REPORT

In-Situ Chemical Oxidation Field Pilot Test Work Plan

Former Dover Electronics Site Kirkwood, New York

Universal Instruments Corporation
Kirkwood, Broome County, New York

May 2005

BBL®
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

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1. Introduction

This work plan for an In-Situ Chemical Oxidation (ISCO) Field Test has been prepared by Blasland, Bouck & Lee, Inc. (BBL) for the Universal Instruments Corporation (Universal Instruments) site in Kirkwood, Broome County, New York (Site Number 7-04-026). This work plan is submitted as part of ongoing groundwater remediation field studies to comply with the groundwater remediation requirements stated in the executed Order on Consent between Universal Instruments and the New York State Department of Environmental Conservation (NYSDEC), dated January 19, 2001, and the Record of Decision (March 2000).

1.1 Purpose

The purpose of this work plan is to present a first phase field test for ISCO in order to provide an assessment of the ability of the selected chemical oxidant to disperse in groundwater and be an effective remedy for the destruction of volatile organic compounds (VOCs). This proposed field study has been designed to assess the viability of using sodium permanganate as an oxidant for groundwater remediation of VOCs in groundwater that have proven to be resistant to enhanced biodegradation.

This work plan is divided into the following sections:

- Section 1 contains the introduction to the ISCO field test proposal and describes the purpose of the proposal.
- Section 2 contains a summary description of present groundwater conditions.
- Section 3 contains a proposal to perform an ISCO field test.
- Section 4 contains the references used in this document.

1.2 Background

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site of approximately 9.58 acres in size. A site location map is shown on Figure 1.

The property is situated in an industrial setting: Major plants in the area include; Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property to the north, east, and west. The property consists of an industrial building with parking areas. The site currently serves as one of Universal Instruments' service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards.

1.2.1 Site History

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments and Dover Electronics. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996,

Dovatron changed its name to the DII Group. Later the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation.

Previous circuit board manufacturing processes used tetrachloroethene (PCE) as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time.

1.2.2 Previous Groundwater Remediation Efforts

After the former aboveground 5,000-gallon flux tank that contained PCE was dismantled in March 1993, a groundwater extraction program was implemented as an interim remedial measure (IRM). Two groundwater recovery wells (RW-1 and RW-2) were installed near the former PCE tanks located at the rear of the facility building in April 1993. These wells were constructed of 4-inch-diameter PVC to a depth of approximately 58 feet below ground surface (bgs).

The interim groundwater treatment system became operational on August 17, 1994. Due to cracked piping, the system was not operational from December 1994 to May 1995. The piping was replaced with polyethylene tubing with heat trace tape. The system was again not operational from July 1995 to October 1995 due to a decline in the groundwater levels to below the bottom of the recovery wells.

Historically, groundwater at the two recovery wells (RW-1 and RW-2) was pumped at very low flow rates. Reportedly, the maximum amount of groundwater pumped in one day was 90 gallons. The recorded flow over 150 days of operation (early operational data) shows the system pumping an average of 30 gallons per day. The system operated on a limited schedule, but was shut down and abandoned in 1996. This IRM may have removed up to 12,000 gallons of groundwater.

Two more recovery wells were installed (RW-3 and RW-4) in 1997. RW-3 was installed adjacent to MW-7 as part of another IRM groundwater extraction and treatment system. RW-4 was used for a vacuum-enhanced pumping (VEP) pilot treatment well in the source area.

The VEP pilot test was performed in December 1997 at well RW-4 to test the potential for source area remediation and to reduce downgradient contaminant migration. The pilot test lasted approximately 3 hours. After a vacuum was applied to RW-4, low magnitude responses were observed in the vapor monitoring points (VMPs) at different depths and lateral points of the formation. The radius of influence (ROI) observed in the field was generally not radially symmetrical. The largest recorded manometer response was in VMP-2 (shallow) at 15 lateral feet from the vacuum well.

The second IRM groundwater extraction and treatment program was installed next to MW-7 to help control the migration of the dissolved-phase PCE plume. Groundwater treatment was accomplished using granulated activated carbon (GAC). This groundwater extraction and treatment system was installed in November 1997 and this IRM became operational in April 1998 and remained in operation into December 1998. During this time, approximately 41,000 gallons of water were extracted from well RW-3. The groundwater withdrawal rate was estimated to average on continuous basis 0.124 gallon per minute (gpm). This well yield was substantially below the estimated yield for RW-3 of 1.0 gpm.

Previous attempts at hydraulic control and plume treatment by groundwater extraction (see above) were unsuccessful because of the tight nature of the subsurface glacial till and the corresponding very low transmissivity in the area of monitoring well MW-7A. For this reason the enhanced bioremediation field pilot test was conducted to evaluate this technology as an alternative remediation method to groundwater extraction. The enhanced bioremediation field study was designed to assess the viability of a combination of HRC® and ORC® as a means to enhance the reductive dechlorination process.

HRC® was injected at a tight grid spacing (10-foot centers) in recognition of the low transmissivity of the subsurface soils. An initial baseline groundwater sampling event was be conducted on all existing monitoring wells and on the newly installed monitoring points (a total of 48 groundwater sampling locations) to establish pre-HRC®/ORC® injection conditions (Figure 2; former HRC®/ORC® injection locations are shown on Figure 3).

Groundwater monitoring wells in the injection areas have been monitored since the HRC®/ORC® injection. Post-injection groundwater monitoring events were conducted in December 2001, January 2002, April 2002, September 2002, March 2003, September 2003, April 2004, and most recently in September 2004. Two of the three areas where HRC® (MW-24 Upper Parking Lot and Pilot Truck Stop) was injected appear to have responded favorably to HRC® application. The third area (MW-7A Lower Parking Lot) did not respond to the injection of HRC®. The reason for the lack of HRC® effectiveness in the MW-7A area is not known with certainty, although the high sulfate and relatively higher dissolved oxygen content are most likely factors.

1.2.3 Site Geology and Hydrogeology

The site is immediately underlain by surficial soils that consist of various types of silty and gravelly loams that were reworked by cut and fill activities when the site was developed. These surficial soils are derived from the underlying till deposits, a dense soil/sediment type of glacial depositional environment origin.

Below the surficial soils, weathered till is encountered. The weathered till (a slightly decomposed version of the unweathered till) consists of light brown to brown, poorly sorted silts and fine sands that contain varying minor amounts of clay and fine gravel. Cobbles are rarely present. The weathered till is dense and appears to be unstratified. The weathered till unit has a thickness that ranges from 10 to 25 feet. As with the surficial soils above, the weathered till appears to be restricted as a geologic unit to the area of the Universal Instruments property. It does not extend onto the Pilot Truck Stop property.

The unweathered till is the next geologic unit encountered beneath the site. The unweathered till consists primarily of brown to olive-gray, poorly sorted silts and fine sands. The unweathered till contains lenses of clay-rich sediment and sand and fine gravel rich lenses. The unweathered till is very dense and has less fracturing. Its thickness ranges from less than 20 feet at the southern part of the site to greater than 80 feet at the northern part of the site. The contact with the overlying weathered till appears to be a gradational boundary rather than a sharp one.

Across Industrial Park Drive, on the Pilot Truck Stop property, surficial soils encountered are composed of imported fill materials consisting of loose to moderately dense, admixed silt, sand, gravel, angular rock fragments, and small brick and concrete debris. This fill layer varies in thickness from 2 feet to about 6 feet. Beneath the fill layer, is an organic rich silt layer, about 1 to 2 feet thick, that contains small plant and wood fragments. This layer has a probable wetland's marsh origin. Below the organic silt layer, till is encountered. The till extends to a depth that varies from 12 feet to 15 feet. Below the till, well-sorted, fine to medium-grained

sands with some fine gravel are found. These sands were encountered in each pilot boring drilled for monitoring wells on the Pilot Truck Stop property and, therefore, appear to be laterally extensive. The sands contain thin layers and lenses of silt and clay.

The deepest layer encountered is a well-sorted, medium to coarse-grained sand unit that contains some fine gravel that was found at a depth of 50 feet bgs at the MW-34 location on the Pilot Truck Stop property. This layer extended to the approximate termination of the boring at a depth of 56 feet.

Bedrock has not been encountered during drilling operations at the site or at the Pilot Truck Stop. Bedrock is believed to start at a depth around 115 feet below the Universal Instruments building or approximately 80 feet below the Pilot Truck Stop (Shield, 2000).

The movement of groundwater at the site can be summarized by the points listed below:

- Two distinct water-bearing zones exist;
- Head differences within the first (uppermost) water-bearing zone vary, both spatially and temporally, with some well-pair locations having upward gradients and others downward gradients;
- There appears to be hydraulic communication between the two halves of the first water-bearing zone, but not any hydraulic communication with the deeper water-bearing zone; and

Groundwater flow directions are to the southwest within the first water-bearing zone, but vary slightly between the upper and lower halves of this zone.

2. Present Groundwater Conditions

2.1 Groundwater Flow Directions

The groundwater within the upper shallow zone flows toward the southwest with a hydraulic gradient that ranges from 0.046 to 0.196 ft/ft. This gradient range is illustrative of the permeability change in the shallow zone as groundwater moves from the dense, silty and clayey till beneath the Universal Instruments property into the more sandy area found beneath the Pilot Truck Stop. Groundwater within the intermediate zone flows toward the southwest, as well, with a hydraulic gradient ranging from 0.019 to 0.063 ft/ft.

2.2 Present Site Groundwater Conditions

Present groundwater conditions show a stable plume at the lower margins with strong attenuation at the upgradient end of the plume. The central area of the plume shows fluctuating, but elevated, concentrations of PCE that do not appear to be affected by appreciable biodegradation. The Pilot Truck Stop "hotspot" appears to have increasing concentrations of PCE; however, the immediate downgradient monitoring point (MP-8S) does not show a trend of similar magnitude.

The beneficial effects of the introduction of HRC® are no longer in evidence in the Pilot Truck Stop "hotspot" area and beneficial effects of HRC® were not observed in the MW-7A area during the pilot study period.

2.3 Conclusions

The decreasing concentrations of PCE within much of the HRC® injection areas coupled with increases in the concentration of daughter products in plume wells over a 30-month timeframe, as represented by comparison of temporal data sets, shows that enhanced biodegradation of PCE has occurred in the PCE groundwater plume in the areas of MW-24 and MW-25. Biodegradation of PCE appears to be occurring throughout most of the rest of the plume, although not as aggressively as observed in the data from MW-24. The inability of the PCE concentration spike observed after the HRC injection to migrate quickly and maintain strength is a direct function of aquifers overall low hydraulic conductivity and the natural ability of the aquifer to attenuate dissolved PCE.

The overall negative redox potential within the saturated groundwater zone, the decreased concentrations of PCE within the source area, the presence of daughter breakdown products derived from the parent PCE, and increased concentrations and ratios of the daughter products show that the process of reductive dechlorination occurred and continues within areas of the aquifer where conditions are favorable. The central part of the plume appears to be recalcitrant with regards to enhanced biodegradation, possibly because of high sulfate and dissolved oxygen within groundwater at that location make that location unfavorable for natural biodegradation.

It is apparent that enhancement of PCE biodegradation was successful in the MW-24 area and favorable results were observed at MW-28. The continued observation of elevated methane concentrations in samples collected from well MW-24 suggests biodegradation is continuing and is self-sustaining in this area. There are indications (presence of daughter products and methane above background) of continued biodegradation of PCE in the Pilot Truck Stop area, although the present rate of biodegradation is probably low.

Because biodegradation does not appear to be occurring aggressively within the central part of the plume, Universal Instruments proposes that an ISCO field test be conducted in this area.

3. Sodium Permanganate Field Test

A groundwater remediation field test using ISCO is proposed for remaining residual chlorinated ethenes within the central part of the groundwater plume. The field test will use sodium permanganate as an oxidant to reduce concentrations of PCE within the area defined by the 1,000 parts per billion (ppb) contour line shown on Figure 5.

Previous attempts at hydraulic control and plume treatment by groundwater extraction (see interim groundwater measures in Section 1.2.2) were unsuccessful because of the tight nature of the subsurface glacial till and the corresponding very low transmissivity in the area of monitoring well MW-7A. For this reason, the enhanced bioremediation field pilot test was conducted to evaluate this technology as an alternative remediation method to groundwater extraction. HRC® was injected at a tight grid spacing (10-foot centers) in recognition of the low transmissivity of the subsurface soils.

As discussed in Section 2, the results of the enhanced bioremediation field pilot test have shown positive results in two of the three areas tested. The third area (MW-7A Lower Parking Lot) did not show positive results. Because the HRC® material was injected in a tight grid pattern to start, further injection in a tighter pattern for better material spread is not technically supported. Additionally, the high sulfate and dissolved oxygen content with groundwater at the MW-7A location appears to be a particularly adverse setting for modification using HRC® product or other bioremediation enhancer products.

For these reasons, Universal Instruments is proposing a Phase I ISCO field test using sodium permanganate. Permanganate is a proven oxidizer of chlorinated ethenes and sodium permanganate is completely miscible in water allowing high concentrations of the oxidant to be introduced into the aquifer.

When sodium permanganate is used to oxidize chlorinated ethenes, the end products of the reaction are carbon dioxide, manganese dioxide, sodium chloride, and hydrogen chloride. These compounds will not create an adverse or toxic environment in the groundwater where the permanganate is applied. Also, the permanganate reaction does not create a free radical intermediate and, therefore, the oxidation reaction is not aggressively exothermic. The heat generated by the oxidation reaction for the proposed application will not generate appreciable heat.

The mass of these compounds generated will not cause adverse effect on aquifer characteristics. Studies have now shown that natural groundwater flow restores pre-existing biologic conditions in an aquifer much more quickly than previously believed when ISCO has been implemented using permanganate, often times in less than 6 months.

Should the Phase I ISCO field test show that the use of sodium permanganate is technically practical, a second phase (Phase II) field test will be performed over a wider area.

3.1.1 In-Situ Permanganate Field Study Design

Sodium permanganate is a strong oxidizer with known capability to remediate chlorinated ethenes. It is completely miscible in water and normally can therefore be infiltrated into groundwater at a high concentration to affect a strong concentration gradient to enhance migration by diffusion. The HRC® material is a very viscous product whose dispersion may have been hampered by the density of the soil within the application area.

Sodium permanaganate is deep purple in color and will color groundwater purple at low concentrations, making it an effective tracer that can be detected visually.

The proposed field test is based on the introduction of a highly concentrated slug of sodium permanganate within the "hotspot" where the slug's dispersion and oxidation of COCs will be monitored and evaluated. The proposed field study can be implemented before the September 2005 groundwater monitoring and sampling event so that COC groundwater concentration data from this sampling event can be used as part of the field test evaluation.

The primary mechanism for distributing the sodium permanganate throughout the target aquifer area will be diffusion and dispersion along a chemical concentration gradient. The high concentration commercially available for sodium permanganate, along with its complete miscibility in water, is the reason sodium permanganate is preferred over potassium permanganate for this application.

Figure 4 shows the proposed point of slug infiltration and the area that treatment during the field test is most likely to occur within. The testing area is near existing monitoring well MW-7A and monitoring point MP-5.

3.2 Residual Area Treatment Test

Groundwater monitoring during the In-Situ Bioremediation Pilot Study has shown a persistent area of fluctuating, PCE concentrations in the central part of the shallow zone portion of the groundwater plume. This area contains monitoring wells and points MW-7A, MP-4, MP-5, and MP-6S.

This area is defined by dense soil that has extremely low permeability and groundwater that has high oxygen and sulfate content. These factors may have contributed to the poor performance of HRC® in this area relative to the better performance observed in the other two enhanced bioremediation test locations.

In the field test, one single infiltration well will be installed to introduce the slug of sodium permanganate into the shallow saturated zone. The targeted infiltration zone will extend throughout the saturated thickness of the upper 10 feet of the PCE-affected water-bearing zone. The preliminary design parameters for the ISCO field study are listed in Table 7.

TABLE 1 - PRELIMINARY DESIGN PARAMETERS FOR THE ISCO FIELD TEST

Design Parameter	MW-7A Area
Contaminant Saturated Thickness	10 feet
Injection Spacing	1 foot
Number of Infiltraton Points	1 point
Permanganate Application Rate	35 gallon slug
Permanganate Material Requirement (20% solution)	70 gallons

3.3 ISCO Field Test Implementation

Implementation of the ISCO field test will consist of:

- Installation of an infiltration well;
- Collection of soil samples;
- Application of sodium permanganate; and
- Monitoring of permanganate distribution and consumption.

3.3.1 Infiltration Well Installation

A new well will be installed to deliver sodium permanganate into the subsurface. The well will be placed in a pilot boring drilled to a depth of 25 feet (same depth as monitoring point MP-5). The boring will be located approximately 10 feet to the east of monitoring point MP-5 (Figure 7). The boring will be drilled with hollow-stem augers to create a pilot boring in the initial 10 feet and using 8-inch- diameter casing spun into the final 15 feet of boring (this method minimizes borehole wall damage and clay smearing). The infiltration well will be constructed using 6-inch diameter Schedule 40 PVC with 15 feet of riser pipe and 10 feet of slotted casing.

The slotted casing will have 0.010 slots. The casing will have flush-threaded connections. There will be a 1-inch sand filter pack around the slotted casing. The well annulus will be sealed with hydrated bentonite from above the sand filter pack to the ground surface. The well will be completed on the surface with a flush-mounted wellhead. After installation, the well will be developed. The well will be installed by an experienced well driller, Parratt Wolff of Syracuse, New York.

3.3.2 Soil Sample Collection

Soil samples will be collected from the pilot boring. The soil samples will be sent to an analytical laboratory for total organic carbon (TOC) analysis using modified United States Environmental Protection Agency (USEPA) Method 415.1. The soil samples will be collected from depths of 11 feet to 12 feet bgs and 16 feet to 17 feet bgs to correspond to the upper and lower parts of the shallow saturated zone. The TOC data will be useful for evaluating competing consumption demands for the oxidant.

3.3.3 Sodium Permanganate Application

The sodium permanganate will be infiltrated by gravity into the saturated subsurface through the infiltration well. The permanganate will be applied as a 20 % solution (strongest solution that is safe to transport and handle) into a funnel place in the top of the well. The permanganate will be manually poured from 5-gallon plastic jerry cans. A total of 35 gallons will be poured into the infiltration well; the calculated amount that the well casing will hold above the groundwater surface in the well.

Once the permanganate surface has fallen in the well to the level of the groundwater depth measured before the introduction of permanganate, a second 35-gallon slug will be poured into the infiltration well. This may occur the same day as the first slug application or may occur on the following day.

3.3.4 Monitoring Program

Baseline groundwater samples will be collected from monitoring points MP-4, MW-7A, MP-5, and MP-6S as well as the test well, prior to permanganate infiltration (Figure 2). These samples will be analyzed for site-specific parameter list (SSPL) volatile organic compounds (VOCs). Groundwater field parameters (temperature, dissolved oxygen, pH, oxygen-reduction potential [ORP], turbidity and conductivity) will be collected during well purging activities. Dispersion of the sodium permanganate will be monitored on an hourly basis during permanganate infiltration (assumed to be about 6 hours) during the first day.

Monitoring points MP-4, MW-7A, MP-5, MP- 6S, and MP-6D will be checked for the color purple in the groundwater, which will indicate the presence of sodium permanganate. These points will be checked hourly for 8 hours the day after infiltration has been completed. If necessary, a third day of dispersion monitoring will be performed.

A 4- week post-infiltration interval will be used to allow the sodium permanganate to oxidize PCE and 1,2-DCE in groundwater. After this period, post-test groundwater samples will be collected from MP-4, MW-7A, MP-5, and MP-6S for SSPL VOC analysis. Groundwater field parameters (temperature, dissolved oxygen, pH, oxygen-reduction potential [ORP], turbidity and conductivity) will be collected during well purging activities. During groundwater sampling, the test monitoring points will be checked for the color purple.

Additionally, the test area will be checked for sodium permanganate during the September 2005 groundwater sampling event at which time groundwater samples will be collected for analysis of COC concentrations, as well as TOC concentrations. Purge water produced from wells within the test area will be visually inspected for the presence of purple color (unconsumed permanganate) or brown color (partially consumed permanganate).

3.4 Performance Evaluation Criteria

To assess the performance of the ISCO test as a remedy for treating the impacted groundwater within the "hotspot" area at the site, the field study will be evaluated according to the following performance evaluation criteria:

- Significant decrease in PCE concentrations in monitoring points MP-5 (sidegradient) and MP-6S (downgradient) relative to historical concentrations;
- Favorable diffusion of the permanganate slug; and
- Acceptable concentrations of TOC within subsurface soils and groundwater.

3.5 ISCO Test Evaluation

The field study results will be analyzed and summarized in the progress report following the September groundwater monitoring and sampling event. The evaluation will include the following:

- Date and descriptions of the field activities;
- Description of test design and procedures;
- Discussion of test results based on the performance evaluation criteria; and
- Refinement of design parameters for a Phase II pilot test and an estimation of removal of COCs.

3.6 Proposed Schedule

The proposed schedule for the Phase I ISCO pilot testing is shown on Figure 7. Upon receiving approval from NYSDEC, we will order the sodium permanganate, which should arrive at the site within 45 to 60 days. During this period, the test infiltration well will be installed. The field test will be initiated within 8 weeks of receiving

approval from NYSDEC. The field work will be performed over an approximate five week period as shown below:

- Collect baseline groundwater sample = 1 day;
- Perform permanganate infiltration = 2 days;
- Observe permanganate dispersion = 2-3 days;
- Allow permanganate oxidation to occur = 4 weeks; and
- Collect post-test groundwater samples = 1 day.

Sample analysis and data evaluation will take 5 weeks and another 3 weeks will be required to prepare a report and final Phase II test plan for submission to NYSDEC. The total time to complete the Phase I scope of work is anticipated to be 20 weeks.

3.7 Phase II ISCO Pilot Test

The Phase II ISCO pilot test work that will follow up the completed Phase I work will consist of a wider application of sodium permanganate within the plume area. We anticipate additional sodium permanganate (up to 2,500 gallons of 20% solution) will be introduced into the plume through infiltration of existing monitoring wells and points. The final layout of the injection points and frequency of injection will depend on the Phase I ISCO test results and field observation.

A work plan for the Phase II ISCO pilot test will be submitted to NYSDEC for approval prior to implementation of the Phase II work. The work plan will describe in detail the planned work and the rationale for the test design. The work plan will describe the basis of design criteria (such as; oxidant dispersion rates, dispersion

limits, mass reduction calculations, rebound quantification, estimated future mass removal requirements, statistical trend analyses) that will be used to evaluate the Phase II ISCO pilot test and develop the scope of work for full-scale implementation.

The Phase II ISCO application may use 15 existing infiltration points located within both the shallow and intermediate depth areas of the plume. The proposed infiltration points may include:

- Shallow Zone – MP-2, MW-24, MW-13, MW-16, MP-4, MW-7A, MP-5, MP-6S, MW-3, MW-19, MW-28; and
- Intermediate Zone – MP-3D, MW-38, MW-26, and MW-25.

The proposed infiltration points are shown on Figures 5 and 6.

The sodium permanganate will most likely be introduced into groundwater by a gravity feed. Shallow zone infiltration would begin in the most upgradient locations with dispersion monitoring of downgradient locations. As permanganate is observed in downgradient locations, permanganate infiltration will be started in infiltration points just behind the dispersion front until all infiltration points have been utilized. Intermediate zone infiltration will be performed after shallow zone infiltration in a similar manner.

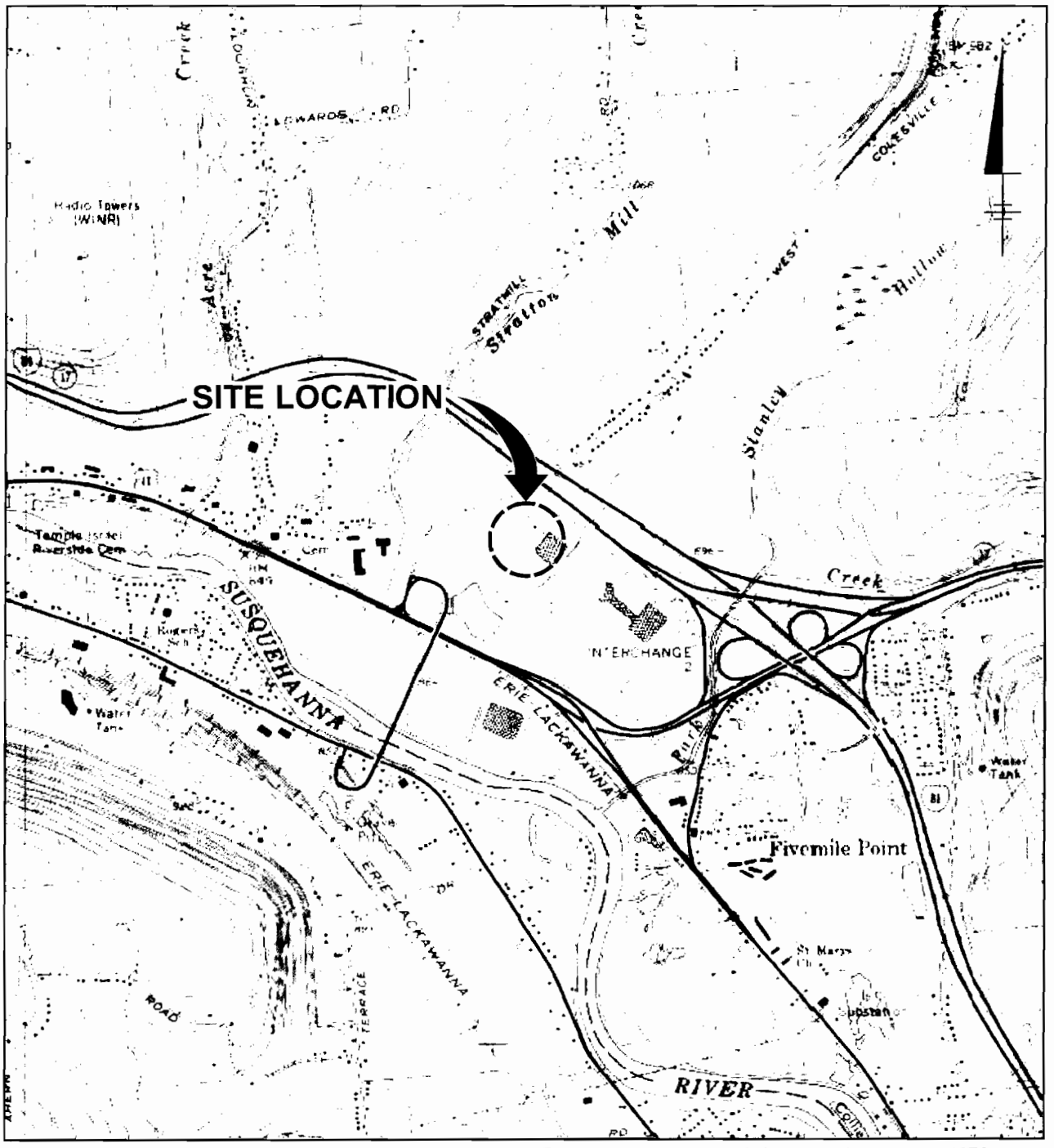
The Phase II pilot test is anticipated to occur 2 months before a semi-annual groundwater monitoring event so that post-test groundwater monitoring will include two semi-annual groundwater monitoring events. A report will be submitted 2 months after the second groundwater monitoring event. Phase II will have an approximate 9- month duration from start to completion.

4. References

New York State Department of Environmental Conservation (NYSDEC). March 2000. *Record of Decision: Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.*

New York State Department of Environmental Conservation (NYSDEC). January 2001. *Order on Consent: Index #B7-0515-97-05.*

Shield Environmental Associates, Inc. July 2000. *Remedial Investigation Report.*



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

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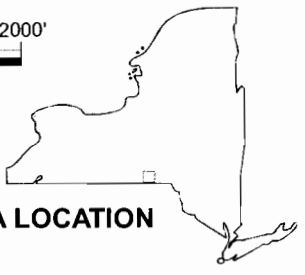
Approximate Scale: 1" = 2000'



AREA LOCATION

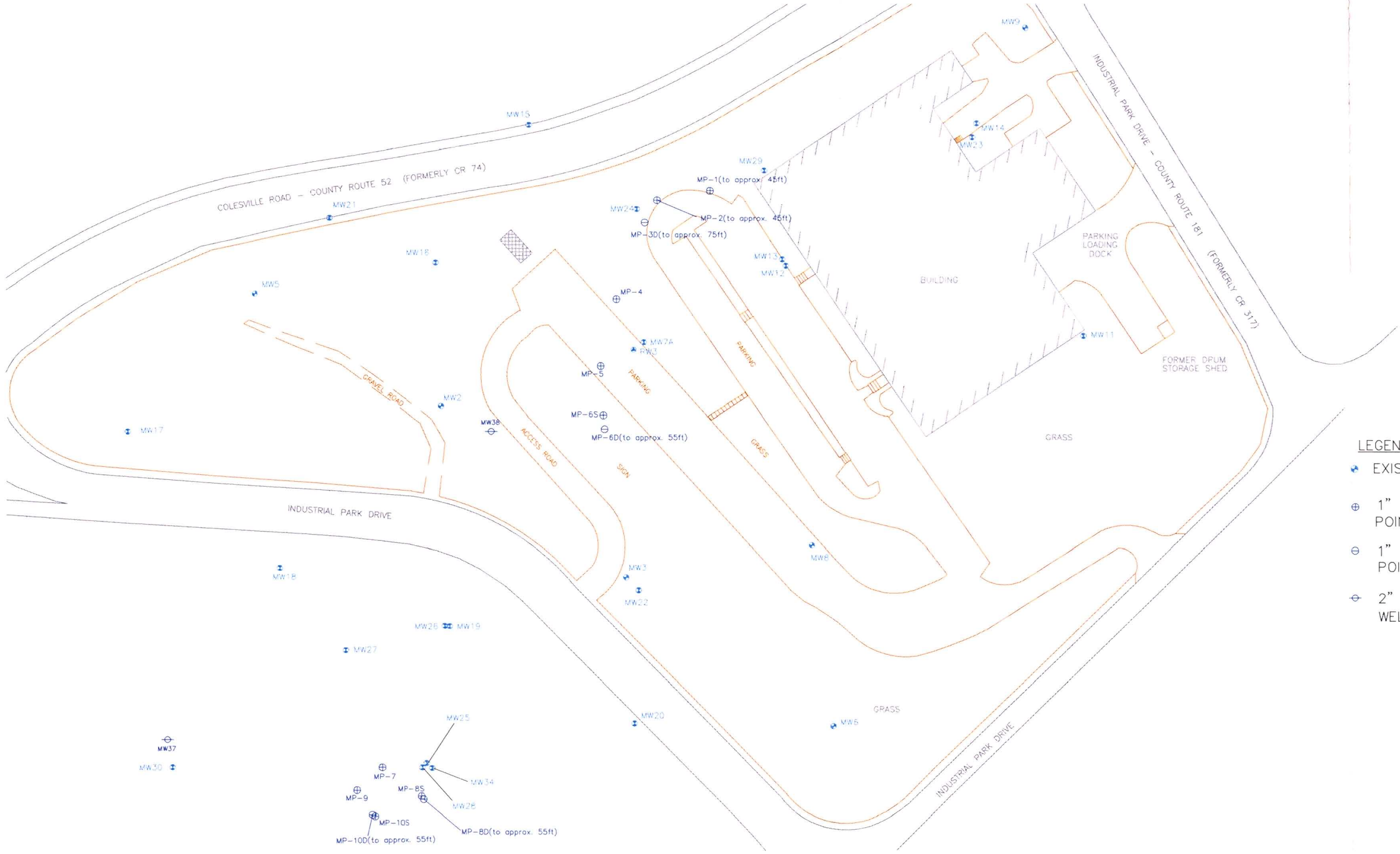
07/18/01 CRA-54-IY
05203003/05203n01.cdr

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

LOCATION MAP

BBL BLASLAND, BOUCK & LEE, INC. *engineers & scientists*

FIGURE 1



LEGEND

- EXISTING MONITORING WELL
- ⊕ 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- ⊖ 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- ⊖ 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH

0 60 120

SCALE IN FEET

SOURCE: FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
GROUNDWATER BIOREMEDIATION
PILOT STUDY

SITE MAP AND MONITORING WELL LOCATIONS

BBL
BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

FIGURE 2

X:
L: OFF=REF
P: PAGESET/PLT-DL
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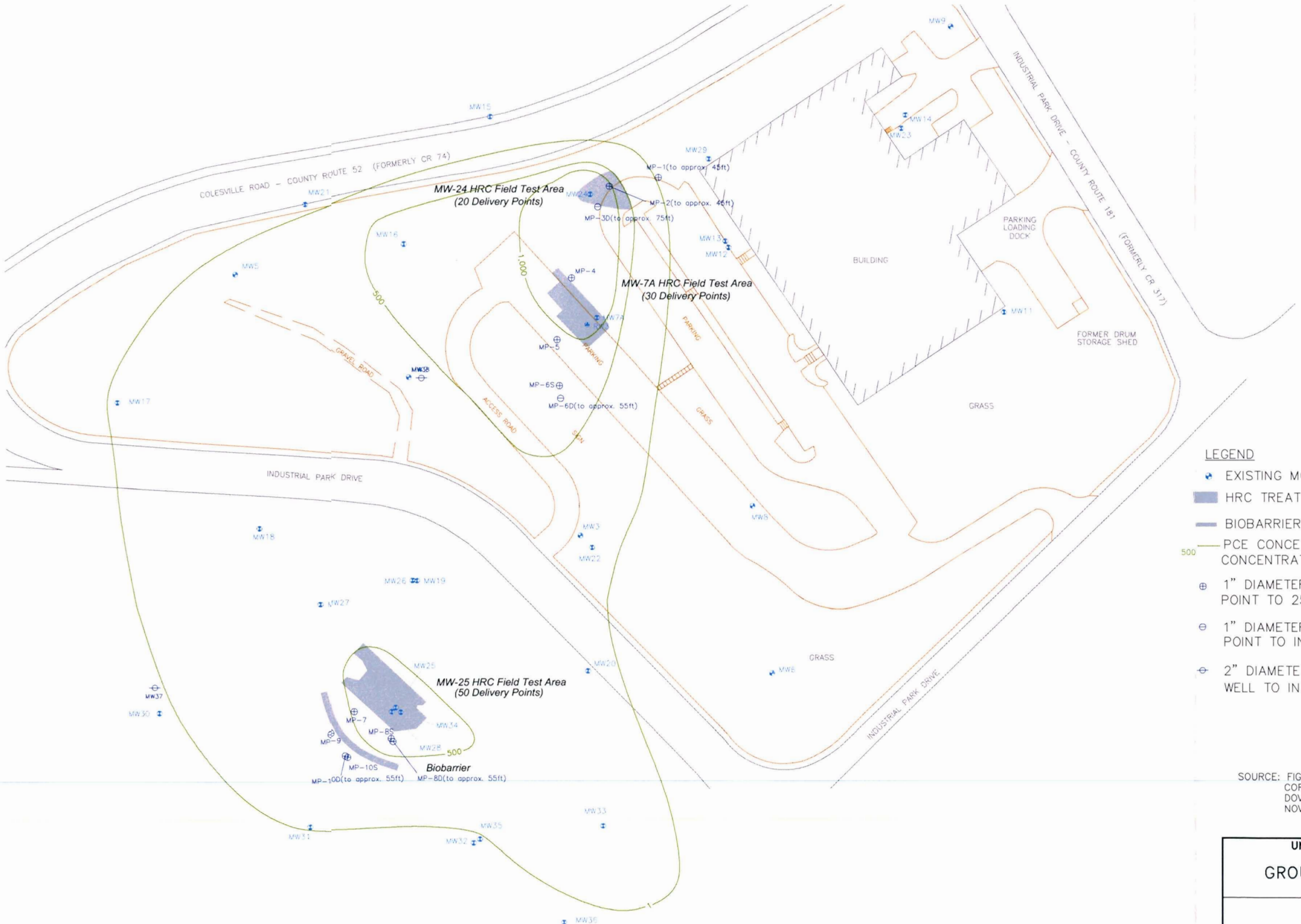


LEGEND

- EXISTING MONITORING WELL
- HRC TREATMENT LOCATION
- BIOBARRIER LOCATION
- 500 PCE CONCENTRATION CONTOUR LINE CONCENTRATIONS IN MICROGRAMS PER LITER
- ⊕ 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- ⊖ 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- ⊖ 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH

0 60 120

SCALE IN FEET

SOURCE: FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

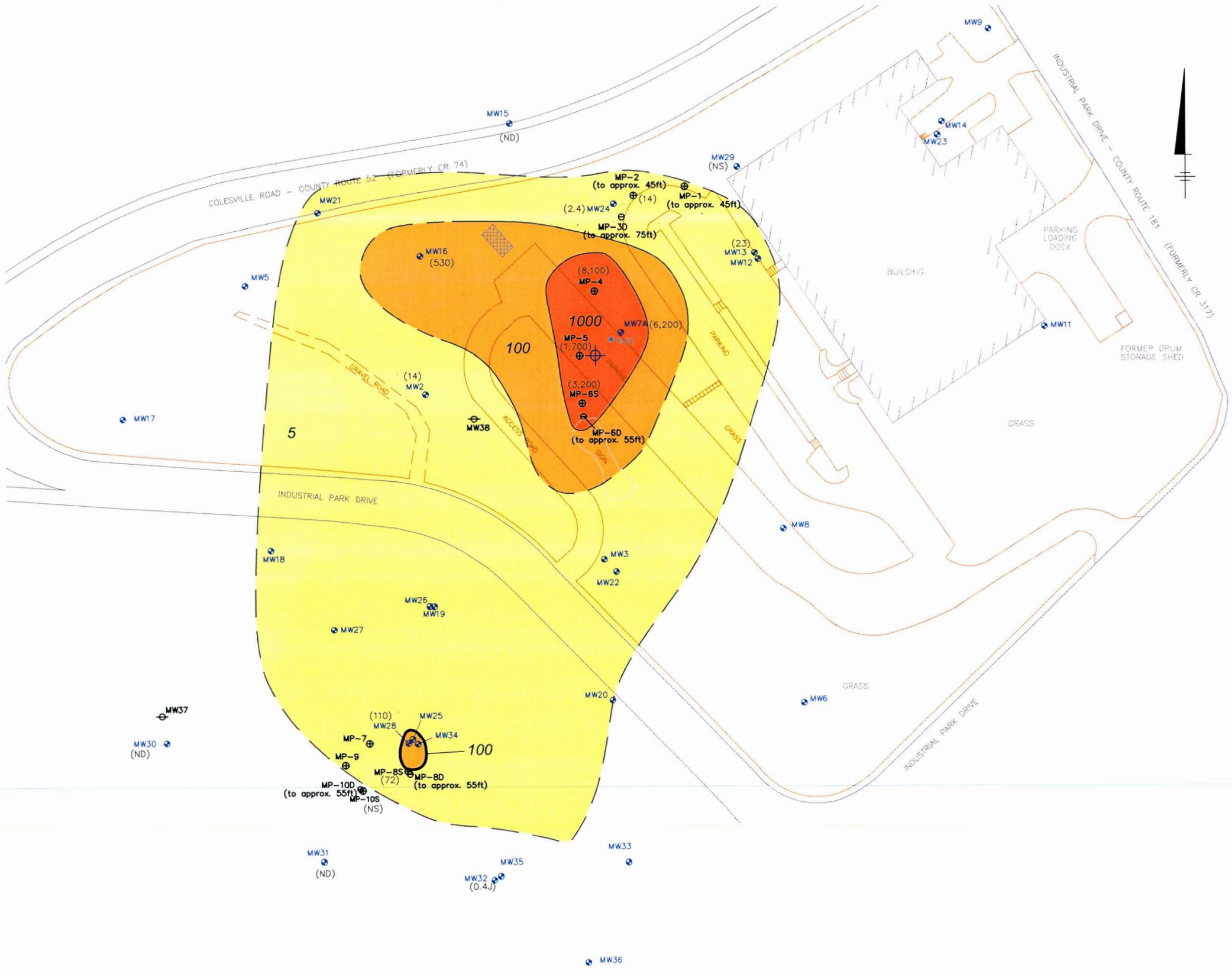
GROUNDWATER BIOREMEDIATION PILOT STUDY

HRC/ORC INJECTION LOCATIONS

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 3

X: NONE
L: REF*-OFF
P: STD-PCP/DL
8/26/02 CRA-54-IY, TLF
05203006/05203B07.DWG



LEGEND

- PROPOSED WELL LOCATION
- EXISTING MONITORING WELL
- 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- 100 — PCE CONCENTRATION CONTOUR LINE CONCENTRATIONS IN MICROGRAMS PER LITER (DASHED WHERE INFERRED)
- J ESTIMATED CONCENTRATION
- NS NOT SAMPLED

SOURCE:

FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'

GRAPHIC SCALE

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

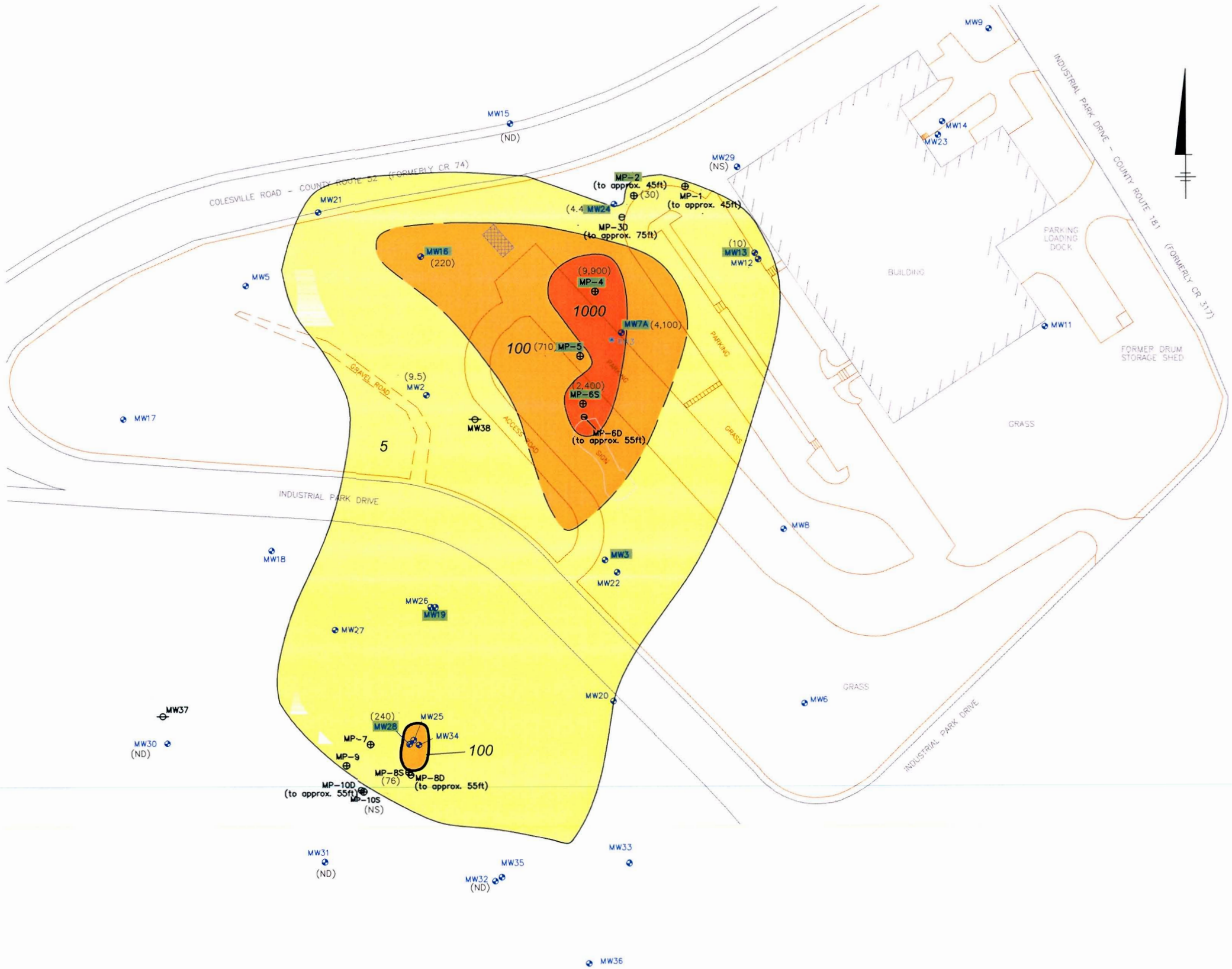
GROUNDWATER BIOREMEDIATION PROGRESS REPORT

PROPOSED PERMANGANATE INFILTRATION WELL LOCATION

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 4

X: 05203X01.DWG
L: OFF=REF*
P: PAGESET/PLT-DL
04/21/05 CRA-BS-TLF
05203011/05203P02.DWG



LEGEND

- EXISTING MONITORING WELL
- ⊕ 1" DIAMETER, SHALLOW MONITORING POINT TO 25ft UNLESS OTHERWISE INDICATED
- ⊖ 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- ⊖ 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- 100 — PCE CONCENTRATION CONTOUR LINE CONCENTRATIONS IN MICROGRAMS PER LITER (DASHED WHERE INFERRED)
- J ESTIMATED CONCENTRATION
- NS NOT SAMPLED
- PROPOSED LOCATION FOR INFILTRATION TEST

SOURCE:

FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'

GRAPHIC SCALE

X: 05203X01.DWG
L: DFF=REF*
P: PAGESET/PLT-DL
04/21/05 CRA-BS-TLF
05203909/05203C05.DWG

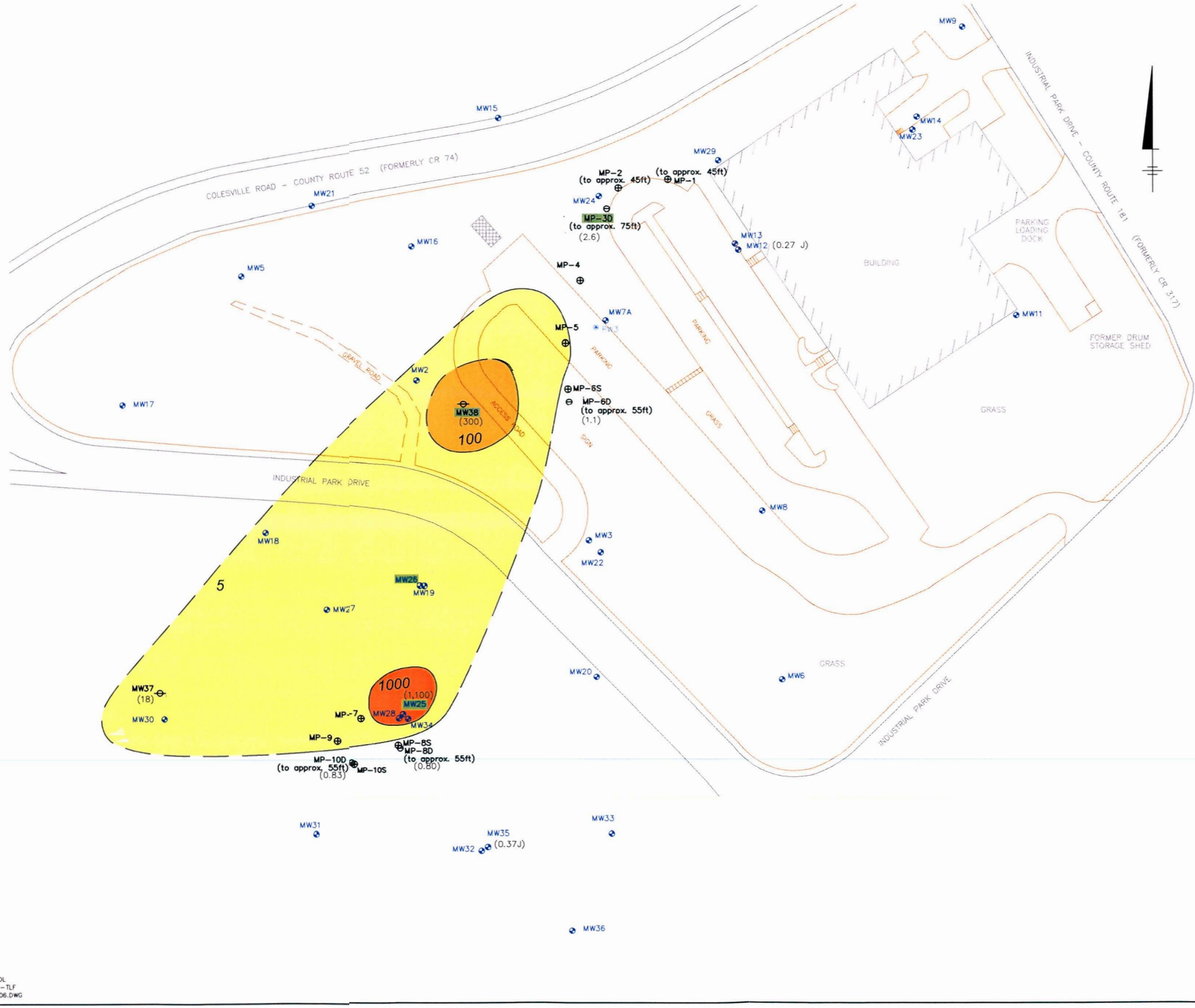
UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

GROUNDWATER BIOREMEDIATION PROGRESS REPORT

PHASE II ISCO TEST INFILTRATION LOCATIONS - SHALLOW WATER BEARING ZONE

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 5



LEGEND

- EXISTING MONITORING WELL
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- ⊖ 1" DIAMETER, DEEP MONITORING POINT TO INDICATED DEPTH
- ⊖ 2" DIAMETER, DEEP MONITORING WELL TO INDICATED DEPTH
- TREATMENT BUILDING
- 100 — PCE CONCENTRATION CONTOUR LINE CONCENTRATIONS IN MICROGRAMS PER LITER (DASHED WHERE INFERRED)
- J ESTIMATED CONCENTRATION
- PROPOSED LOCATION FOR INFILTRATION TEST

SOURCE:

FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

0 120' 240'

GRAPHIC SCALE

X: 05203X01.DWG
L: OFF=REF*
P: PAGESET/PLT-DL
04/21/05 CRA-BS-TLF
05203909/05203C06.DWG

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

GROUNDWATER BIOREMEDIATION PROGRESS REPORT

PHASE II ISCO TEST INFILTRATION LOCATIONS - INTERMEDIATE WATER BEARING ZONE

BBL BLASLAND, BOUCK & LEE, INC. engineers, scientists, economists

FIGURE 6

FIGURE 7

Proposed ISCO Phase I Field Test Schedule
Former Dover Electronics Site, Kirkwood, NY