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Report
In-Situ Chemical Oxidation Pilot Test (Task 4) Former Allied Stamping Plant South Bend, Indiana

Prepared For:

City of South Bend
Office of the Board of Public Works
13th Floor, County-City Building, Room 1316
227 West Jefferson Boulevard
South Bend, IN 46601

COLUMBUS, OHIO
CHICAGO, ILLINOIS
GRIFFITH, INDIANA
FORT WORTH, TEXAS
SOUTH BEND, INDIANA
SPRINGFIELD, ILLINOIS
DOWNERS GROVE, ILLINOIS

WEAVER BOOS CONSULTANTS LLC

GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

TABLE OF CONTENTS

IN-SITU CHEMICAL OXIDATION
PILOT TEST (TASK 05)
FORMER ALLIED STAMPING PLANT
SOUTH BEND, INDIANA

FIGURES

APPENDICIES

1.0 INTRODUCTION

Weaver Boos Consultants, LLC (Weaver Boos) has completed pilot testing of In-Situ Chemical Oxidation consistent with Task 4 of the March 2005 Remediation Work Plan (RWP) approved by the Indiana Department of Environmental Management (IDEM) Voluntary Remediation Program (VRP) for the Former Allied Stamping Plant (the Site). The City of South Bend authorized this work by its June 13, 2005 notice to proceed with Weaver Boos Proposal No. M50402. The scope of the pilot test was subsequently extended by the City of South Bend to include Addenda No. 2 and No. 3, authorized on August 28, and September 25, 2006, respectively. Funding for this project is being provided by a U.S. EPA Brownfields Cleanup grant.

The Site is a portion of Area A (VRP #6020803) comprising five contiguous properties that occupy approximately 88 acres located at 601 West Broadway Street, South Bend, Indiana. The Site was historically used as a lumberyard and later in the manufacturing of automobiles and automobile parts. Operations under Studebaker Corporation began as early as 1927 and extended into the early 1960's, when the Site was sold to Allied Products Corporation in 1963. Between 1963 and 1999, the Site was operated by the Allied Products Corporation, EWI, or Tecumseh Metals. Between 1999 and 2002 the Site was vacant, until purchased through bankruptcy proceedings by the South Bend Redevelopment Commission. Buildings at the Site are slated for demolition during 2005 and 2006.

Phase II Investigations conducted by Hull & Associates, Inc. (Hull) indicate that the former Die Wash area in Building 142 is a source of volatile organic compounds (VOCs) in groundwater beneath the southwest portion of the Site (see **Figure 1**). Chlorinated solvents such as tetrachloroethene (PCE) are believed to have been used in the die washing process. PCE has been detected in shallow soils beneath the slab of Building 142 at relatively low concentrations (i.e., not exceeding 50 µg/Kg) and in the underlying shallow groundwater at concentrations as high as 974 µg/L. Based on the distribution of dissolved VOCs in groundwater samples, Hull concluded that the source area appears to be in the vicinity of the former Die Wash area or just west of the former Die Wash area.

The overall objective of the In-Situ Chemical Oxidation project is to reduce current groundwater VOC concentrations beneath the former Die Wash area to concentrations below VRP Tier II Nonresidential Cleanup Goals. The Task 4 pilot test of the in-situ chemical oxidation process

was implemented using potassium permanganate as recommended at the conclusion of the Task 3 bench test completed by Weaver Boos. The purpose of the pilot test is to assess whether the oxidative process is effective in-situ beneath the Site and whether treatment of the groundwater using potassium permanganate (or sodium permanganate) is capable of achieving significant contaminant destruction.

This Task 4 Pilot Test report is organized as follows: **Section 2.0** further describes the initial condition of the Site, its hydrogeology, the contaminant of concern, and its initial concentrations. **Section 3.0** presents the theory behind the chemical oxidation process and summarizes the results of bench testing used to design the field-scale pilot test. Field procedures used implement the pilot test are provided in **Section 4.0**. Post-treatment groundwater sampling results are described in **Section 5.0**. Conclusions supported by the pilot test results are described in **Section 6.0**. Supporting data and information are appended.

2.0 INITIAL CONDITIONS

2.1 General

Initial conditions at the Site were established by Weaver Boos in accordance with the Remediation Work Plan (RWP) prepared by Hull. and approved by the Indiana Department of Environmental Management under the Voluntary Remediation Program (VRP). As specified in RWP Task 1, this included the installation of nine (9) new groundwater monitoring wells and the drilling of reagent application wells. Baseline groundwater sampling and analysis was completed in accordance with the RWP Task 2. The methods and results obtained are described below.

2.2 Monitoring Well and Reagent Application Well Installation

Monitoring wells PSAMW-1U, M, and L, PSAMW-2U, M, and L, and PSAMW-3U, M, and L were drilled at the locations shown in **Figure 2**. A Geoprobe® direct-push sampling rig was used to obtain continuous soil core samples at each groundwater monitoring well location prior to drilling the wells. With the assistance of our subcontractor (Enviro-Dynamics, LLC, of Hebron, Indiana) Weaver Boos advanced soil probes at three locations, PSAMW-1, PSAMW-2, and PSAMW-3 on June 19, 2006. Dual Tube and Macro-Core® soil sampling tools, each four feet in length, were used to sample the subsurface soil. The Dual Tube sampler was used in the vadose zone, and the Macro-Core® sampler was used below the water table. Weaver Boos visually examined the soil cores as they were retrieved and recorded relevant observations in the soil boring logs provided in **Appendix A**. The soil cores were field screened for volatile organic vapors using a photoionization detector (PID); no measurements above zero ppm (by volume) were recorded. The soil probes were subsequently sealed with bentonite and the new monitoring wells were drilled in accordance with the RWP.

A Geoprobe® 6600 direct-push sampling rig turning 4.25-inch I.D. hollow stem augers was used to drill the monitoring wells. Three monitoring wells were completed adjacent to each soil probe, providing screened intervals representing the upper (U), middle (M), and lower (L) aquifer target intervals. The monitoring wells were constructed of 2-inch diameter ASTM Schedule 40 PVC well casing, and each terminated with a length of machine-cut #10 slot well screen. Bagged silica sand in the 20 to 40 US Standard Sieve size range was backfilled around each well screen to form a filter pack, the annular space was backfilled with bentonite chips, and

each well completed at the surface with a protective steel cover set in a concrete surface seal. The hand bailing of approximately 10 well volumes by Weaver Boos developed the wells after they were completed. Development waters were retained on Site and later blended with the potable water used during reagent application as described in **Section 4.3.1**.

The "U" monitoring wells were each terminated with 15 feet of well screen, extending from about 20.6 feet down to about 35.6 feet below ground surface (bgs). Because the groundwater table was encountered at depths of about 27 feet bgs, the "U" monitoring well screens straddle the water table so as to allow checking for the presence of floating contaminants, none of which were encountered. The "M" monitoring wells are each screened from about 35.6 feet to 45.6 feet bgs. The "L" monitoring wells are screened from about 45.5 to 55.5 feet bgs. Monitoring well completion diagrams illustrating the construction of monitoring wells PSAMW-1U, M, and L, PSAMW-2U, M, and L, and PSAMW-3U, M, and L are provided in **Appendix A**.

The 25 reagent application wells were advanced at the locations shown in **Figure 2** using a Geoprobe® 5400 direct-push sampling rig driving 3-inch I.D. casing tipped with an expendable point. Each reagent application well was terminated with 20 feet of #10-slot well screen. As the drive casing was withdrawn, the natural formation was allowed to collapse around the screen until the water table was reached. The balance of the screen was backfilled from the surface using bagged silica sand to a depth approximately two feet above the well screen, and the balance of the annular space was backfilled using granular bentonite to the surface. Each of the reagent application wells was completed to a depth of approximately 40 feet bgs, such that the majority of the well screens are located below the water table.

Following the completion of drilling, the new monitoring wells and reagent application wells were surveyed by Weaver Boos to measure their coordinate positions and relevant elevations. Their well identifications, dates of completion, coordinates, elevations, and other data are summarized in **Table 1** for all wells utilized during the field pilot test.

2.3 Subsurface Geology and Hydrogeology

The Site is located in the St. Joseph Aquifer System composed of fine to medium sand with zones of coarse sand and gravel. Subsurface conditions encountered by Weaver Boos were generally consistent with the regional setting and the previous Phase II Investigation completed by Hull.

The soil cores obtained during the field pilot test generally encountered approximately 1 foot of recently placed topsoil underlain by dark reddish loam to about 4 feet bgs. At deeper intervals, to the terminus of the probes 53 feet below ground surface, soils consisted of horizontally stratified beds of fine to coarse sand. As the soil cores were examined, no visible indications of impact such as oily staining or distinctive odors were encountered. The subsurface geology of the Site, including the various sand layers and position of the water table are illustrated in the geologic cross section presented in **Figure 3**. The screened intervals for the groundwater monitoring wells and reagent application wells are also illustrated to show their relationship with the water table and various sand layers encountered.

Water levels measured by Weaver Boos in the monitoring wells and reagent application wells are summarized in **Table 2**. As shown therein, water table elevations ranged from about 705 to 706 feet above mean sea level. **Figure 4** illustrates the resulting potentiometric surface as measured on June 27 and 28, 2006. **Figure 5** illustrates the potentiometric surface, including reagent application wells, as measured on August 22 and 23, 2006. In both cases the potentiometric surface indicates a northeasterly flow of groundwater beneath the Site, with a horizontal flow gradient of about 0.0044 feet/foot. Weaver Boos estimated the hydraulic conductivity for the same aquifer located in neighboring Mishawaka as 270 feet/day based on a small scale pumping test. This value for hydraulic conductivity is nearly equal to that reported by Bayless and Arihood (1996) on a regional basis. Assuming a reasonable porosity of 37.5 percent (Freeze and Cherry, 1979), the groundwater flow velocity beneath the Site is estimated in accordance with Darcy's law as approximately (270 feet/day)(0.0044 feet/foot)/0.375 = 3 feet/day. This flow velocity is probably representative of the coarsest-textured aquifer materials, such as the medium-coarse sands encountered below the water table beneath the Site.

2.4 Baseline Groundwater Sampling and Analysis

Baseline groundwater samples were collected from the new and existing monitoring wells PSAMW-1U, M, and L, PSAMW-2U, M, and L, and PSAMW-3U, M, and L, MW-9S and I, and MW-11I and D on June 27 and 28, 2006. The wells were purged to remove three casing volumes and then sampled with dedicated polyethylene bailers. Groundwater sampling was performed in accordance with the Quality Assurance Project Plan (QAPjP) the Standard Operating Procedures (SOPs) Developed by Hull. Accordingly, the wells were measured for temperature, pH, and specific conductivity to demonstrate the stability of water quality prior to sampling. Groundwater samples for VOC analyses were acquired in triplicate 40-ml VOA vials

preserved with hydrochloric acid. Groundwater samples for total iron analyses were acquired in a 250 ml polyethylene container and preserved with nitric acid for. Groundwater samples for TOC analysis were collected in 1L amber glass containers preserved with sulfuric acid to a pH less than 2.0. The samples were subsequently hand delivered to Microbac Laboratories, Inc., located in Merrillville, Indiana where they were analyzed for the indicated parameters.

2.5 Contaminant of Concern and Initial Concentrations

With the exception of tetrachloroethene (PCE), VOCs were either not detected in the baseline groundwater samples, or were detected at concentrations less than their respective VRP Tier II industrial cleanup goals (IDEM, 1996). PCE was detected in monitoring wells PSAMW-1U and M, PSAMW-2U, M, and L, PSAMW-3U and M, MW-9S, and MW-11D at concentrations ranging from 140 to 390 µg/L, which are greater than the VRP Tier II cleanup goal set at 56.1 µg/L. Groundwater sampling results from the monitoring wells during the field pilot test are summarized in **Table 3**. The horizontal and vertical distribution of PCE concentrations measured in the Site groundwater is further summarized and illustrated in **Figure 6**. As shown therein, the deepest groundwater monitoring wells generally indicated the lowest concentrations of PCE.

3.0 CHEMICAL OXIDATION PROCESS

3.1 Description

In-situ chemical oxidation is a class of remediation technologies in which organic contaminants are degraded in place by oxidants delivered to the subsurface. Organic contaminants such as PCE are mineralized to innocuous compounds such as chloride, carbon dioxide, and water when the process is taken to completion. Oxidants used for this technology include Fenton's reagent, potassium permanganate, sodium permanganate, and others. Prior to implementing the field pilot test, an extensive bench test was completed by Weaver Boos as described in our In-Situ Chemical Oxidation Bench Test (Task 3) Report dated March 17, 2006. Relevant results of the bench test are summarized below.

3.2 Theory

Fenton's reagent is a term describing a mixture of hydrogen peroxide (H_2O_2), an iron (II) catalyst, and sometimes a buffer to control pH in the acidic range. Fenton's reagent oxidizes contaminants via the release of non-selective hydroxyl radicals that react under favorable environmental conditions with organic contaminants via bond addition and hydrogen abstraction. Insomuch as the initial phase of bench testing indicated that Fenton's reagent would not be effective under conditions specific to the Site, this reagent was not selected for use in the pilot test.

The permanganate ion (MnO_4^-) is a powerful oxidant that has been used for the treatment of numerous organic contaminants such as phenols, formaldehyde, pesticides, and PCE. Most applications of permanganate are directed toward aqueous phase contaminants. Although the reaction will occur over a range of pH, the acidic condition created by the H^+ production is expected to improve the reaction rate. Potassium permanganate is fast acting, but typically persists for several months following placement in the subsurface (USDOE, 1999). The anticipated reaction for PCE oxidation is given by:

$$C_2Cl_4 + 2MnO_4^- \quad \text{--►} \quad 2CO_2 + 2\ MnO_{2\ (solid)} + 4Cl^- + H^+ \qquad [5]$$

The use of in-situ chemical oxidation requires consideration of other materials that might compete with the targeted contaminants for oxidation. This is because the oxidants are not selective; they may react with any reduced material that is present (such as natural organic

carbon, manganese, copper, etc.). Assessment of such effects was addressed in the bench test by evaluating several stoichiometric ratios for each treatment reagent considering not only the mass of PCE, but the mass of total organic carbon as well. Additionally, Weaver Boos completed a permanganate soil oxidant demand test during the field pilot test as described in **Section 5.5**.

3.3 Bench Test Methods

The experimental procedure was designed to model conditions in the aquifer beneath the Site. Five test cells were first filled with soil obtained from the depth interval of 24 to 38 feet below ground surface. The soil contained within the cells was then saturated using groundwater collected at the Site. Control reagents (D.I. water), catalysts, or oxidizers were then injected into the cells as solutions totaling approximately one pore volume and allowed to react at room temperature for 24 hours. Soil and pore water from each of the test cells were then sampled and analyzed for VOCs. The bench test was performed in two phases as discussed below.

3.4 Bench Test Results

3.4.1 Phase 1

The Phase 1 bench yielded uncertain results because the test indicated that the PCE concentrations in the post-treatment soil samples varied widely. The concentration for the initial sample was reported at 4,900 µg/Kg, while the concentrations for samples collected from the test cells ranged from non-detect up to 2,900 µg/Kg. This wide range of values suggested that heterogeneity characterized the soil samples used in the Phase 1 bench test. The soil samples used in the Phase 1 bench test was not homogenized prior to sampling owing to concern for the potential volatilization of PCE during the mixing process.

With regard to PCE in the water samples analyzed during the Phase 1 bench test, similar concentrations were found in all samples except for Cell 3 which had received the largest dose of potassium permanganate. No PCE was detected in the water sample obtained from Cell 3. Because that sample was diluted 100:1 prior to analysis, however, its non-detect concentration was censored by an elevated reporting limit of <500 µg/L, and was therefore of limited consideration. Fenton's reagent was found to have no effect on the soil or groundwater concentrations in the Phase 1 bench test. Phase 2 was therefore implemented focusing on permanganate as described below.

3.4.2 Phase 2

Analytical data resulting from the Phase 2 bench test were better constrained than those obtained during Phase 1. Because the soil samples were physically homogenized prior to loading the test cells, PCE concentrations in each of the soil samples were equal to within a factor of 2 (i.e., they ranged from 120 µg/Kg for Cell 4 and 220 µg/Kg for the initial sample WBBT-2). Additionally, the selected concentrations of potassium permanganate obviated the need to excessively dilute the water samples prior to analysis. With excessive heterogeneity removed and improved analytical detection limits afforded by the phase 2 bench test, Weaver Boos concluded the following:

1. PCE was successfully eliminated from the groundwater in Cells 4 and 5 at the method detection limit of <8.2 µg/L. These cells were dosed with potassium permanganate solutions of 3,600 mg/L and 20,000 mg/L, respectively. Because detectable concentrations of PCE remained in all of the soil samples, it appeared that chemical oxidation occurred primarily in the aqueous phase.

2. Reaction of the Site media with potassium permanganate yielded several organic byproducts including acetone, 2-butanone, chloroform, methylene chloride, or chloromethane. Resulting concentrations increased as the dose of potassium permanganate was increased. Chloroform, methylene chloride, and chloromethane occurred only with the greatest doses of potassium permanganate. According to representatives of the Carus Corporation (the manufacturer of the permanganates used in the field pilot test), the production of acetone, 2-butanone, and other byproducts is not uncommon shortly after the injection of permanganate solutions into an impacted soil/groundwater system. However, such byproducts do not usually persist in the media at the conclusion of the reaction which may take several weeks or months.

3. Aqueous flushing of the test cells with D.I. water appeared to have little effect on PCE concentrations in either the soil or pore water.

4. Owing to the persistent purple staining of the soil remaining in test Cells 4 and 5 six weeks after the Phase 2 bench test, it was concluded that Cells 4 and 5 were dosed with sufficient potassium permanganate to provide a residual oxidation effect.

Considering the results obtained during bench testing, Weaver Boos recommended that potassium permanganate be chosen for implementation with field injections in solution at a

concentration corresponding to Cell 4 of the Phase 2 bench test (3,600 mg/L). This concentration appeared effective in reducing PCE concentrations in the water, it was expected to provide residual oxidizing power for several weeks, and was believed appropriate to control the development of reaction byproducts to concentrations less than their respective Tier II cleanup goals.

Consistent with the scope of work originally proposed by Weaver Boos for the Task 4 pilot study, an injection well field with 25 injection locations IW-A1 through IW-E5 was recommended to be installed as illustrated in **Figure 2**. Assuming that the PCE-impacted portion of the aquifer to be addressed under the pilot study measured 40 x 40 x 30 feet thick, the aquifer volume to be treated was found to total approximately 48,000 ft^3. At a porosity of 0.375, the impacted volume of the aquifer was estimated to include a pore volume of approximately 18,000 ft^3 (134,640 gallons). It was therefore concluded that treatment conditions utilized in Cell 4 of the Phase 2 bench test could be duplicated by the field injection of approximately 4,040 pounds of potassium permanganate dissolved in approximately 134,640 gallons of water.

During discussions with the City of South Bend, Hull suggested that the permanganate dose be cut in half to help prevent the development of undesirable reaction products. Depending upon whether PCE or reaction byproducts remained in the groundwater following the initial dose, a second dose of permanganate solution would be injected, or the extended groundwater monitoring program would be initiated. Weaver Boos determined that 2-inch diameter cased wells terminated with slotted screens for injection into the aquifer would be most appropriate to accommodate the large volume of treatment solution. Installation of cased wells would also facilitate a second injection event if found appropriate based on groundwater monitoring results.

4.0 FIELD PILOT TEST PROCEDURES

4.1 General

The field pilot test was generally implemented by injecting permanganate solutions into the groundwater using the 5 by 5 injection well field installed as described in **Section 2.2**. The first two applications used solid potassium permanganate manufactured and marketed by the Carus Corporation for use in groundwater remediation as RemOX®S. A third application was completed using liquid sodium permanganate also manufactured and marketed by the Carus Corporation for use in groundwater remediation as RemOX®L. The solid permanganate was dissolved in potable water obtained from a fire hydrant using a diesel powered pump to circulate the solution between two large mobile water tanks. The liquid permanganate was mixed in line with potable water using two gasoline powered and two magnetic drive pumps. The solutions were subsequently drained into the injection well field, directly to the aquifer. Additional details are provided below.

4.2 Significant Equipment

Significant equipment used for the first two applications included two 21,000-gallon mobile storage tanks, a diesel powered pump rated at 900 gpm, and various hoses, pipes, and fittings temporarily leased from Baker Tanks, Inc., of Chicago Heights, Illinois. The third application was accomplished using two 6,000-galloon mobile storage tanks from Baker Tanks, Inc., two small portable gasoline powered pumps, and two small magnetic drive pumps. For all applications, a main delivery line was laid to the injection well field, and each injection well attached using a 2-inch hose. Delivery of permanganate solution to the well field was controlled by a combination of pump throttle and delivery valve control at the mixing plant. Delivery to each injection well was controlled using a wellhead valve and visually balanced by observation of solution flow inside the transparent PVC stand pipe affixed to the top of each well. Photographs of the pilot test mixing plant, injection well field, and control systems are provided in **Appendix B**.

4.3 Application Procedures

4.3.1 First Reagent Application

On June 28, 2006 equipment and materials were received and assembled as needed to perform the first application of 1,985 pounds of potassium permanganate. The first application was completed in three parts, which totaled approximately 114,000 gallons of solution. The two 21,000-gallon portable tanks were filled with a total of approximately 38,000 gallons of water by use a fire hydrant and hose. The hydrant used to fill the tanks was located on Kendall Street, near the southwest corner of the Site.

On the morning of June 29, twelve (12) 5-gallon pails of potassium permanganate, each containing 25 Kg, were added to the water contained in the portable tanks. The chemical was added at the top of the tanks in accordance with procedures described in the Health and Safety Plan prepared by Weaver Boos. Personal protective equipment (PPE) including nitrile gloves, an OSHA approved dust respirator, apron, face shield, goggles, and hard hat were worn by Weaver Boos personnel while handling the solid permanganate.

Following the addition of the potassium permanganate, the solution was mixed using the diesel pump and a 4-inch diameter hose to transfer material from one tank to the other. Circulation between the tanks was provided by an additional 4-inch hose. To provide increased turbulence for mixing, an electric generator was used to power two (2) submersible electric sump pumps each capable of pumping an estimated 70 gallons per minute. Circulation between the tanks continued for approximately four hours at which time the 38,000 gallons of solution exhibited a uniform dark purple appearance.

Beginning at 12:30 p.m. on the afternoon of June 29, the diesel pump was used to distribute the solution through a 4-inch hose while maintaining 1,500 and 1,600 revolution per minute (rpm). Based on the time it required to discharge the 38,000 gallons of solution (3 hours), it was determined that the injection well field readily accepted the solution at an average rate of approximately 210 gpm. During the application, the injection wells were continuously monitored and adjusted to maintain an even distribution of solution among wells. This was accomplished by adjusting the flow valve located on each well so that and equal amount of solution was visible in each transparent stand pipe. At 4:00 p.m. the solution was exhausted. The remainder of the day involved preparation for the second part of the application on the following day, June 30th. This included refilling of the mobile tanks with an additional 38,000 gallons of

water. The second part of the first application was completed on June 30th, as described above. The third part of the first application was completed on July 3, 2006. Upon concluding the first application, approximately three to four pails of solid potassium permanganate were found to reside on the bottoms of the mixing tanks. This material was subsequently rinsed from the tanks using additional potable water, and delivered to the injection well field using the diesel pump. The concentration of the solution used during the first application is estimated at approximately 2,100 mg/L as potassium permanganate.

4.3.2 Second Reagent Application

A second application of potassium permanganate was implemented beginning on August 1, 2006. Application procedures were modified to reduce the volume of water and to increase the concentration of the solution. An equal quantity of potassium permanganate (1,985 pounds) was mixed with approximately 76,000 gallons of water and a second diesel powered pump was used to more rapidly circulate the solution between the mixing tanks. The second application was completed in two parts, on August 1 and 2, 2006, using the same procedures described above. The concentration of the solution used during the second application is estimated at approximately 3,100 mg/L as potassium permanganate.

4.3.3 Third Reagent Application

The third application of reagent was implemented on October 4, and 5, 2006. So as to further increase the concentration of the permanganate solution, 9,000 pounds of liquid sodium permanganate solution (40 percent as sodium permanganate) was mixed with approximately 10,000 gallons of potable water and injected through the well field. The concentration of the solution used during the third application is therefore estimated at approximately 43,000 mg/L (or 4.3 percent) as sodium permanganate.

5.0 POST-TREATMENT GROUNDWATER SAMPLING

5.1 General

Groundwater was sampled following each application of reagents to assess the effectiveness of the in-situ chemical oxidation process. The first post-treatment groundwater sampling event was completed seven days after reagent application. The second post-treatment sampling event was completed 20 days after reagent application. The third post-treatment sampling event was completed 14 days after reagent application. Post-treatment groundwater sampling included the new and existing groundwater monitoring wells as previously described, as well as selected injection wells to directly assess groundwater quality in the injection well field. Results are described below.

5.2 First Post-Treatment Sampling Event

Post-treatment groundwater samples were collected from the new and existing monitoring wells PSAMW-1U, M, and L, PSAMW-2U, M, and L, and PSAMW-3U, M, and L, MW-9S and I, and MW-11I and D on July 10 and 11, 2006. Injection wells IW-A1, -A5, -B2, -B3, -B4, -D2, -D3, D4, -E1, and IW-E5 were also sampled. Sampling procedures were unchanged from those previously described in **Section 2.4**.

With the exception of tetrachloroethene (PCE), VOCs were either not detected in the groundwater samples, or were detected at concentrations less than their respective Tier II industrial cleanup goals. PCE was detected in monitoring wells PSAMW-1U and M, PSAMW-2U, M, and L, PSAMW-3U and M, MW-9S and I, and MW-11D at concentrations ranging from 61 to 840 µg/L. Similar results were indicated in the injection wells, where PCE was detected at concentrations ranging from 250 to 600 µg/L. Little change in groundwater PCE concentrations was therefore indicated following the first reagent application.

5.3 Second Post-Treatment Sampling Event

Post-treatment groundwater samples were collected from the new and existing monitoring wells and same selection of injection wells on August 22 and 23, 2006. Sampling procedures were maintained consistent with previous efforts.

With the exception of tetrachloroethene (PCE), VOCs were either not detected in the groundwater samples, or were detected at concentrations less than their respective Tier II industrial cleanup goals. PCE was detected in monitoring wells PSAMW-1U and M, PSAMW-2U, M, and L, PSAMW-3U and M, MW-9S, and MW-11D at concentrations ranging from 62 to 840 µg/L. Similar results were indicated in the injection wells, where PCE was detected at concentrations ranging from 60 to 550 µg/L. Little change in groundwater PCE concentrations was therefore indicated following the first reagent application.

5.4 Third Post-Treatment Sampling Event

Post-treatment groundwater samples were collected from the new and existing monitoring wells and three additional injection wells on October 18 and 19, 2006. Sampling procedures were maintained consistent with previous efforts.

With the exception of tetrachloroethene (PCE), VOCs were either not detected in the groundwater samples, or were detected at concentrations less than their respective Tier II industrial cleanup goals. PCE was detected in monitoring wells PSAMW-1U and M, PSAMW-2U, M, and L, PSAMW-3U and M, MW-9S, and MW-11D at concentrations ranging from 150 to 890 µg/L. Groundwater obtained from monitoring well MW-9S was pink in color, indicating that some permanganate had migrated from the injection well field to its location.

Little change in PCE concentration was indicated in the majority of the injection wells, where PCE was detected at concentrations ranging from 200 to 640 µg/L. However, injection wells IW-B2, IW-B3, IW-C4, and IW-D2 all indicated PCE concentrations that were either not detected or were less than the Tier II cleanup goal of 56.1 µg/L. Additionally, groundwater samples obtained from injection wells IW-B2, IW-B3, IW-C4, and IW-E5 exhibited a dark purple color, indicating that elevated concentrations of permanganate remained in the groundwater at their locations. The third reagent application therefore reduced the PCE concentration measured in several of the injection wells.

5.5 Discussion of Results

All groundwater sampling results obtained during the field pilot test are summarized in **Tables 3** and **4**. **Table 3** provides the results obtained from the groundwater monitoring wells. **Table 4** provides the results for samples collected directly from selected injection wells. The horizontal and vertical distribution of PCE concentrations measured in the Site groundwater is further

summarized and illustrated as shown in **Figure 6**. Analytical reports and field sampling sheets are provided in **Appendix C**. Complete analytical quality assurance/quality control data are available as electronic files, if requested, and are omitted from this report for brevity.

The groundwater monitoring results obtained during the field pilot study are surprising in several respects. Firstly, the injection of 7,570 pounds of potassium and sodium permanganate appears to have reduced groundwater PCE concentrations at only selected locations within the injection well field. Secondly, little or no dilution is apparent despite the injection of 200,000 gallons of solution. Finally, the effect of in-situ chemical oxidation at this Site appears to exhibit a threshold behavior, whereby the PCE is either unaffected, or almost completely eliminated. Review of the data summarized in **Table 3** and **4** suggest few if any trends that might be expected due to gradual chemical reactions or dilution. However, injection wells IW-B2, IW-B3, and IW-D2 all indicate a precipitous drop in PCE concentrations from an average of 343 µg/L down to non-detectable concentrations (less than 5 µg/L). **Figure 6** illustrates the resulting areas of the shallow groundwater where PCE appears to have been eliminated (or reduced to levels less than Tier II cleanup goals). Behavior of this nature might suggest the existence of a threshold dosage or concentration of permanganate, below which little chemical oxidation occurs, and above which, the process is rapidly completed.

Weaver Boos explored for the existence of such a threshold by completing a 48-hour permanganate soil oxidizer demand test (PSOD-1) in general accordance with the method recently published by U.S. EPA (June 2006). In the PSOD-1 test, a known amount of permanganate is added to a specific amount of soil and water and allowed to react for a predetermined amount of time. After the reaction period, the residual permanganate is measured and the difference from the initial amount is the permanganate soil oxidizer demand. Results of the test indicate that the permanganate demand of the Site soil is about 0.4 to 0.7 grams of $KMnO_4$ per kilogram of soil. Weaver Boos estimates that the first two applications of potassium permanganate provided a total dosage of about 0.6 grams of KMnO4 per kilogram of soil, or an amount approximately equal to the soil demand. Because the soil demand was apparently met by the first two applications, Weaver Boos believes that the Site should have been more amenable to in-situ chemical oxidation during the third reagent application. Such amenability to treatment is suggested by the apparent reductions in PCE concentrations measured in injection wells IW-B2, IW-B3, IW-C4, and IW-D2. The question remains; however, as to why the third application was not more consistently effective in the injection wells or downgradient monitoring wells.

Reasonable explanations might include either the heterogeneity of the subsurface, or the influx of additional PCE through the upgradient boundary of the treatment zone. Heterogeneity of the subsurface with respect to hydraulic conductivity might have led to the migration of permanganate solution along preferred migration pathways, even though the aquifer is comprised almost entirely of sand. **Figure 3** illustrates the textural stratification of the aquifer and suggests that the injection well screens tap a horizontally continuous layer of medium to coarse sand that is underlain by a stratum of medium sand. Rapid movement of groundwater along this layer might have dispersed the permanganate, or might have allowed for the rapid influx of new contamination from upgradient areas.

The potential for additional PCE influx is suggested by the relatively high concentrations present in monitoring wells PSAMW-1U and M (62 µg/L to 470 µg/L) and the groundwater flow velocity estimated at 3 feet per day. In the 14 days that transpired between the third reagent application and the last sampling of the injection wells, the groundwater might have flowed about 40 feet, a distance approximately equal to the width of the treatment zone parallel to the groundwater flow direction. A combination of these influences may have rendered the in-situ chemical oxidation less consistently effective than anticipated based on the bench test.

Overall, Weaver Boos believes that the results of the field pilot test indicate that in-situ chemical oxidation at the Site was successful over a limited horizontal extent of the shallow reaches of the aquifer. Insomuch as residual permanganate was indicated to remain in several injection wells approximately two weeks after the last application, some additional contaminant reduction may yet occur. The extent of additional chemical oxidation can be assessed by additional groundwater monitoring at the Site in accordance with the RWP.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

Weaver Boos has completed the in-situ chemical oxidation field pilot test in accordance with the approved RWP and QAPjP. Field observations revealed that the Site is underlain by texturally stratified sands to the lower limit of exploration at 53 feet below the ground surface. Groundwater occurs as a water table approximately 27 feet below the ground surface, and flows towards the northeast at a velocity estimated at about 3 feet per day. Baseline groundwater sampling and analyses conducted prior to the application of chemical oxidation reagents indicated the presence of PCE impacts exceeding the VRP's Tier II industrial cleanup goals in all monitoring wells screened in the upper reach (27 to 35 feet below ground surface) and middle reach (35 to 45 feet below ground surface). Lower concentrations were generally measured in monitoring wells screened at deeper depths (45 to 55 feet below ground surface).

In-situ chemical oxidation was evaluated during the field pilot test by applying 7,570 pounds of potassium and sodium permanganate consistent with the RWP prepared by Hull and the recommendations developed during the Task 3 pilot test by Weaver Boos. The reagent was divided into three doses and applied at continually increased concentrations in an effort to promote the oxidation of the PCE without causing the development of undesirable reaction products at concentrations greater than Tier II cleanup goals.

At the conclusion of the third permanganate application, the results of the field pilot test indicate that in-situ chemical oxidation at the Site was successful over a limited horizontal extent of the shallow reaches of the aquifer. Several gaps appear to have been opened in the laterally extensive plume of PCE, and residual permanganate was indicated to remain in several injection wells approximately two weeks after the last application. Some additional contaminant reduction might therefore yet occur. However, because chemical oxidation is a rapid process, the extent of future contaminant reductions is not expected to be great. Additionally, the PCE in monitoring wells directly upgradient of the treatment zone may allow for the influx of additional contaminants after the remaining effective concentrations of permanganate are exhausted. The competitive character of these influences makes it difficult to predict future trends in groundwater PCE concentration beneath the Site.

6.2 Recommendations

The conclusions reached from the field pilot test include inferences from a variety of data collected over a relatively short period of time. Weaver Boos therefore recommends that groundwater monitoring be conducted consistent with the quarterly schedule specified in the RWP. The first quarterly groundwater monitoring event specified in the RWP should be completed during January 2007. The resulting data should be reviewed to assess the long-term effectiveness of the permanganate treatment, and whether it will be appropriate to continue the proposed long-term groundwater monitoring program. Unless significant additional reductions in PCE concentration are observed during the quarterly groundwater monitoring, Weaver Boos recommends that this technology be further evaluated before it is deployed at other locations within the St. Joseph Aquifer System.

7.0 REFERENCES CITED

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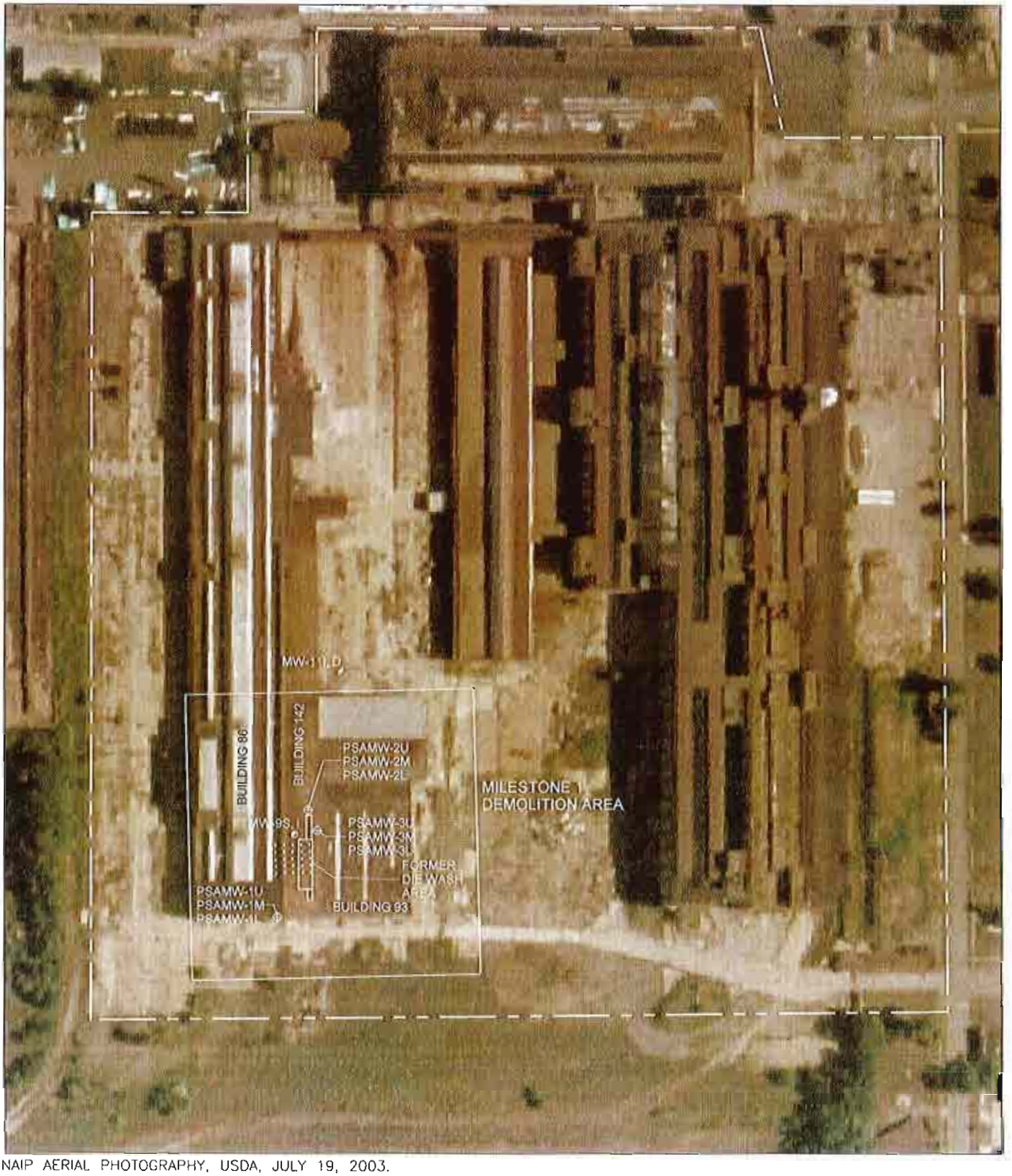
FIGURES



NAIP AERIAL PHOTOGRAPHY, USDA, JULY 19, 2003.

N

SITE BOUNDARY (APPROXIMATE)

SCALE (APPROXIMATE)

0 100' 200'

SITE LAYOUT MAP
FORMER ALLIED STAMPING PLANT

601 W. BROADWAY STREET
SOUTH BEND, IN 46601

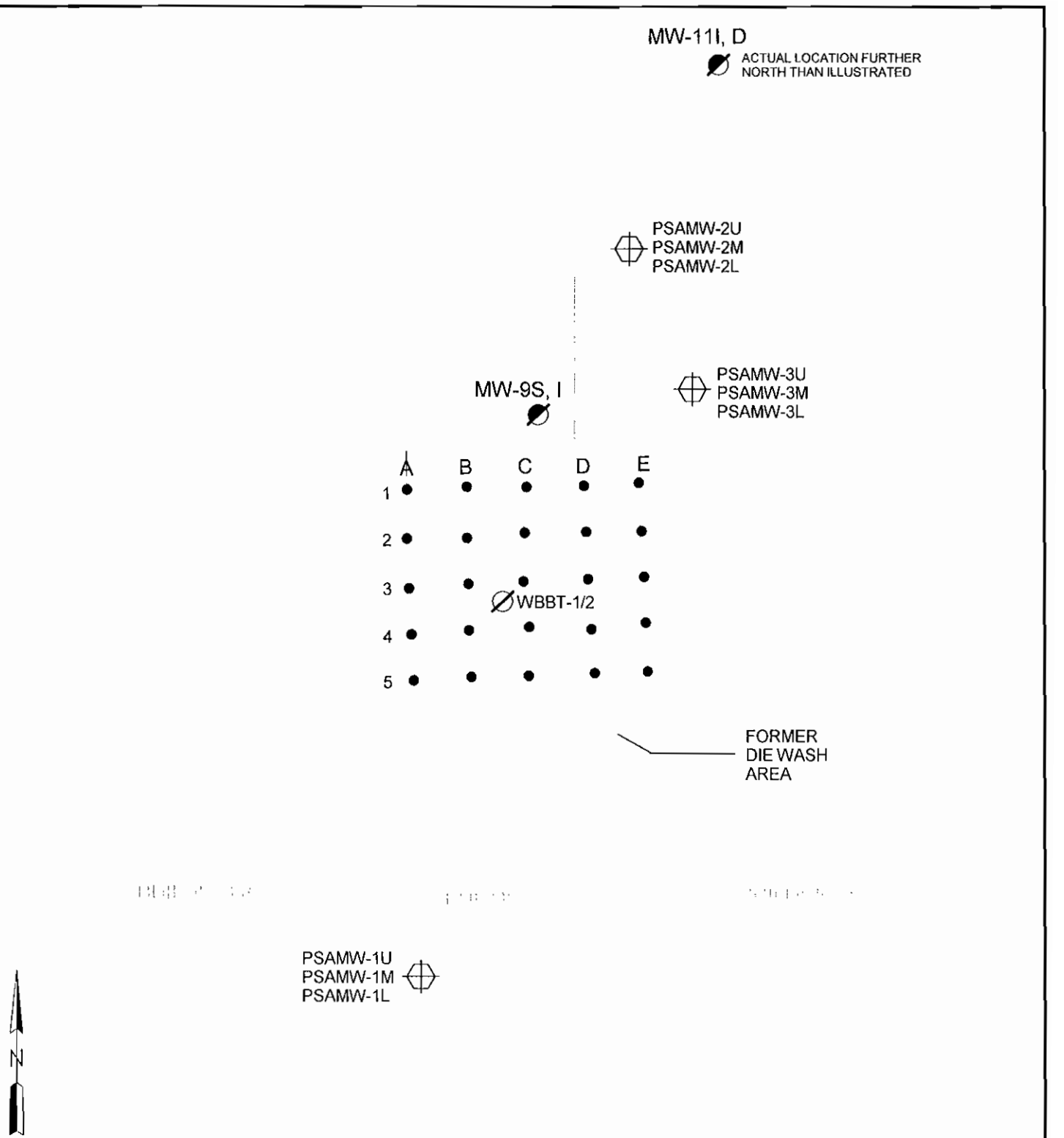
WEAVER BOOS CONSULTANTS

CHICAGO, IL
FT. WORTH, TX

GRIFFITH, IN
(219) 923-9609

NAPERVILLE, IL
SPRINGFIELD, IL

DRAWN BY: CJB	DATE: 12/30/06	FILE: 0058366-02
REVIEWED BY: SMS	CAD: 0058366-04F1.dgn	FIGURE 1



LEGEND

- EXISTING MONITORING WELL
- BENCH TEST SOIL PROBE LOCATION
- PSAMW-1U, M and L - PILOT STUDY MONITORING WELL LOCATION
- OXIDANT INJECTION WELL LOCATION

APPROXIMATE SCALE

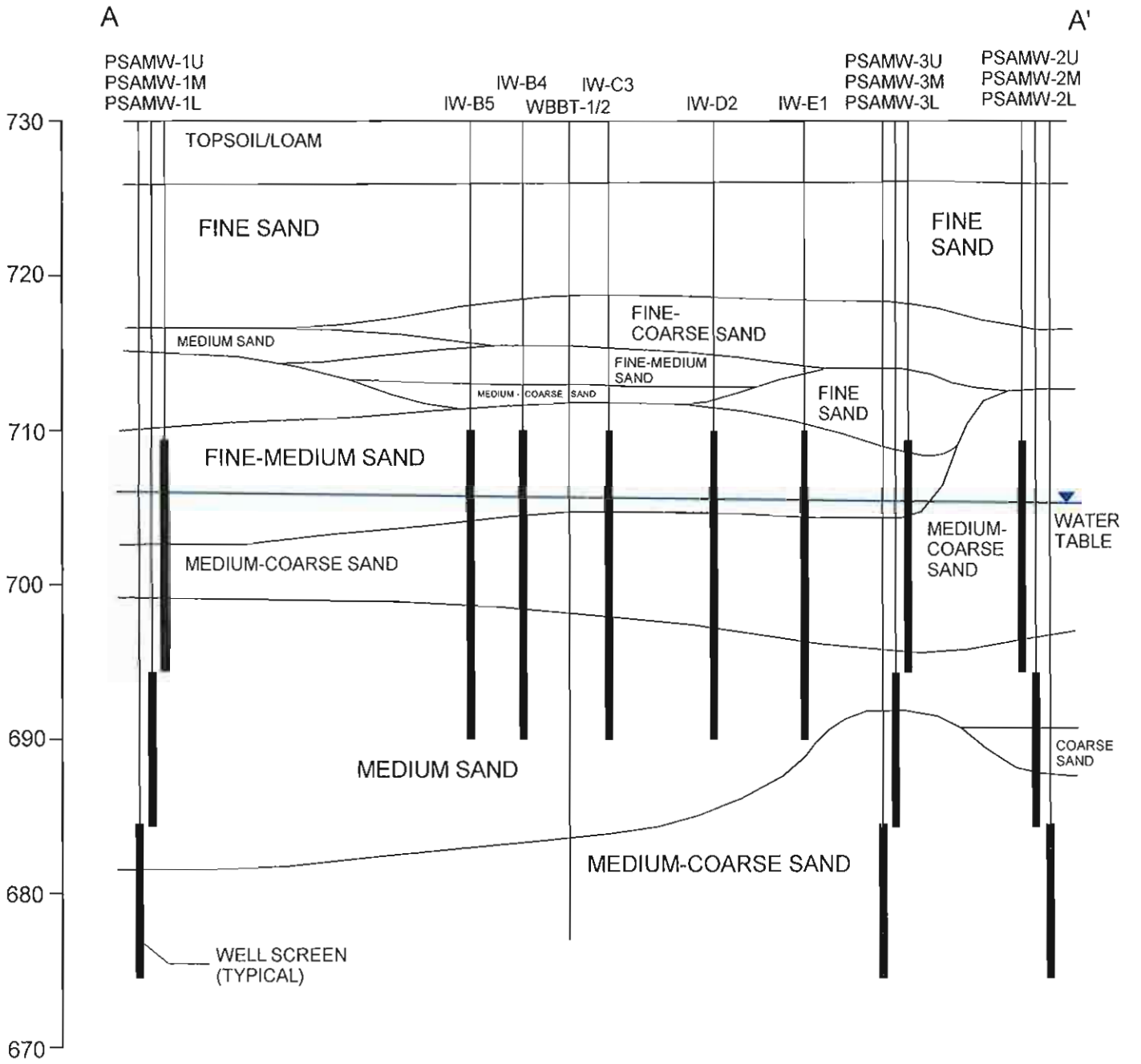
0 15' 30' 60'

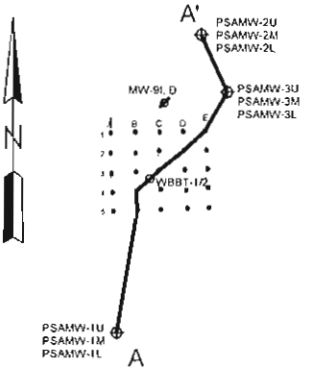
PILOT TEST SAMPLING LOCATIONS AND PILOT TEST INJECTION POINTS

FORMER ALLIED STAMPING PLANT
601 W. BROADWAY STREET
SOUTH BEND, INDIANA

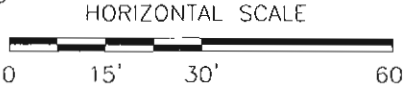
WEAVER BOOS CONSULTANTS
CHICAGO, IL
FT. WORTH, TX
GRIFFITH, IN
(219) 923-9609
NAPERVILLE, IL
SPRINGFIELD, IL

DRAWN BY: CJB | DATE: 12/28/06 | FILE: 0058366-04
REVIEWED BY: SMS | CAD 0058366-04F2.TCW | FIGURE 2





CROSS SECTION TRANSECT



GEOLOGIC CROSS SECTION

FORMER ALLIED STAMPING PLANT
601 W. BROADWAY STREET
SOUTH BEND, INDIANA

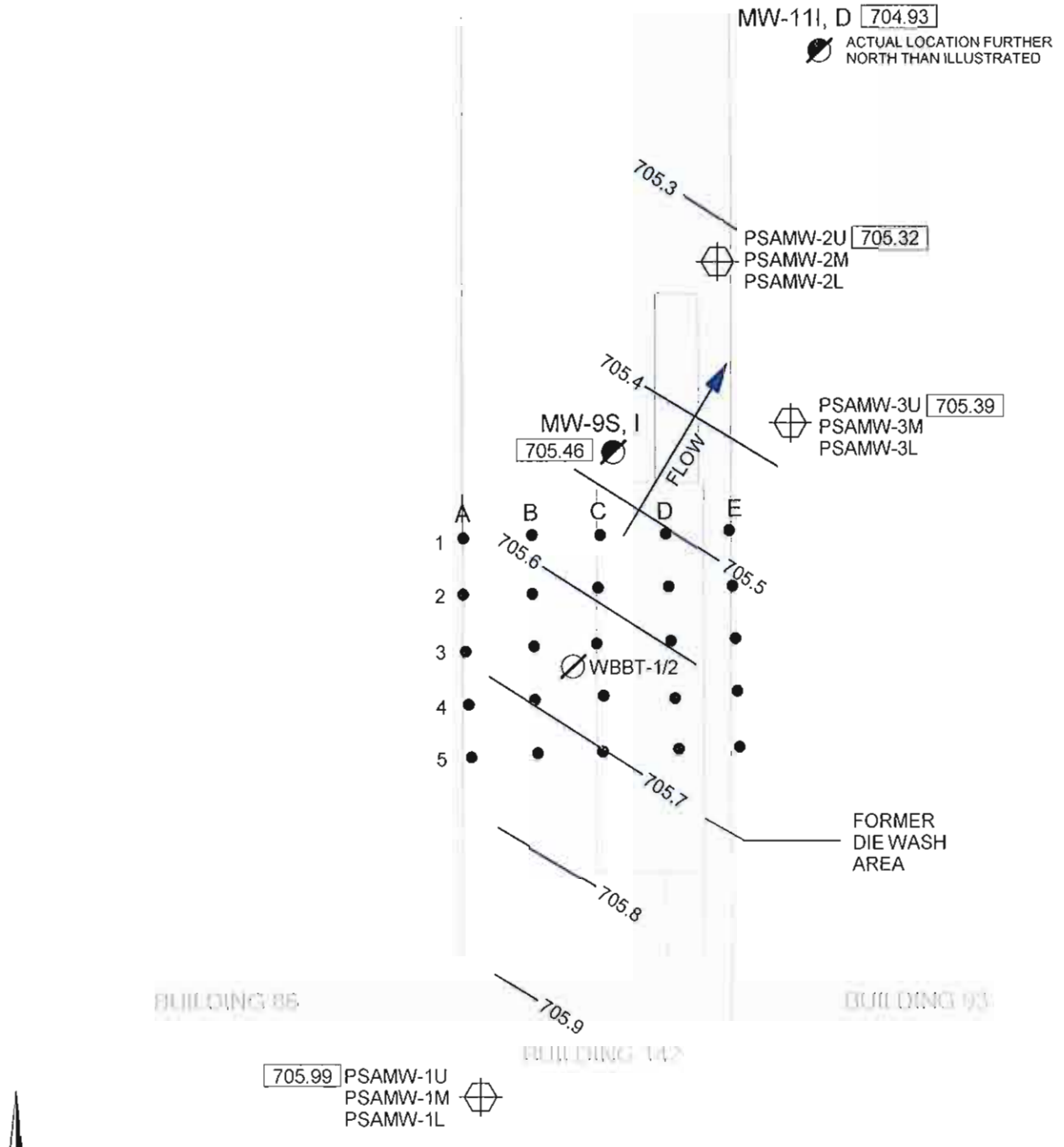
WEAVER BOOS CONSULTANTS

CHICAGO, IL
FT. WORTH, TX

GRIFFITH, IN
(219) 923-9609

NAPERVILLE, IL
SPRINGFIELD, IL

DRAWN BY: CJB	DATE: 12/29/06	FILE: 0058366-04
REVIEWED BY: SMS	CAD: 0058366-04F3.ICW	FIGURE 3

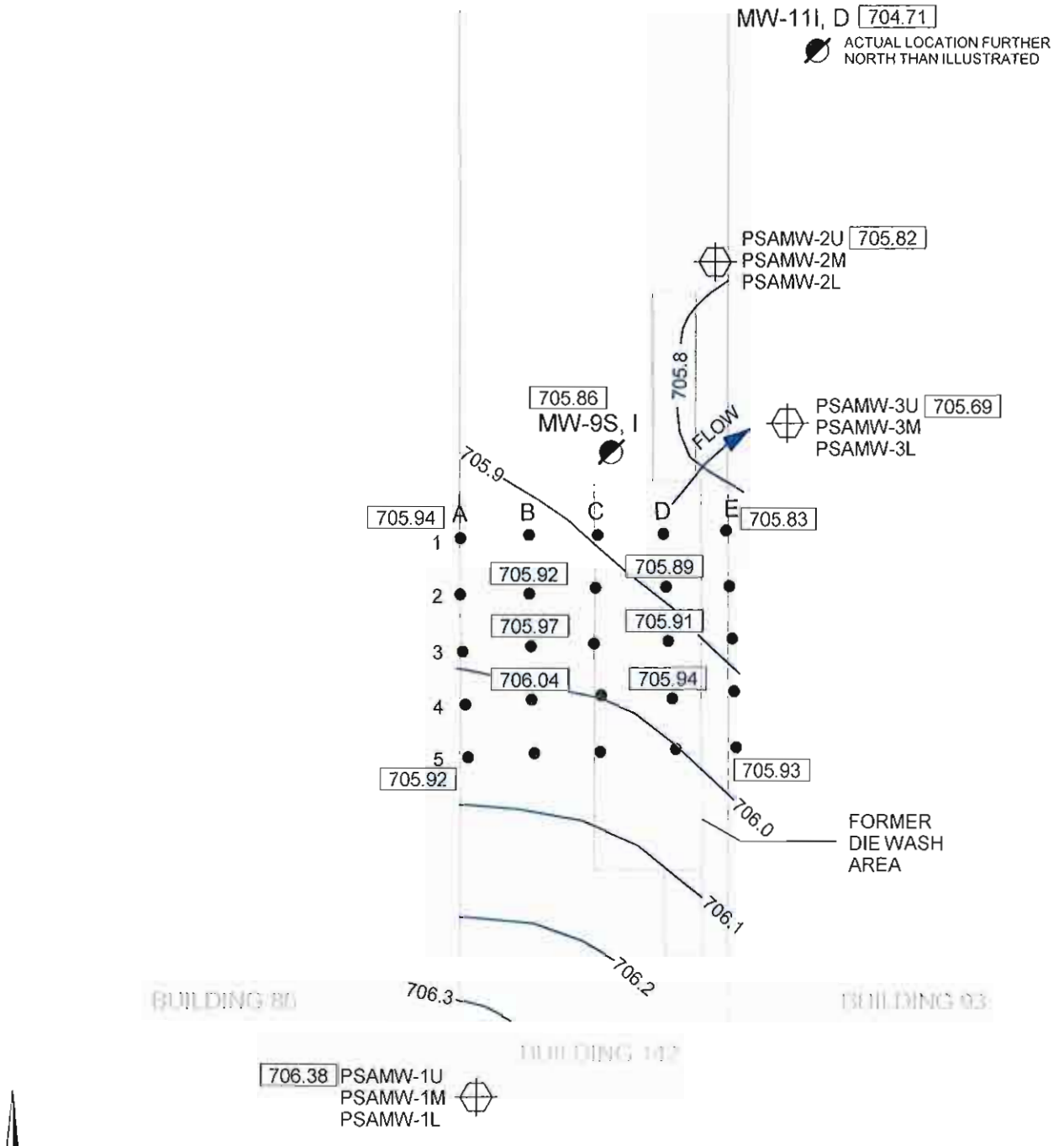


POTENTIOMETRIC MAP
JUNE 27 & 28, 2006

FORMER ALLIED STAMPING PLANT
601 W. BROADWAY STREET
SOUTH BEND, INDIANA

WEAVER BOOS CONSULTANTS
CHICAGO, IL FT. WORTH, TX | GRIFFITH, IN (219) 923-9609 | NAPERVILLE, IL SPRINGFIELD, IL

DRAWN BY: CJB	DATE: 12/28/06	FILE: 0058366-04
REVIEWED BY: SMS	CAD: 0058366-04F4.TCW	FIGURE 4



LEGEND

- EXISTING MONITORING WELL
- BENCH TEST SOIL PROBE LOCATION
- PILOT STUDY MONITORING WELL LOCATION (PSAMW-1U, M and L)
- OXIDANT INJECTION WELL LOCATION
- 705.99 - GROUNDWATER ELEVATION
- 705.9 - GROUNDWATER CONTOUR

APPROXIMATE SCALE

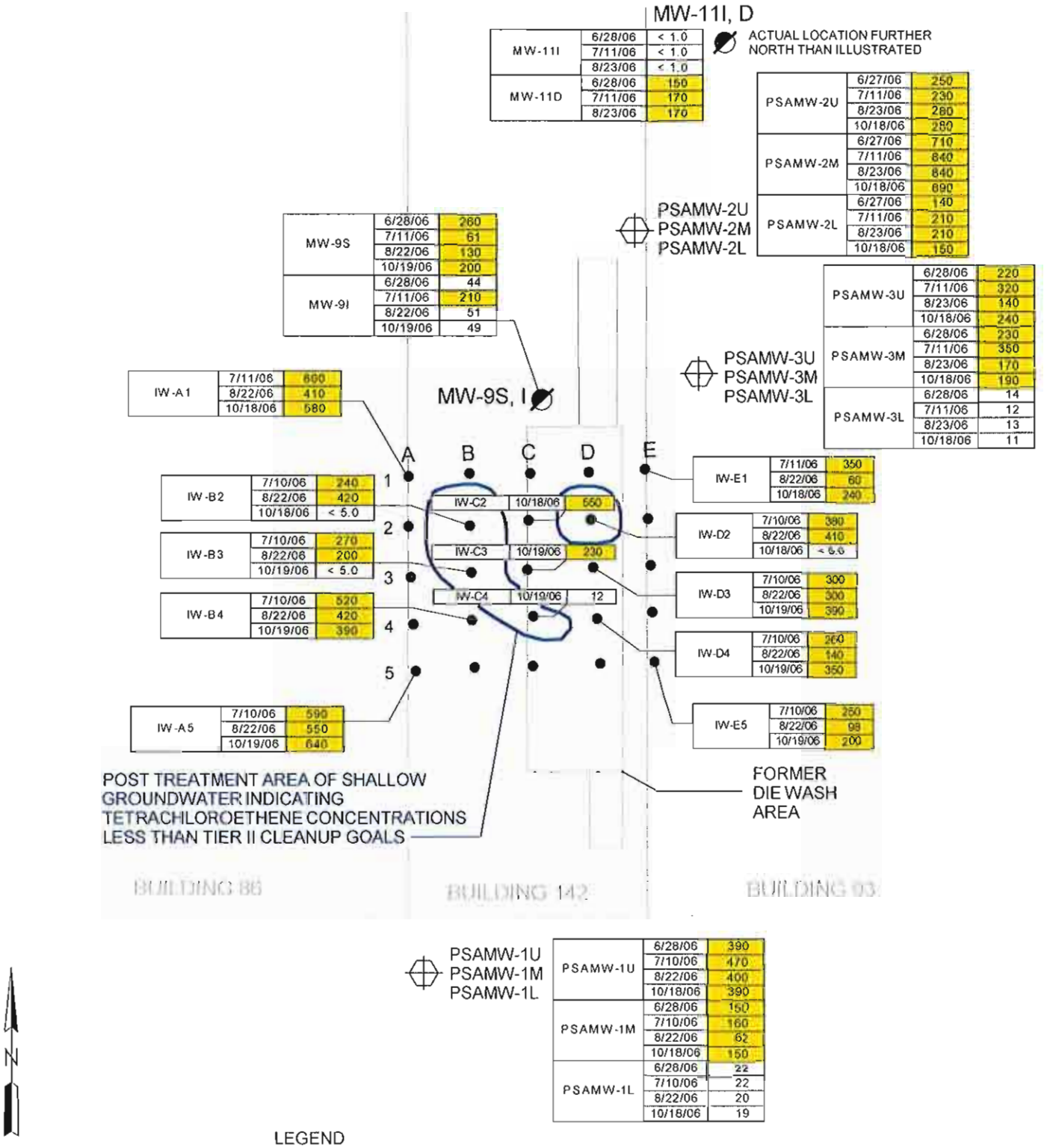
0 15' 30' 60'

POTENTIOMETRIC MAP
AUGUST 22 & 23, 2006

FORMER ALLIED STAMPING PLANT
601 W. BROADWAY STREET
SOUTH BEND, INDIANA

WEAVER BOOS CONSULTANTS
CHICAGO, IL FT. WORTH, TX | GRIFFITH, IN (219) 923-9609 | NAPERVILLE, IL SPRINGFIELD, IL

DRAWN BY: CJB | DATE: 12/28/06 | FILE: 0058366-04
REVIEWED BY: SMS | CAD: 0058366-04F5.TCW | FIGURE 5



LEGEND

- EXISTING MONITORING WELL
- PSAMW-1U, M and L - PILOT STUDY MONITORING WELL LOCATION
- OXIDANT INJECTION WELL LOCATION

WELL ID	DATE	CONC.	
IW-B3	7/10/06	270	- GREATER THAN TIER II CLEANUP GOAL (56.1 ug/l)
	8/22/06	200	
	10/19/06	< 5.0	- LESS THAN TIER II CLEANUP GOAL (56.1 ug/l)

APPROXIMATE SCALE

0 15' 30' 60'

GROUNDWATER MONITORING RESULTS FOR TETRACHLOROETHENE (ug/l)

FORMER ALLIED STAMPING PLANT
601 W. BROADWAY STREET
SOUTH BEND, INDIANA

WEAVER BOOS CONSULTANTS
CHICAGO, IL FT. WORTH, TX | GRIFFITH, IN (219) 923-9609 | NAPERVILLE, IL SPRINGFIELD, IL

DRAWN BY: CJB | DATE: 12/28/06 | FILE: 0058366-04
REVIEWED BY: SMS | CAD: 0058366-04F2.TCW | FIGURE 6

TABLES

Table 1
Monitoring and Injection Well Information
In-Situ Chemical Oxidation
Former Allied Stamping Plant
South Bend, Indiana

Well I.D.	Date Completed	Northing	Easting	Ground Surface Elevation (feet)	TOIC Elevation (feet)	Stickup (feet)	Depth to Top of Screen (feet)	Depth to Bottom of Screen (feet)	Depth to Bottom of Well (feet)	Well Screen Length (feet)	Well Screen Center Elevation (feet)
Groundwater Monitoring Wells											
PSAMW-1U	06/23/06	2,336,617.66	3,178,180.90	730.50	733.20	2.70	20.62	35.62	35.62	15.0	702.4
PSAMW-1M	06/23/06	2,336,616.90	3,178,178.88	730.44	733.38	2.94	35.65	45.65	45.65	10.0	689.8
PSAMW-1L	06/23/06	2,336,615.78	3,178,176.76	730.50	733.20	2.70	45.51	55.51	55.51	10.0	680.0
PSAMW-2U	06/22/06	2,336,769.78	3,178,223.34	729.94	732.66	2.72	20.55	35.55	35.55	15.0	701.9
PSAMW-2M	06/22/06	2,336,771.72	3,178,223.40	729.88	732.50	2.62	35.48	45.48	45.48	10.0	689.4
PSAMW-2L	06/22/06	2,336,774.20	3,178,223.90	729.86	732.58	2.72	45.42	55.52	55.42	10.1	679.4
PSAMW-3U	06/21/06	2,336,745.04	3,178,236.76	730.08	732.62	2.54	20.55	35.55	35.55	15.0	702.0
PSAMW-3M	06/22/06	2,336,741.88	3,178,237.04	730.08	732.48	2.40	35.45	45.45	45.45	10.0	689.6
PSAMW-3L	06/22/06	2,336,738.76	3,178,236.92	730.02	732.58	2.56	45.25	55.25	55.50	10.0	679.8
MW-9S	By others	2,336,735.66	3,178,197.80	729.98	730.90	0.92	By others	By others	29.74	By others	By others
MW-9I	By others	2,336,736.52	3,178,204.00	729.78	730.64	0.86	By others	By others	50.10	By others	By others
MW-11I	By others	2,336,972.72	3,178,271.50	730.74	730.16	-0.58	By others	By others	37.65	By others	By others
MW-11D	By others	2,336,975.90	3,178,274.90	730.68	730.34	-0.34	By others	By others	67.76	By others	By others
Oxidation Reagent Injection Wells											
IW-A1	06/21/06	2,336,720.54	3,178,175.94	729.96	732.88	2.92	20	40	40	20.0	700.0
IW-A2	06/21/06	2,336,710.12	3,178,175.90	730.02	732.86	2.84	20	40	40	20.0	700.0
IW-A3	06/21/06	2,336,699.54	3,178,176.36	730.06	732.96	2.90	20	40	40	20.0	700.1
IW-A4	06/21/06	2,336,689.72	3,178,176.90	730.06	732.94	2.88	20	40	40	20.0	700.1
IW-A5	06/21/06	2,336,679.94	3,178,177.38	730.00	732.86	2.86	20	40	40	20.0	700.0
IW-B1	06/21/06	2,336,721.16	3,178,188.72	729.94	732.84	2.90	20	40	40	20.0	699.9
IW-B2	06/21/06	2,336,710.26	3,178,188.78	729.96	732.86	2.90	20	40	40	20.0	700.0
IW-B3	06/21/06	2,336,700.52	3,178,189.08	730.00	732.90	2.90	20	40	40	20.0	700.0
IW-B4	06/20/06	2,336,690.62	3,178,189.20	730.02	732.88	2.86	20	40	40	20.0	700.0
IW-B5	06/20/06	2,336,680.70	3,178,189.74	729.96	732.78	2.82	20	40	40	20.0	700.0
IW-C1	06/20/06	2,336,721.14	3,178,201.48	730.02	732.86	2.84	20	40	40	20.0	700.0
IW-C2	06/20/06	2,336,711.38	3,178,201.06	729.98	732.86	2.88	20	40	40	20.0	700.0
IW-C3	06/20/06	2,336,701.04	3,178,200.80	729.98	730.74	0.76	20	40	40	20.0	700.0
IW-C4	06/20/06	2,336,691.36	3,178,202.06	730.08	732.98	2.90	20	40	40	20.0	700.1
IW-C5	06/20/06	2,336,680.98	3,178,201.96	730.06	732.86	2.80	20	40	40	20.0	700.1
IW-D1	06/20/06	2,336,721.40	3,178,213.70	730.02	732.88	2.86	20	40	40	20.0	700.0
IW-D2	06/20/06	2,336,711.60	3,178,214.20	729.94	732.80	2.86	20	40	40	20.0	699.9
IW-D3	06/20/06	2,336,701.54	3,178,214.60	730.06	733.00	2.94	20	40	40	20.0	700.1
IW-D4	06/19/06	2,336,690.88	3,178,215.36	730.10	733.00	2.90	20	40	40	20.0	700.1
IW-D5	06/19/06	2,336,681.52	3,178,216.04	730.12	732.98	2.86	20	40	40	20.0	700.1
IW-E1	06/19/06	2,336,722.04	3,178,225.44	730.06	732.94	2.88	20	40	40	20.0	700.1
IW-E2	06/19/06	2,336,711.74	3,178,226.06	730.04	732.92	2.88	20	40	40	20.0	700.0
IW-E3	06/19/06	2,336,702.02	3,178,226.60	730.12	732.98	2.86	20	40	40	20.0	700.1
IW-E4	06/19/06	2,336,692.26	3,178,226.96	730.10	732.98	2.88	20	40	40	20.0	700.1
IW-E5	06/19/06	2,336,681.88	3,178,227.38	730.16	732.98	2.82	20	40	40	20.0	700.2

Notes:
TOIC - Top of inner PVC well pipe elevation.
By others - This well was drilled by others, and the indicated datum was not measured by Weaver Boos.
Elevations relative to GPS basestation bench mark pin set by Wightman-Petri along southern boundary of the property (Elevation = 731.98 ft).

Table 2

Groundwater Elevation Measurements
In-Situ Chemical Oxidation
Former Allied Stamping Plant
South Bend, Indiana

Well I.D.	TOIC Elevation (feet)	June 27 & 28, 2006		July 10 & 11, 2006		August 22 & 23, 2006		October 18 & 19, 2006	
		Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)	Depth to Water (feet)	Water Level Elevation (feet)
Groundwater Monitoring Wells									
PSAMW-1U	733.20	27.21	705.99	27.36	705.84	26.82	706.38	27.30	705.90
PSAMW-1M	733.38	27.49	705.89	27.61	705.77	27.10	706.28	27.31	706.07
PSAMW-1L	733.20	27.28	705.92	27.40	705.80	26.88	706.32	27.31	705.89
PSAMW-2U	732.66	27.34	705.32	27.48	705.18	26.84	705.82	27.09	705.57
PSAMW-2M	732.50	27.15	705.35	27.31	705.19	26.74	705.76	27.05	705.45
PSAMW-2L	732.58	27.27	705.31	27.40	705.18	26.86	705.72	27.07	705.51
PSAMW-3U	732.62	27.23	705.39	27.40	705.22	26.93	705.69	27.07	705.55
PSAMW-3M	732.48	27.10	705.38	27.25	705.23	26.69	705.79	27.00	705.48
PSAMW-3L	732.58	27.19	705.39	27.32	705.26	26.77	705.81	27.02	705.56
MW-9S	730.90	25.44	705.46	25.33	705.57	25.02	705.88	25.26	705.64
MW-9I	730.64	25.19	705.45	25.58	705.06	24.78	705.86	25.26	705.38
MW-11I	730.16	25.23	704.93	25.95	704.21	25.45	704.71	---	---
MW-11D	730.34	25.51	704.83	25.99	704.35	25.42	704.92	---	---
Oxidation Reagent Injection Wells									
IW-A1	732.88	---	---	---	---	26.94	705.94	27.31	705.57
IW-A5	732.86	---	---	---	---	26.81	706.05	27.06	705.80
IW-B2	732.86	---	---	---	---	26.94	705.92	27.25	705.61
IW-B3	732.90	---	---	---	---	26.93	705.97	27.10	705.80
IW-B4	732.88	---	---	---	---	26.84	706.04	27.09	705.79
IW-C2	732.86	---	---	---	---	---	---	27.22	705.64
IW-C3	730.74	---	---	---	---	---	---	27.19	703.55
IW-C4	732.98	---	---	---	---	---	---	27.18	705.80
IW-D2	732.80	---	---	---	---	26.91	705.89	27.35	705.45
IW-D3	733.00	---	---	---	---	27.09	705.91	27.33	705.67
IW-D4	733.00	---	---	---	---	27.06	705.94	27.20	705.80
IW-E1	732.94	---	---	---	---	27.11	705.83	27.40	705.54
IW-E5	732.98	---	---	---	---	27.05	705.93	27.33	705.65

Notes:

TOIC - Top of inner PVC well pipe elevation.

Elevations relative to GPS basestation bench mark pin set by Wightman-Petri along southern boundary of the property (Elevation = 731.98 ft).

---- - Not measured.

TABLE 3
Analytical Results for Groundwater Monitoring Wells
Former Allied Stamping Plant
South Bend, Indiana

Sample I.D. No.	Date Collected	Volatile Organic Compounds Detected (ug/L)														Total Iron (mg/L)	Total Organic Carbon (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	pH (-log[H+])	Dissolved Oxygen (mg/L)	Specific Conductance (S/cm)	Visual Appearance
		Acetone	Bromodichloro-methane	2-Butanone	Carbon-disulfide	Carbon-tetrachloride	Chloroform	Dibromo-chloromethane	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	2-Hexanone	4-Methyl-2-pentanone	Tetrachloro-ethene	Toluene	Trichloro-ethene								
PSAMW-1U	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	390	< 1.0	5.0	36	1.80	59	590	7.20	---	0.96	Turbid
	7/10/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	470	< 1.0	4.2	16	1.60	66	640	7.23	5.21	0.94	Brown
	8/22/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	400	< 1.0	4.0	25	1.60	---	620	7.19	4.03	1.03	Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	390	< 5.0	< 5.0	16	1.60	110	660	7.19	5.1	0.57	Lt Brown
PSAMW-1M	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	150	< 1.0	< 1.0	3.4	0.800	41	650	7.39	---	1.09	Turbid
	7/10/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	160	< 1.0	< 1.0	0.70	0.900	32	660	7.41	11.13	1.06	Colorless
	8/22/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	62	< 1.0	< 1.0	0.56	1.50	---	620	7.30	3.08	1.10	Colorless
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	150	< 5.0	< 5.0	0.77	1.00	43	670	7.32	3.23	0.71	Colorless
PSAMW-1L	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	22	< 1.0	< 1.0	4.0	0.900	35	600	7.36	NR	1.08	Turbid
	7/10/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	22	< 1.0	< 1.0	0.60	1.10	32	670	7.65	5.62	1.05	Colorless
	8/22/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	20	< 1.0	< 1.0	1.4	1.10	---	640	7.23	2.53	1.09	Colorless
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	19	< 5.0	< 5.0	1.2	0.900	41	660	7.34	3.06	0.68	Colorless
PSAMW-2U	6/27/2006	< 5.0	< 1.0	< 2.0	< 2.0	2.1	2.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	250	< 1.0	< 1.0	< 0.050	1.80	41	610	7.20	---	1.30	Colorless
	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	2.6	2.5	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	230	< 1.0	< 1.0	3.9	3.5	67	600	7.11	---	0.88	Brown
	8/23/2006	10	1.5	< 2.0	< 2.0	4.5	4.8	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	280	< 1.0	< 1.0	24	13.6	---	760	7.08	2.12	1.27	Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	280	< 5.0	< 5.0	7.9	7.90	86	760	7.28	2.76	0.85	Colorless
PSAMW-2M	6/27/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	710	< 1.0	< 1.0	< 0.050	1.20	29	690	7.35	---	1.05	Colorless
	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	840	< 1.0	< 1.0	2.9	10.5	41	620	7.30	5.15	0.95	Brown
	8/23/2006	8.2	1.3	< 2.0	< 2.0	< 1.0	1.3	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	840	< 1.0	< 1.0	1.2	18.0	---	780	7.37	1.97	1.23	Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	890	< 1.0	< 1.0	0.43	7.10	44	720	7.45	2.87	0.82	Colorless
PSAMW-2L	6/27/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	140	< 1.0	< 1.0	1.3	0.900	26	590	7.40	---	1.07	Colorless
	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	210	< 1.0	< 1.0	2.0	3.80	27	720	7.33	3.4	1.00	---
	8/23/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	210	< 1.0	< 1.0	2.7	5.90	---	620	7.33	2.62	1.12	Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	150	< 5.0	< 5.0	1.3	13.4	42	680	7.41	3.31	0.78	Colorless
PSAMW-3U	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	3.8	3.5	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	220	< 1.0	4.5	9.0	1.90	66	940	7.19	---	0.88	Turbid
	7/11/2006	64	1.2	17	< 2.0	4.0	4.4	< 1.0	< 1.0	< 1.0	2.6	< 1.0	320	< 1.0	2.5	1.4	17.80	100	760	7.17	3.54	1.10	Brown
	8/23/2006	32	1.7	< 2.0	< 2.0	5.0	6.1	2.1	< 1.0	< 1.0	< 2.0	< 1.0	140	< 1.0	1.1	20	19.00	---	920	7.27	2.8	1.48	Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	240	< 5.0	< 5.0	3.9	5.50	65	720	7.26	3.43	0.85	Colorless
PSAMW-3M	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	230	< 1.0	< 1.0	< 0.050	0.800	27	640	7.26	---	1.07	Colorless
	7/11/2006	28	< 1.0	8.6	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	350	< 1.0	< 1.0	4.1	6.00	51	680	7.36	5.4	1.03	Brown
	8/23/2006	30	< 1.0	< 2.0	< 2.0	< 1.0	1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	170	< 1.0	< 1.0	0.32	25.0	---	1000	7.48	2.33	1.51	Lt Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	190	< 5.0	< 5.0	0.058	6.20	39	700	7.50	2.2	0.82	Colorless
	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	14	< 1.0	< 1.0	< 0.050	0.700	28	640	7.34	---	1.03	Colorless
PSAMW-3L	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	12	< 1.0	< 1.0	4.1	1.50	45	610	7.43	4.01	0.99	Brown
	8/23/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	13	< 1.0	< 1.0	12	1.50	---	570	7.42	2.76	1.00	Brown
	10/18/2006	81	< 5.0	13	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	11	< 5.0	< 5.0	11	33.0	13	820	7.71	2.46	0.82	Colorless
MW-9S	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	260	< 1.0	< 1.0	11	1.90	46	530	7.21	---	0.89	Turbid
	7/11/2006	13	< 1.0	2.4	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	61	< 1.0	< 1.0	4.5	2.50	34	650	7.35	3.05	0.96	Reddish Brown
	8/22/2006	18	1.0	< 2.0	< 2.0	4.6	3.4	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	130	< 1.0	< 1.0	4.5	15.5	---	900	7.12	2.23	1.45	Colorless
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	200	< 5.0	< 5.0	4.8	11.7	< 100	760	7.36	3.21	0.84	Pink
MW-9I	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	44	< 1.0	< 1.0	0.088	0.800	34	600	7.28	---	1.06	Colorless
	7/11/2006	140	2.6	42	< 2.0	1.4	2.8	3.1	< 1.0	< 1.0	5.3	1.4	210	< 1.0	< 1.0	4.4	27.0	100	900	7.28	3.28	1.35	Pink
	8/22/2006	6.4	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	51	< 1.0	< 1.0	1.1	4.40	---	660	7.23	2.52	1.15	Colorless
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	49	< 5.0	< 5.0	0.31	16.1	31	710	7.51	4.52	0.85	Colorless
MW-11I	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	31	5.3	< 2.0	< 1.0	< 1.0	< 1.0	14	0.29	5.00	35	550	7.38	---	0.92	Turbid
	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	32	5.4	< 2.0	< 1.0	< 1.0	< 1.0	14	0.9	16.0	51	620	7.64	2.36	0.91	Gray
	8/23/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	34	5.4	< 2.0	< 1.0	< 1.0	< 1.0	15	1.4	3.00	---	520	7.62	2.84	0.92	Gray
MW-11D	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	150	< 1.0	< 1.0	0.65	0.800	38	600	7.21	---	1.02	Turbid
	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	170	< 1.0	< 1.0	5.0	---	120	340	7.41	4.67	0.94	Brown
	8/23/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	170	< 1.0	< 1.0	4.4	1.30	---	540	7.40	4.3	1.02	Brown
FIELD QA/QC SAMPLES																							
Duplicate (MW-9I)	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	47	1.0	< 1.0	0.098	0.900	42	610	7.28	---	1.06	Colorless
Dup-1 (PSAMW-1U)	7/10/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	380	< 1.0	4.2	13.00	1.70	54	640	7.23	5.21	0.94	Brown
Dup-2 (MW-9I)	7/11/2006	110	2.3	37		1.0	2.5	2.7	< 1.0	< 1.0	4.5	1.3	240	< 1.0	< 1.0	5.9	25.0	100	820	7.28	3.28	1.35	Pink
Dup-1/3L (PSAMW-1L)	10/18/2006	79	< 5.0	16	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	11	< 5.0	< 5.0	11	32.20	14	820	7.71	2.46	0.82	Colorless
Dup-2/C4 (IW-C4)	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	7.4	< 5.0	< 5.0	36	2.60	< 10	700	7.34	5.61	0.76	Dk Purple
Field Blank	6/28/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.500	< 10	< 10	---	---	---	Colorless
IW-F10 (Field Blank)	7/10/2006	< 5.0	< 1.0	< 2.0	2.4	< 1.0	< 1.0	<1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.500	< 10	21	---	---	---	Colorless
IW-F11 (Field Blank)	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	<1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.500	< 10	21	---	---	---	Colorless
FB-1/2U (Field Blank)	10/18/2006	< 50.0	< 5.0	31	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 0.050	0.800	< 10	28	---	---	---	Colorless
Trip Blank	6/19/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	---	---	---	---	---	---	---	Colorless
Trip Blank	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	---	---	---	---	---	---	---	Colorless
Trip Blank	7/12/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	---	---	---	---	---	---	---	Colorless
Trip Blank	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	---	---	---	---	---	---	---	Colorless
VPR Tier II Industrial	---	10,220	---	5,110	---	---	468.9	---	1,022	---	---	5,110	56.1	20,440	260	---	---	---	---	---	---	---	---

Note: June results are for samples collected before potassium permanganate injections. Later results are for samples collected after injection.
--- - Not applicable/not analyzed.
250 - Concentration is greater than VRP Tier II Industrial Cleanup Goal.

TABLE 4
Analytical Results for Groundwater Injection Wells Sampled Like Monitoring Wells
Former Allied Stamping Plant
South Bend, Indiana

Sample I.D. No.	Date Collected	Volatile Organic Compounds Detected (ug/L)														Total Iron (mg/L)	Total Organic Carbon (mg/L)	Sulfate (mg/L)	Total Dissolved Solids (mg/L)	pH (-log[H+])	Dissolved Oxygen (mg/L)	Specific Conductance (S/cm)	Visual Appearance
		Acetone	Bromodichloro-methane	2-Butanone	Carbon-disulfide	Carbon-tetrachloride	Chloroform	Dibromo-chloromethane	cis-1,2-Dichlroethene	trans-1,2-Dichloroethene	2-Hexanone	4-Methyl-2-pentanone	Tetrachloro-ethene	Toluene	Trichloro-ethene								
IW-A1	7/11/2006	68	1.2	22	< 2.0	< 1.0	1.5	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	600	< 1.0	< 1.0	18	16.7	72	780	7.37	3.40	1.21	Reddish Brown
	8/22/2006	6.1	< 1.0	< 2.0	< 2.0	1.1	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	410	< 1.0	< 1.0	54	5.7	---	650	7.12	2.52	1.04	Reddish Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	580	< 5.0	< 5.0	31	4.70	60	610	7.26	5.38	0.66	Dk Brown
IW-A5	7/10/2006	5.7	< 1.0	3.9	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	590	< 1.0	< 1.0	36	3.50	50	680	7.32	5.10	0.97	Brown
	8/22/2006	6.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	550	< 1.0	< 1.0	73	3.20	---	570	7.23	4.51	1.03	Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	640	< 5.0	< 5.0	17	2.10	< 100	590	7.32	6.34	0.62	Dk Brown
IW-B2	7/10/2006	150	2.1	60	< 2.0	< 1.0	1.9	2.7	< 1.0	< 1.0	< 2.0	1.2	240	< 1.0	< 1.0	68	27.0	93	870	7.20	7.27	1.23	Reddish Brown
	8/22/2006	16	< 1.0	7.7	< 2.0	< 1.0	1.0	2.7	< 1.0	< 1.0	< 2.0	< 1.0	420	< 1.0	< 1.0	53	7.40	---	700	7.27	2.96	1.20	Reddish Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	33	6.50	< 100	750	7.45	3.55	0.81	Dk Purple
IW-B3	7/10/2006	27	< 1.0	11	< 2.0	1.6	1.5	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	270	< 1.0	< 1.0	7.1	10.1	57	750	7.28	4.80	1.01	Reddish Brown
	8/22/2006	7.8	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	200	< 1.0	< 1.0	63	4.8	---	610	7.25	3.17	1.11	Reddith Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	15	4.90	< 100	730	7.28	6.10	0.74	Dk Purple
IW-B4	7/10/2006	16	< 1.0	8.6	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	520	< 1.0	< 1.0	22	7.17	48	620	7.25	11.13	0.99	Reddish Brown
	8/22/2006	6.4	< 1.0	2.3	< 2.0	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	420	< 1.0	< 1.0	49	3.50	---	580	7.18	3.60	1.06	Reddish Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	390	< 5.0	< 5.0	8.6	2.10	50	590	7.23	5.33	0.64	Dk Brown
IW-C2	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	550	< 5.0	< 5.0	36	4.20	73	700	7.31	3.28	720.00	Dk Brown
IW-C3	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	230	< 5.0	< 5.0	41	5.40	< 100	690	7.35	5.31	0.54	Dk Brown
IW-C4	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	12	< 5.0	< 5.0	49	2.40	< 100	720	7.34	5.61	0.76	Dk Purple
IW-D2	7/10/2006	230	1.7	52	< 2.0	2.0	2.9	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	380	< 1.0	< 1.0	20	30.0	96	820	7.15	9.50	1.10	Reddish Brown
	8/22/2006	22	< 1.0	13	< 2.0	1.3	1.1	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	410	< 1.0	< 1.0	30	6.40	---	720	7.23	2.06	1.35	Reddish Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	19	7.30	< 100	810	7.39	2.61	0.87	Dk Brown
IW-D3	7/10/2006	210	1.3	26	< 2.0	2.0	2.1	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	300	< 1.0	< 1.0	6.9	18.0	70	780	7.18	8.73	1.06	Reddish Brown
	8/22/2006	12	< 1.0	< 2.0	< 2.0	2.2	1.5	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	300	< 1.0	1.1	57	18.0	---	780	7.22	2.32	1.21	Reddish Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	390	< 5.0	< 5.0	12	3.10	56	640	7.43	4.40	0.71	Dk Brown
IW-D4	7/10/2006	21	< 1.0	14	< 2.0	2.7	2.7	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	260	< 1.0	2.9	52	8.40	71	760	7.25	4.10	1.08	Purple
	8/22/2006	7.3	< 1.0	< 2.0	< 2.0	1.5	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	140	< 1.0	1.8	59	4.10	---	580	7.14	3.09	1.08	Reddish Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	350	< 5.0	< 5.0	20	3.40	< 100	630	7.46	5.43	0.57	Dk Brown
IW-E1	7/11/2006	170	2.3	76	< 2.0	1.2	2.9	< 1.0	< 1.0	< 1.0	7.2	2.0	350	< 1.0	< 1.0	13	32.0	95	840	7.25	3.70	1.19	Reddish Brown
	8/22/2006	65	< 1.0	25	< 2.0	1.7	2.4	< 1.0	< 1.0	< 1.0	2.0	< 1.0	60	< 1.0	< 1.0	55	13.3	---	860	7.23	2.81	1.44	Reddish Brown
	10/18/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	240	< 5.0	< 5.0	2.4	4.70	62	720	7.42	3.21	0.77	Dk Brown
IW-E5	7/10/2006	< 5.0	< 1.0	3.4	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	250	< 1.0	1.8	9.7	4.70	40	710	7.31	4.30	1.04	---
	8/22/2006	5.9	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	98	< 1.0	1.8	71	3.20	---	550	7.20	4.32	1.09	Reddish Brown
	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	200	< 5.0	< 5.0	14	1.90	< 100	630	7.43	5.62	0.71	Dk Purple
FIELD QA/QC SAMPLES																							
Dup-1 (PSAMW-1U)	7/10/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	380	< 1.0	4.2	13.00	1.70	54	640	7.23	5.21	0.94	Brown
Dup-2 (MW-9I)	7/11/2006	110	2.3	37	< 2.0	1.0	2.5	2.7	< 1.0	< 1.0	4.5	1.3	240	< 1.0	< 1.0	5.9	25.0	100	820	7.28	3.28	1.35	Pink
Dup-1/3L (PSAMW-1L)	10/18/2006	79	< 5.0	16	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	11	< 5.0	< 5.0	11	32.2	14	820	7.34	3.06	0.68	Colorless
Dup-2/C4 (IW-C4)	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	7.4	< 5.0	< 5.0	36	2.60	< 10	700	7.34	5.61	0.76	Dk Purple
IW-F10 (Field Blank)	7/10/2006	< 5.0	< 1.0	< 2.0	2.4	< 1.0	< 1.0	<1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.500	< 10	21	---	---	---	Colorless
IW-F11 (Field Blank)	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	<1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 0.050	< 0.500	< 10	21	---	---	---	Colorless
FB-1/2U (PSAMW-2U)	10/18/2006	< 50.0	< 5.0	31	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 0.050	0.800	< 10	28	---	---	---	Colorless
Trip Blank	7/11/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	---	---	---	---	---	---	---	Colorless
Trip Blank	7/12/2006	< 5.0	< 1.0	< 2.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 2.0	< 1.0	< 1.0	< 1.0	< 1.0	---	---	---	---	---	---	---	Colorless
Trip Blank	10/19/2006	< 50.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 10	< 10	< 5.0	< 5.0	< 5.0	---	---	---	---	---	---	---	Colorless
VPR Tier II Industrial		10,220	---	5,110	---	---	468.9	---	1,022	---	---	5,110	56.1	20,440	260	---	---	---	---	---	---	---	---

Note: All results for samples collected following potassium permanganate injection.
--- - Not applicable/not analyzed.
250 - Concentration is greater than VRP Tier II Industrial Cleanup Goal.

APPENDIX A

Soil Probe and Monitoring Well Completion Diagrams

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS
630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Soil Boring No.: PSAMW-1
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
____ Ft at Completion
____ Ft at __ hours after drilling

Time Started: 0900
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 730.5

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
1.0	Black TOPSOIL (Fill)			
2.0	Dark Reddish Brown LOAM	63	0	Damp
3.0			0	
4.0				
5.0	Light Reddish Brown FINE SAND			
6.0		50	0	Damp
7.0			0	
8.0				
9.0				
10.0		50	0	Damp
11.0			0	
12.0				
13.0	Light Brown FINE SAND			
14.0		91	0	Damp
15.0	Light Brown FINE to MEDIUM SAND		0	
16.0				
17.0				
18.0	Light Brown FINE SAND	92.5	0	Damp
19.0			0	
20.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-1L.

Logged by: Jodi Slough

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(574) 232-4833 Fax

Soil Boring No.: PSAMW-1
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
____ Ft at Completion
____ Ft at __ hours after drilling

Time Started: 0900
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 730.5

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
21.0 – 24.0	Light Greyish Brown FINE to MEDIUM SAND	50	0 0	Damp
25.0 – 27.0	Light Greyish Brown FINE to MEDIUM SAND	100	0 0	Wet
28.0 – 30.0	Light Brown MEDIUM to COARSE SAND	100	0 0	Wet
31.0 – 35.0	Light Brown MEDIUM SAND	100	0 0	Wet
36.0 – 39.0	Light Brown MEDIUM SAND	100	0 0	Wet
40.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-1L.

Logged by: Jodi Slough, Staff Scientist

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Soil Boring No.: PSAMW-1
File No.: 0058-366-04
Client: City of South Bend

WATER LEVEL DATA
27' Ft While Drilling
Ft at Completion
Ft at __ hours after drilling

Time Started: 0900
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

Date: June 19, 2006

GROUND ELEVATION: 730.5

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
41.0	Light Brown MEDIUM SAND	100	0	Wet
42.0				
43.0			0	
44.0				
45.0		100	0	Wet
46.0				
47.0			0	
48.0				
49.0	Light Brown MEDIUM-COARSE SAND	100	0	Wet
50.0				
51.0			0	
52.0				
53.0		100	0	Wet
54.0	End of Boring			
55.0				
56.0				
57.0				
58.0				
59.0				
60.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-1L.

Logged by: Jodi L. E. Slough

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-1U

BOREHOLE #: PSAMW-1

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,617.66 EASTING 3,178,180.90 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA) DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough DATE STARTED: June 23, 2006 DATE FINISHED: June 23, 2006

REPORT FORM COMPLETED BY: Jodi Slough DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR (PELLET) SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

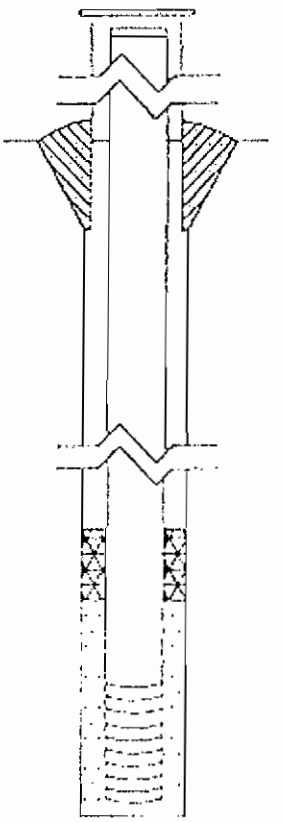
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
733.20	2.70	TOP OF RISER PIPE
730.50	0.00	GROUND SURFACE
729.75	0.75	TOP OF ANNULAR SEALANT
703.29	27.21	STATIC WATER LEVEL (AFTER COMPLETION)
729.75	0.75	TOP OF SEAL
711.88	18.62	TOP OF SANDPACK
709.88	20.62	TOP OF SCREEN
694.88	35.62	BOTTOM OF SCREEN
694.88	35.62	BOTTOM OF WELL
694.88	35.62	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR **OTHER**:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, **PVC** OR OTHER:	
RISER PIPE BELOW W.T	SS304, SS316, PTFE, **PVC** OR OTHER:	
SCREEN	SS304, SS316, PTFE, **PVC** OR OTHER	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	21.32
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	15
TOTAL LENGTH OF CASING (ft)	38.32
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-1M

BOREHOLE #: PSAMW-1

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,616.90 EASTING 3,178,178.88 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 23, 2006

DATE FINISHED: June 23, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, (PELLET), SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF SAND PACK: Quartz

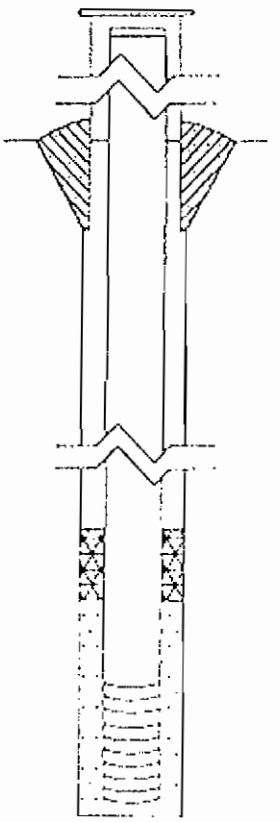
GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:

(IF APPLICABLE)

INSTALLATION METHOD



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
733.38	2.98	TOP OF RISER PIPE
730.40	0.00	GROUND SURFACE
729.65	0.75	TOP OF ANNULAR SEALANT
702.91	27.49	STATIC WATER LEVEL (AFTER COMPLETION)
729.65	0.75	TOP OF SEAL
696.75	33.65	TOP OF SANDPACK
694.75	35.65	TOP OF SCREEN
684.75	45.65	BOTTOM OF SCREEN
684.75	45.65	BOTTOM OF WELL
684.75	45.65	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR (OTHER)	Steel
RISER PIPE ABOVE W.T	SS304, SS316, PTFE, (PVC) OR OTHER:	
RISER PIPE BELOW W.T	SS304, SS316, PTFE, (PVC) OR OTHER:	
SCREEN	SS304, SS316, PTFE, (PVC) OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	38.59
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	48.59
SCREEN SLOT SIZE: **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS

630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-1L

BOREHOLE #: PSAMW-1

SITE NAME: Former Allied Stamping Plant

NORTHING: 2,336,615.78 EASTING: 3,178,176.76 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 23, 2006

DATE FINISHED: June 23, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, (PELLET), SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

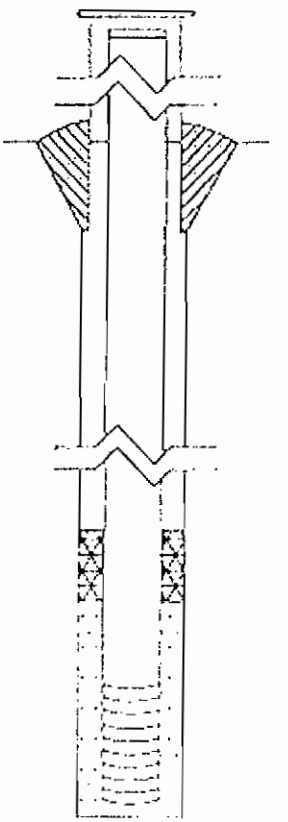
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
733.20	2.70	TOP OF RISER PIPE
730.50	0.00	GROUND SURFACE
729.75	0.75	TOP OF ANNULAR SEALANT
703.22	27.28	STATIC WATER LEVEL (AFTER COMPLETION)
729.75	0.75	TOP OF SEAL
686.99	43.51	TOP OF SANDPACK
684.99	45.51	TOP OF SCREEN
674.99	55.51	BOTTOM OF SCREEN
674.99	55.51	BOTTOM OF WELL
674.99	55.51	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR **OTHER**:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, **PVC** OR OTHER:	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, **PVC** OR OTHER:	
SCREEN	SS304, SS316, PTFE, **PVC** OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	48.21
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	58.21
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS
630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Soil Boring No.: PSAMW-2
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
____ Ft at Completion
____ Ft at __ hours after drilling

Time Started: 1300
Time Completed: 1700
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 729.9

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
1.0	Black TOPSOIL (Fill)			
2.0	Light Greyish Brown FINE SAND (with crushed red and yellow brick from 4 - 4.5')	50	0	Damp
3.0			0	
4.0				
5.0	Light Reddish Brown FINE SAND	75	0	Damp
6.0				
7.0			0	
8.0				
9.0		37.5	0	Damp
10.0				
11.0			0	
12.0				
13.0	Light Greyish Brown FINE to MEDIUM SAND	25	0	Damp
14.0				
15.0			0	
16.0				
17.0	Light Greyish Brown MEDIUM to COARSE SAND	50	0	Damp
18.0				
19.0			0	
20.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-2L.

Logged by: Jodi L. E. Slough

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS
630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Soil Boring No.: PSAMW-2
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
____ Ft at Completion
____ Ft at __ hours after drilling

Time Started: 1300
Time Completed: 1700
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 729.9

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
21.0 – 24.0	Light Greyish Brown MEDIUM to COARSE SAND	50	0 0	Damp
25.0 – 28.0	Light Greyish Brown MEDIUM to COARSE SAND	75	0 0	Wet
29.0 – 33.0	Light Brown MEDIUM to COARSE SAND	50	0 0	Wet
34.0 – 36.0	Light Brown MEDIUM SAND	100	0 0	Wet
37.0 – 38.0	Light Brown MEDIUM SAND	100	0 0	Wet
39.0 – 40.0	Light Brown COARSE SAND			

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-2L.

Logged by: Jodi L. E. Slough

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Soil Boring No.: PSAMW-2
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
____ Ft at Completion
____ Ft at __ hours after drilling

Time Started: 1300
Time Completed: 1700
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 729.9

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
41.0	Light Brown COARSE SAND	100	0	Wet
42.0				
43.0			0	
44.0				
45.0	Light Brown MEDIUM to COARSE SAND	100	0	Wet
46.0				
47.0			0	
48.0				
49.0		100	0	Wet
50.0				
51.0			0	
52.0				
53.0		100	0	Wet
54.0	End of Boring			
55.0				
56.0				
57.0				
58.0				
59.0				
60.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-2L.

Logged by: Jodi L. E. Slough

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South Bend, IN 46601
(574) 232-4826 Tel
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Well Completion Report

WELL #: PSAMW-2U

BOREHOLE #: PSAMW-2

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,769.78 EASTING 3,178,223.34 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 22, 2006

DATE FINISHED: June 22, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, PELLET, SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

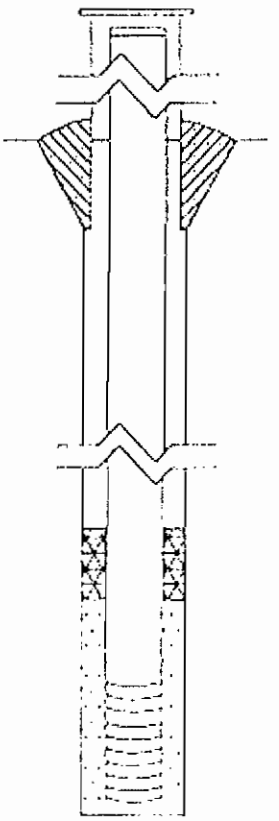
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
732.66	0.00	TOP OF RISER PIPE
729.90	0.00	GROUND SURFACE
729.15	0.75	TOP OF ANNULAR SEALANT
702.58	27.32	STATIC WATER LEVEL (AFTER COMPLETION)
729.15	0.75	TOP OF SEAL
711.90	18.00	TOP OF SANDPACK
709.35	20.55	TOP OF SCREEN
694.35	35.55	BOTTOM OF SCREEN
694.35	35.55	BOTTOM OF WELL
694.35	35.55	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR OTHER:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, PVC OR OTHER.	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, PVC OR OTHER:	
SCREEN	SS304, SS316, PTFE, PVC OR OTHER.	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	23.27
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	15
TOTAL LENGTH OF CASING (ft)	38.27
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

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630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
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Well Completion Report

WELL #: PSAMW-2M

BOREHOLE #: PSAMW-2

SITE NAME: Former Allied Stamping Plant

NORTHING: 2,336,771.72 EASTING: 3,178,223.40 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 22, 2006

DATE FINISHED: June 22, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL: GRANULAR, (PELLET), SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

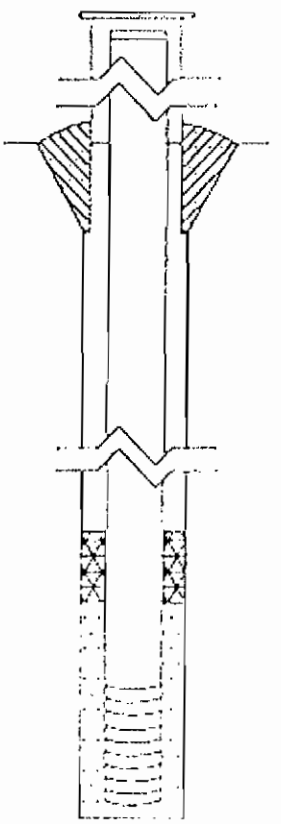
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL: ____
(IF APPLICABLE)

INSTALLATION METHOD: ____



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
732.50	0.00	TOP OF RISER PIPE
729.90	0.00	GROUND SURFACE
729.15	0.75	TOP OF ANNULAR SEALANT
702.75	27.15	STATIC WATER LEVEL (AFTER COMPLETION)
729.15	0.75	TOP OF SEAL
696.42	33.48	TOP OF SANDPACK
694.42	35.48	TOP OF SCREEN
684.42	45.48	BOTTOM OF SCREEN
684.42	45.48	BOTTOM OF WELL
684.42	45.48	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR (OTHER:)	Steel
RISER PIPE ABOVE W.T	SS304, SS316, PTFE, (PVC) OR OTHER:	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, (PVC) OR OTHER:	
SCREEN	SS304, SS316, PTFE, (PVC) OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	38.10
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	48.10
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

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South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-2L

BOREHOLE #: PSAMW-2

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,774.20 EASTING 3,178,223.90 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 22, 2006

DATE FINISHED: June 22, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, (PELLET), SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF SAND PACK: Quartz

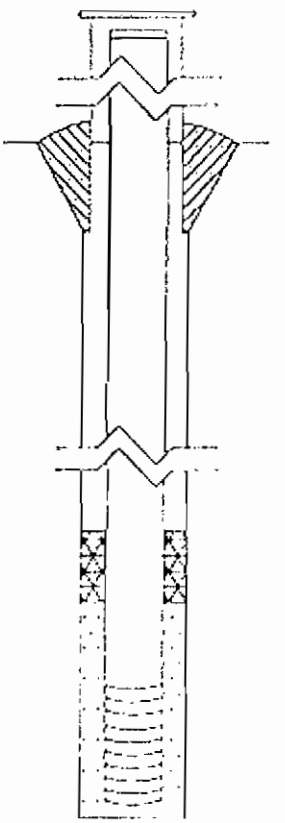
GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:

(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
732.58	0.00	TOP OF RISER PIPE
729.90	0.00	GROUND SURFACE
729.15	0.75	TOP OF ANNULAR SEALANT
702.63	27.27	STATIC WATER LEVEL (AFTER COMPLETION)
729.15	0.75	TOP OF SEAL
686.48	43.42	TOP OF SANDPACK
684.48	45.42	TOP OF SCREEN
674.48	55.42	BOTTOM OF SCREEN
674.48	55.42	BOTTOM OF WELL
674.48	55.42	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR (OTHER:)	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, (PVC) OR OTHER:	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, (PVC) OR OTHER:	
SCREEN	SS304, SS316, PTFE, (PVC) OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	48.14
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	58.14
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

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GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS
630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Soil Boring No.: PSAMW-3
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
Ft at Completion
Ft at __ hours after drilling

Time Started: 800
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 730.1

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
1.0	Black TOPSOIL (Fill)			
2.0	Dark Reddish Brown LOAM	55	0 0	Dry
3.0				
4.0				
5.0	Light Reddish Brown FINE SAND	50	0 0	Dry
6.0				
7.0				
8.0				
9.0		50	0 0	Dry
10.0				
11.0				
12.0				
13.0	Light Brown FINE to COARSE SAND	50	0 0	Dry
14.0				
15.0	Light Brown FINE to COARSE SAND			
16.0				
17.0	Light Greyish Brown FINE SAND	60	0 0	Dry
18.0				
19.0				
20.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-3L.

Logged by: Jodi L. E. Slough

WEAVER BOOS CONSULTANTS LLC
GEO-ENVIRONMENTAL ENGINEERS AND SCIENTISTS
630 East Bronson Street, Suite 1
South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Soil Boring No.: PSAMW-3
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
Ft at Completion
Ft at __ hours after drilling

Time Started: 800
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 730.1

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
21.0	Light Greyish Brown FINE SAND	50	0	Damp
22.0				
23.0	Light Greyish Brown FINE to MEDIUM SAND		0	
24.0				
25.0	Light Brown MEDIUM to COARSE SAND	60	0	Damp
26.0				
27.0			0	
28.0				
29.0		100	0	Wet
30.0				
31.0			0	
32.0				
33.0		95	0	Wet
34.0	Light Brown MEDIUM SAND			
35.0			0	
36.0				
37.0		100	0	Wet
38.0				
39.0	Light Brown MEDIUM to COARSE SAND		0	
40.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-3L.

Logged by: Jodi L. E. Slough

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Soil Boring No.: PSAMW-3
File No.: 0058-366-04
Client: City of South Bend
Date: June 19, 2006

WATER LEVEL DATA
27' Ft While Drilling
Ft at Completion
Ft at __ hours after drilling

Time Started: 800
Time Completed: 1200
Driller: Enviro-Dynamics, LLC
Location: Former Allied Stamping Plant

GROUND ELEVATION: 730.1

DEPTH (ft)	SOIL DESCRIPTION	SAMPLE DATA: RECOVERY (%)	PID (ppm)	MOISTURE CONTENT
41.0 – 42.0	Light Brown MEDIUM to COARSE SAND	100	0	Wet
42.0 – 43.0			0	
43.0 – 44.0				
44.0 – 45.0				
45.0 – 46.0		100	0	Wet
46.0 – 47.0			0	
47.0 – 48.0				
48.0 – 49.0				
49.0 – 50.0		25	0	Wet
50.0 – 51.0			0	
51.0 – 52.0				
52.0 – 53.0		100	0	Wet
53.0 – 54.0	End of Boring			
54.0 – 55.0				
55.0 – 56.0				
56.0 – 57.0				
57.0 – 58.0				
58.0 – 59.0				
59.0 – 60.0				

NOTES: Boring terminated at 53' bgs.
Boring completed as monitoring well PSAMW-31..

Logged by: Jodi L. E. Slough

WEAVER BOOS CONSULTANTS LLC
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(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-3U

BOREHOLE #: PSAMW-3

SITE NAME: Former Allied Stamping Plant

NORTHING: 2,336,745.04 EASTING: 3,178,236.76 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 21, 2006 DATE FINISHED: June 21, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, PELLET, SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

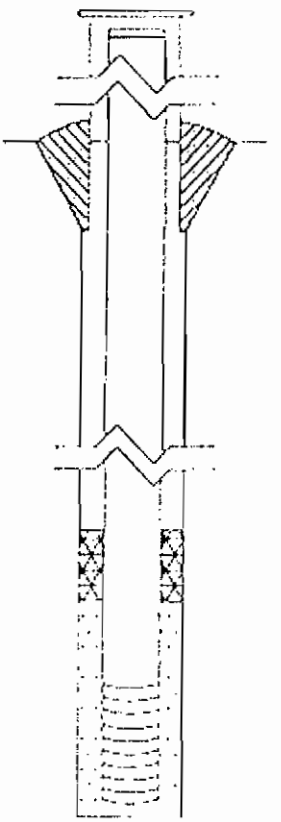
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
732.62	0.00	TOP OF RISER PIPE
730.10	0.00	GROUND SURFACE
729.35	0.75	TOP OF ANNULAR SEALANT
702.87	27.23	STATIC WATER LEVEL (AFTER COMPLETION)
729.35	0.75	TOP OF SEAL
711.55	18.55	TOP OF SANDPACK
709.55	20.55	TOP OF SCREEN
694.55	35.55	BOTTOM OF SCREEN
694.55	35.55	BOTTOM OF WELL
694.55	35.55	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR OTHER:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, PVC OR OTHER:	
RISER PIPE BELOW W.T	SS304, SS316, PTFE, PVC OR OTHER:	
SCREEN	SS304, SS316, PTFE, PVC OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	23.09
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	15
TOTAL LENGTH OF CASING (ft)	38.09
SCREEN SLOT SIZE: **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

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South Bend, IN 46601
(574) 232-4826 Tel
(574) 232-4833 Fax

Well Completion Report

WELL #: PSAMW-3M

BOREHOLE #: PSAMW-3

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,741.88 EASTING 3,178,237.04 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 22, 2006

DATE FINISHED: June 22, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL- GRANULAR, PELLET, SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

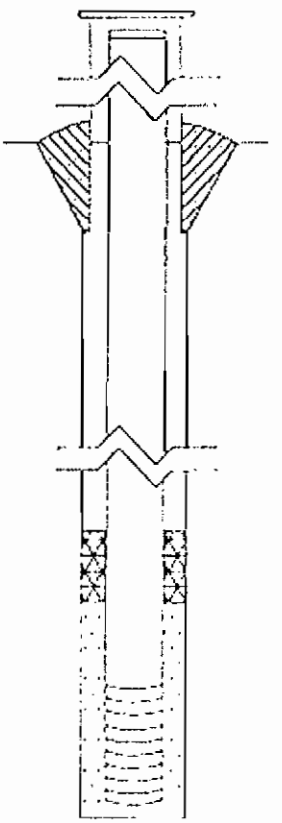
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
732.48	0.00	TOP OF RISER PIPE
730.10	0.00	GROUND SURFACE
729.35	0.75	TOP OF ANNULAR SEALANT
703.00	27.10	STATIC WATER LEVEL (AFTER COMPLETION)
729.35	0.75	TOP OF SEAL
696.90	33.20	TOP OF SANDPACK
694.65	35.45	TOP OF SCREEN
684.65	45.45	BOTTOM OF SCREEN
684.65	45.45	BOTTOM OF WELL
684.65	45.45	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR OTHER:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, PVC OR OTHER:	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, PVC OR OTHER:	
SCREEN	SS304, SS316, PTFE, PVC OR OTHER:	

CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	0.0
RISER PIPE LENGTH (ft)	37.85
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	47.85
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

WEAVER BOOS CONSULTANTS LLC
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(574) 232-4826 Tel
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Well Completion Report

WELL #: PSAMW-3L

BOREHOLE #: PSAMW-3

SITE NAME: Former Allied Stamping Plant

NORTHING 2,336,738.76 EASTING 3,178,236.92 (or) LATITUDE: ° ' " LONGITUDE: ° ' "

DRILLING CONTRACTOR: EnviroDynamics

DRILLER: Mark Montalvo

CONSULTING FIRM: Weaver Boos Consultants

SUPERVISOR: Rob Mores

DRILLING METHOD: Hollow Stem Auger (HSA)

DRILLING FLUIDS (TYPE): None

LOGGED BY: Jodi Slough

DATE STARTED: June 22, 2006

DATE FINISHED: June 22, 2006

REPORT FORM COMPLETED BY: Jodi Slough

DATE: August 24, 2006

ANNULAR SPACE DETAILS

TYPE OF SURFACE SEAL: Lehigh Portland Cement

TYPE OF ANNULAR SEALANT: Bentonite Chips

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

TYPE OF BENTONITE SEAL: GRANULAR, (PELLET), SLURRY
(CIRCLE ONE)

INSTALLATION METHOD: Gravity Fall

SETTING TIME: 1 hour

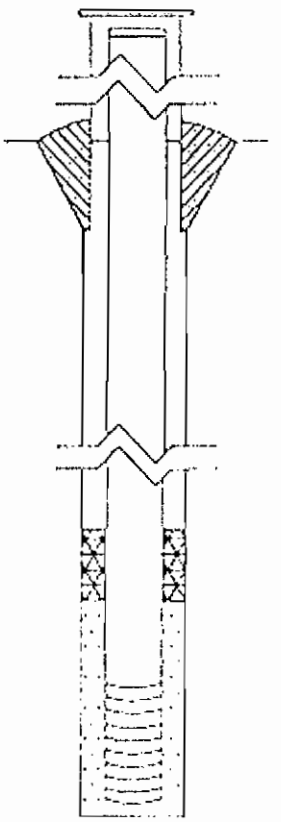
TYPE OF SAND PACK: Quartz

GRAIN SIZE: 20-40 (SIEVE SIZE)

INSTALLATION METHOD: Gravity Fall

TYPE OF BACKFILL MATERIAL:
(IF APPLICABLE)

INSTALLATION METHOD:



	ELEVATIONS (MSL)*	DEPTHS (.01 ft) (BGS)	
	732.58	0.00	TOP OF RISER PIPE
	730.00	0.00	GROUND SURFACE
	729.25	0.75	TOP OF ANNULAR SEALANT
	702.81	27.19	STATIC WATER LEVEL (AFTER COMPLETION)
	729.25	0.75	TOP OF SEAL
	686.75	43.25	TOP OF SANDPACK
	684.75	45.25	TOP OF SCREEN
	674.75	55.25	BOTTOM OF SCREEN
	674.50	55.50	BOTTOM OF WELL
	674.50	55.50	BOTTOM OF BOREHOLE

*REFERENCED TO A NATIONAL GEODETIC VERTICAL DATUM

WELL CONSTRUCTION MATERIALS (CIRCLE ONE)

PROTECTIVE CASING	SS304, SS316, PTFE, PVC OR (OTHER:	Steel
RISER PIPE ABOVE W.T.	SS304, SS316, PTFE, PVC OR OTHER	
RISER PIPE BELOW W.T.	SS304, SS316, PTFE, PVC OR OTHER	
SCREEN	SS304, SS316, PTFE, PVC OR OTHER	

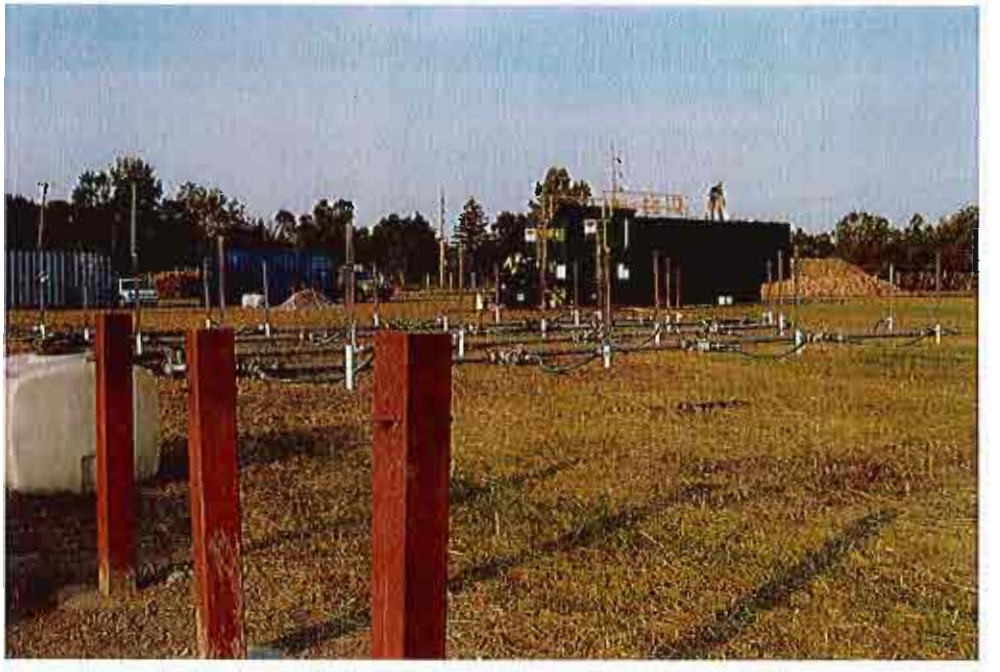
CASING MEASUREMENTS

DIAMETER OF BOREHOLE (in)	9.0
ID OF RISER PIPE (in)	2.0
PROTECTIVE CASING LENGTH (ft)	5.0
RISER PIPE LENGTH (ft)	47.81
BOTTOM OF SCREEN TO END CAP (ft)	0
SCREEN LENGTH (1ST SLOT TO LAST SLOT) (ft)	10
TOTAL LENGTH OF CASING (ft)	58.06
SCREEN SLOT SIZE **	10

** HAND-SLOTTED WELL SCREENS ARE UNACCEPTABLE

APPENDIX B

Photographic Log of Field Pilot Test



No. 1 – Nested groundwater monitoring wells PSAMW-3U, M, and L are shown in the foreground; the permanganate injection system is visible in the background.

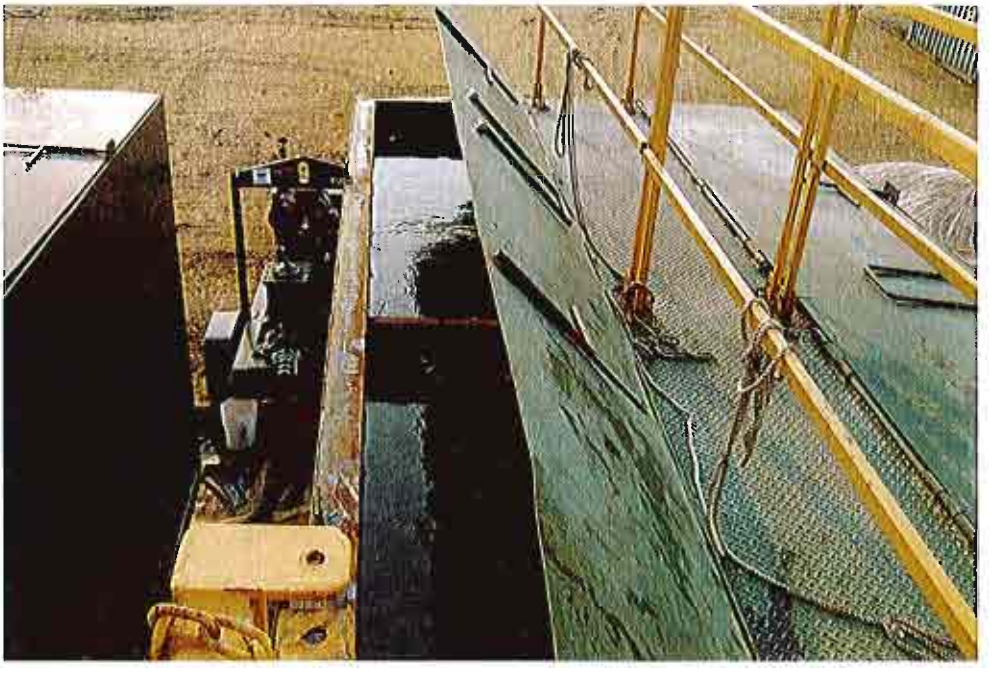
No. 2 – Two 21,000-gallon portable water tanks used for mixing of permanganate solution.

No. 3 – Diesel pump (900 gpm) used for mixing and injecting the permanganate solution.

No. 4 – This is an overview of the permanganate injection well field looking to the northeast. The injection well at the far left is IW-A1. The well at the top is IW-E1. The well furthest right is IW-E5. The well at the bottom of the photograph is IW-A5.

No. 5 – This close up image illustrates a typical injection well head and its control valve.

No. 6 – This photograph illustrates the main feed from the mixing/injection pump to the well field distribution system.



No. 7 – The potassium permanganate powder was poured into each of the portable tanks and mixed using the diesel pump for approximately four hours prior to injection.

No. 8 – The potassium permanganate solution is being injected.