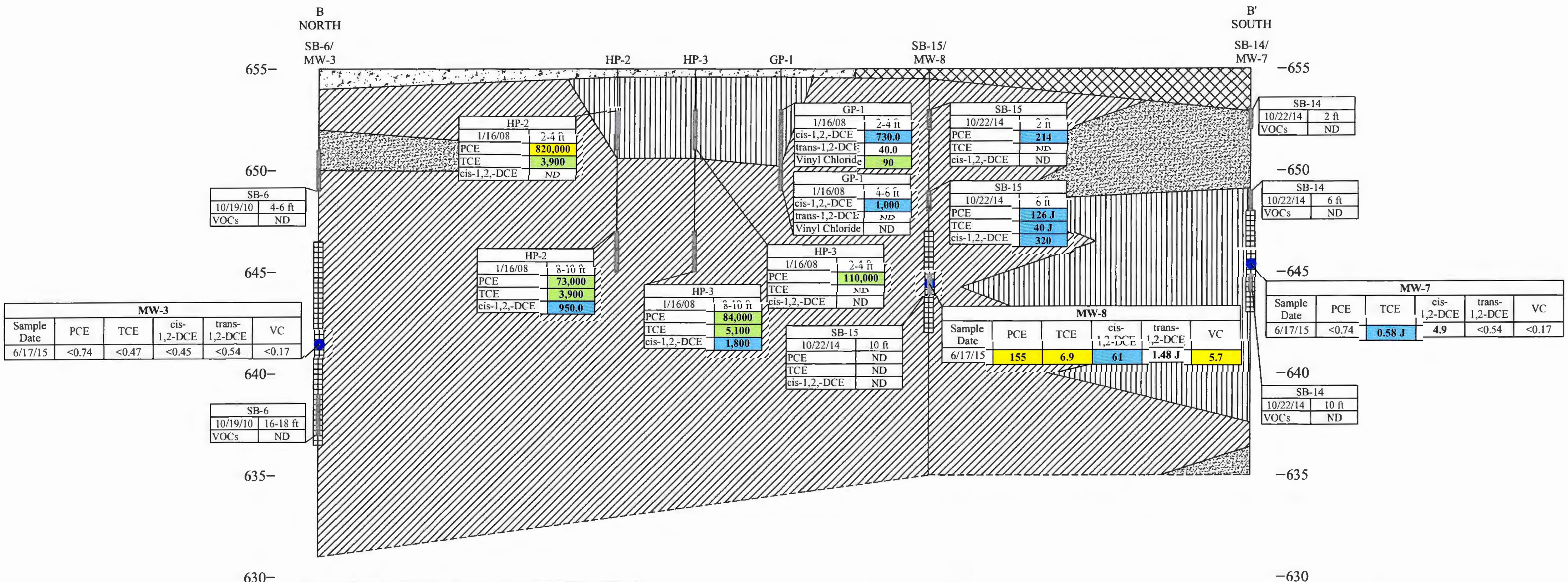
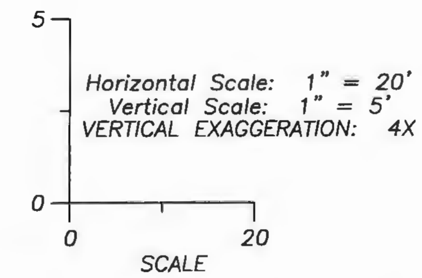
Figure 4

Project 6190





Legend

- Concrete/Asphalt
- Top Soil
- Fill
- Sand
- Clay
- Silt
- Dashed boundaries are inferred
- Water table
- Soil sample depth interval
- Groundwater sample depth interval
- Monitoring well screen

Analyte	Soil to Groundwater Residual Contaminant Level	Residential Residual Contaminant Level	Industrial Residual Contaminant Level
PCE	4.5	30,700	153,000
TCE	3.6	1,260	8,810
cis-1,2,-DCE	41.2	156,000	2,400,000
trans-1,2-DCE	58.8	211,000	976,000
Vinyl Chloride	0.1	67	2,030
1,2,4-TMB	1,394	89,800	219,000

Soil Note:

1. Bolded and blue shaded values exceed the Soil to Groundwater Residual Contaminant Level
2. Bolded and green shaded values exceed the Residential Residual Contaminant Level
3. Bolded and orange shaded values exceed the Industiral Residual Contaminant Level
4. Bolded values are above detection limits
5. J = Analyte concentration less that laboratory detection limits
6. Samples analyzed using EPA SW-846 Method 8260
7. All results reported in units of micrograms per kilogram (ug/kg)
8. PCE = Tetrachloroethene
9. TCE = Trichloroethene
10. cis-1,2-DCE = cis-1,2-Dichloroethene
11. trans-1,2-DCE = trans-1,2-Dichloroethene
12. 1,2,4-TMB = 1,2,4-Trimethylbenzene
13. ND = Not detected
14. VOCs = Violate Organic Compounds

Analytes	Public Health Preventive Action Limit	Public Health Enforcement Standard
PCE	0.5	5
TCE	0.5	5
cis-1,2-DCE	7	70
trans-1,2-DCE	20	100
VC	0.02	0.2

Groundwater Notes:

1. Bold, shaded orange values exceed Public Health Enforcement Standard
2. Bold, shaded blue values exceed Public Health Preventive Action Limit
3. Bold values equal or exceed laboratory detection limits
4. Only compounds exceeding public health standards are shown in this figure
5. Results reported in micrograms per liter (ug/L)
6. PCE = Tectrachloroethene
7. TCE = Trichloroethene
8. cis-1,2-DCE = cis-1,2-Dichloroethene
9. trans-1,2-DCE = trans-1,2-Dichloroethene
10. VC = Vinyl Chloride
11. J = Analyte concentration detected between the laboratory Reporting Limit and the laboratory Method Detection Limit
12. Samples analyzed for VOCs according to EPA Method 8260
13. * = Indicated the highest concentrations detected in duplicate sample are reported

GEOLOGIC CROSS SECTION B-B'

Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin

Date:	7/20/15
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6190-0643

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Figure 5

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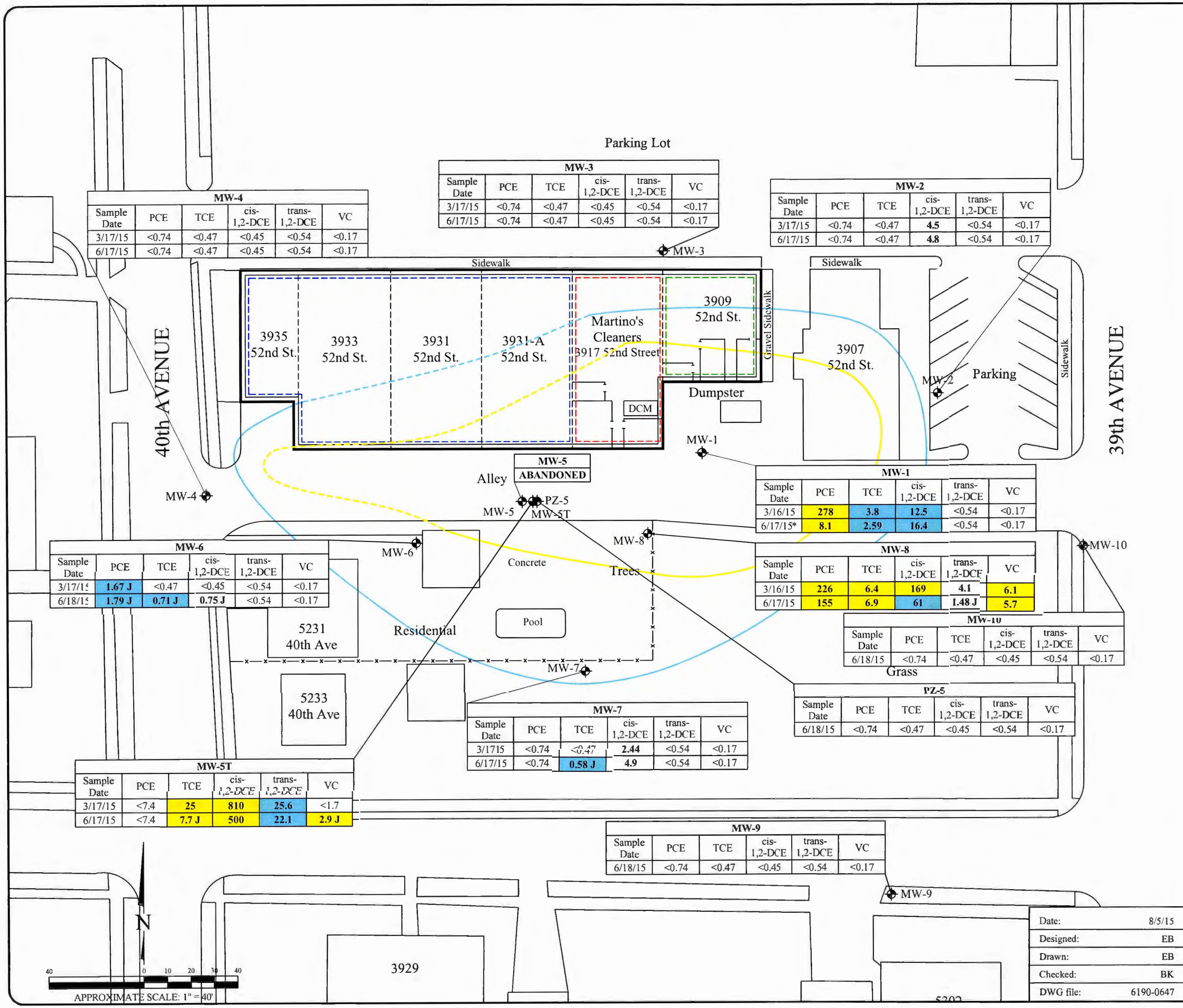

MW-1

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/16/15	**278**	**3.8**	**12.5**	<0.54	<0.17
6/17/15*	**8.1**	**2.59**	**16.4**	<0.54	<0.17

MW-2

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	<0.74	<0.47	**4.5**	<0.54	<0.17
6/17/15	<0.74	<0.47	**4.8**	<0.54	<0.17

MW-3

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	<0.74	<0.47	<0.45	<0.54	<0.17
6/17/15	<0.74	<0.47	<0.45	<0.54	<0.17

MW-4

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	<0.74	<0.47	<0.45	<0.54	<0.17
6/17/15	<0.74	<0.47	<0.45	<0.54	<0.17

MW-5
ABANDONED

MW-6

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	**1.67 J**	<0.47	<0.45	<0.54	<0.17
6/18/15	**1.79 J**	**0.71 J**	**0.75 J**	<0.54	<0.17

MW-7

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	<0.74	<0.47	**2.44**	<0.54	<0.17
6/17/15	<0.74	**0.58 J**	**4.9**	<0.54	<0.17

MW-8

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/16/15	**226**	**6.4**	**169**	**4.1**	**6.1**
6/17/15	**155**	**6.9**	**61**	**1.48 J**	**5.7**

MW-9

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
6/18/15	<0.74	<0.47	<0.45	<0.54	<0.17

MW-10

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
6/18/15	<0.74	<0.47	<0.45	<0.54	<0.17

PZ-5

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
6/18/15	<0.74	<0.47	<0.45	<0.54	<0.17

MW-5T

Sample Date	PCE	TCE	cis-1,2-DCE	trans-1,2-DCE	VC
3/17/15	<7.4	**25**	**810**	**25.6**	<1.7
6/17/15	<7.4	**7.7 J**	**500**	**22.1**	**2.9 J**

Legend

MW-1 Monitoring well location

Grab groundwater sample from soil gas sampling point

Slab foundation #1

Slab foundation #2

Slab foundation #3

Analytes	Public Health Preventive Action Limit	Public Health Enforcement Standard
PCE	0.5	5
TCE	0.5	5
cis-1,2-DCE	7	70
trans-1,2-DCE	20	100
VC	0.02	0.2

Notes:
1. Bold, shaded orange values exceed Public Health Enforcement Standard
2. Bold, shaded blue values exceed Public Health Preventive Action Limit
3. Bold values equal or exceed laboratory detection limits
4. Only compounds exceeding public health standards are shown in this figure
5. Results reported in micrograms per liter (ug/L)
6. PCE = Tetrachloroethene
7. TCE = Trichloroethene
8. cis-1,2-DCE = cis-1,2-Dichloroethene
9. trans-1,2-DCE = trans-1,2-Dichloroethene
10. VC = Vinyl Chloride
11. J = Analyte concentration detected between the laboratory Reporting Limit and the laboratory Method Detection Limit
12. Samples analyzed for VOCs according to EPA Method 8260
13. * = Indicated the highest concentrations detected in duplicate sample are reported

Extent of CVOC groundwater impacts above enforcement standards (dashed where inferred)

Extent of CVOC groundwater impacts above preventive action limits (dashed where inferred)

MONITORING WELL SAMPLE ANALYTICAL RESULTS

Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin

Date:	8/5/15
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6190-0647

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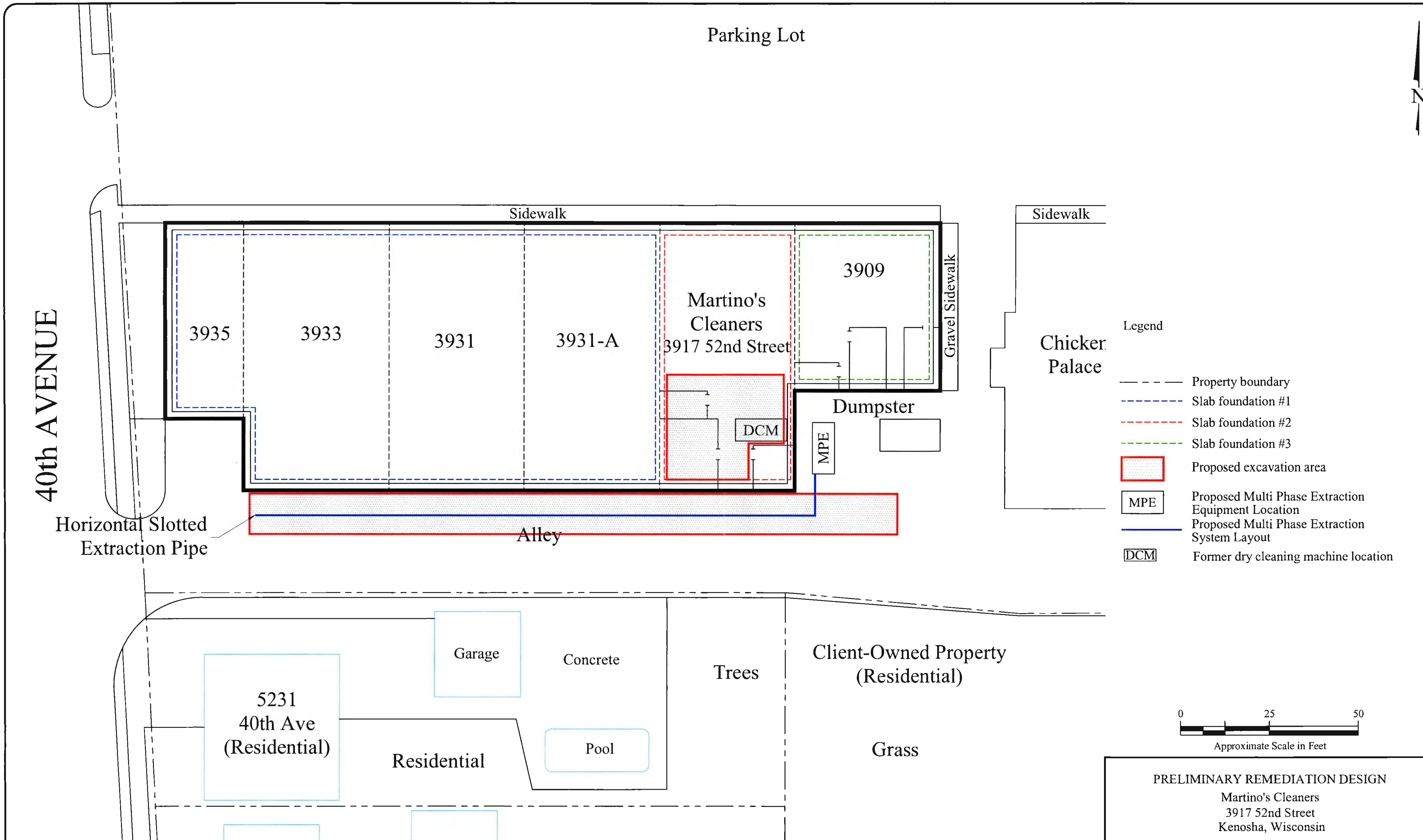
Figure 6

Project 6190



PRELIMINARY REMEDIATION DESIGN
Martino's Cleaners
3917 52nd Street
Kenosha, Wisconsin

Date:	6 8 16
Designed:	EB
Drawn:	EB
Checked:	BK
DWG file:	6190-0215

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Figure
7
Project
6190