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February 14, 2012

Tara M. Blum, P.E.
Environmental Engineer
NYSDEC Region 7
Division of Environmental Remediation
615 Erie Boulevard West
Syracuse, New York 13204-2400

Subject: Carrier Thompson Road Facility, DeWitt, Onondaga County, New York – Soil Vapor Mitigation

Ms. Blum:

EnSafe Inc., on behalf of United Technologies Corporation, has conducted sub-slab depressurization (SSD) communication testing in conformance with "Guidance for Evaluating Soil Vapor Intrusion in the State of New York", October 2006, at four site buildings where sub-slab concentrations have the potential for intrusion – building TR-4, -6, -18, and -18S. This letter outlines our plans for installation of SSD systems.

Testing Process

The process used for testing was the same for each building. Prior to the depressurization testing, an inspection was made of the slab condition and, except for a section of damaged slab in TR-18, no cracks or openings were observed that would have obviously interfered with the testing.

EnSafe tested each slab with a temporary vacuum source, a 5-horsepower (HP) regenerative blower rated to induce up to 75 inches of water column (" WC) vacuum under the slab. Vacuum was applied to each building, via a single extraction point (a short length of 4-in diameter stainless steel, wire-wrapped screen inserted into a shallow excavation through a core hole in the slab and affixed to a pipe grouted into the slab) installed for the purpose of testing.

The lateral extent of induced vacuum was measured at several pressure testing points, either existing or added to support the test, using a digital micro-manometer. Vacuum was applied stepwise at three increasing levels in each case, and pressure points observed one-by-one. At each level of applied vacuum the blower was run and all observation points were measured for vacuum level. Measurements were recorded at each observation point sequentially, and this cycle repeated until observed vacuum levels stabilized at all points.

Results and Design Proposal

Attached is the communication testing report from the subcontractor, Intex Environmental Group, Inc. As shown in the report, the results were generally consistent and communication apparent across a broad area in each building. There was no need to install and test secondary extraction points to confirm coverage. For buildings TR-6, -18 and 18S the design intent is to depressurize the entire building slab.[1]

TR-4

Building TR-4 is a much larger building and sub-slab sampling indicates that only a subset of total floor space at the midpoint of the building (adjacent to the historical chlorinated solvent release outside) exhibits elevated sub-slab concentrations. We plan to confirm extent of elevated sub-slab vapor concentrations before finalizing the SSD design.

Attachment figures 5 and 5a show good communication below the slab in target area of the building. EnSafe has recently sampled all three pressure observation points shown in the figures for sub-slab concentrations to establish whether this coverage area is sufficient. Depending on results, additional sampling will be conducted to establish necessary area of SSD coverage and/or the SSD design will be finalized, and submitted for Division concurrence. If coverage is sufficient, the system that would be proposed is as described below. Sampling results will be forwarded to you on receipt.

TR-18

Due to a collapsed slab in the northeast corner of this building the first floor at TR-18 is currently unoccupied. Carrier does not plan to repair and reoccupy the floor at this time. Thus, as an initial step, a 20 mil HDPE membrane will be installed over the affected corner of the slab and sealed with adhesive caulk to be air tight. The area and entrance will be roped off from foot traffic. Communication with the pilot extraction point installed at the extreme west wall may have been affected by the nearby storm line, but two additional extraction points planned for installation with SSD should suffice to meet objectives.

All Buildings

EnSafe proposes a separate SSD system fitted with multiple extraction points for each building, piped to individual vacuum blowers set just outside the buildings in secured enclosures. Multiple extraction points will better assure even and sufficient depressurization with minimal energy input. System layout will be selected for minimum impact of extraction manifold piping on building users (with pipe to be routed overhead along the ceilings), and isolation, especially in the case of TR-4, where sub-slab concentrations are elevated near to a vibration testing laboratory.

For each, the blower discharge will be muffled, and the outlet routed up along the exterior wall, extending a few feet above the roof line with a tee rain cap. Pending DEC approval of this approach, EnSafe will coordinate with facility engineers to confirm precise locations of both the extraction points and mechanical equipment considering sub-slab utilities, vibration/noise, snow removal issues, and proximity to electrical service. We may elect to install the blower inside the first floor at TR-18 because of available space.

Each enclosure will be labeled to discourage casual disruption and with a designated facility point of contact if trouble is observed or if the system must be de-energized.

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[1] Sampling at TR-6 indicates that sub-slab vapor concentrations are elevated only in the northern half of the building, but we plan to depressurize the entire slab as a precaution.

The following table presents our recommendations for each system (with the TR-4 selection tentative, based on coverage being sufficient with one additional extraction point to the east of the test point).

Building	Blower / Nominal HP	Flow Rate, cfm	Vacuum, "WC
TR-18	Regenerative/ 5 to 7.5	110	50
TR-18S	Regenerative/7.5	300	45 to 50
TR-6	Regenerative/7.5	300	30 to 45
TR-4	Centrifugal Blower/10	500	50

All blowers will be configured to restart without need for human intervention after a power outage. One or more pressure monitoring points on the piping manifolds will be maintained for direct observation of vacuum levels, and for control of variable speed drives on the blowers. A visible and audible alarm external to each enclosure will sound if the blower stops, or vacuum is otherwise lost.

Start-Up and Monitoring Program

Once installed in each building, the SSD systems will be started and motor frequency, blower speed, and applied vacuum level set, based on observation of produced vacuum field over one or two days. Additional pressure monitoring points will be installed as needed. A follow-up visit will be scheduled two to four weeks after start-up to confirm suitable operating conditions, and look for trends. In this testing, pressure field changes will be assessed, looking for increases in reach, or potentially decreases due pressure drop such as extraction point or filter loading with dust. Adjustments to blower speed will be made as needed to maintain the SSD areal coverage, while minimizing energy consumption. If significant changes are made, the confirmatory visit will be repeated. Thereafter, monitoring will consist of annual checks of SSD vacuum readings and reporting to the Division.

Installation is tentatively planned for the next two months, pending approval and finalization of the TR-4 SSD system configuration. We will relay testing results in support of that confirmation as received. Please call May Heflin or me if you have any questions, at (901) 372-7962.

Sincerely,

EnSafe Inc.

Craig A Wise

By: Craig Wise, P.E.
Environmental Engineer

Copy: May Heflin
William Penn, UTC
Nelson Wong, UTC
Mark Sergott, DOH

Attachment: Pilot Test Phase II Report

ENSAFE

PILOT TEST - PHASE II REPORT
CARRIER FACILITY
Buildings TR-18, TR-18s, TR-6 and TR-4

Prepared for:

ENSAFE, Inc.
5724 Summer Trees Drive
Memphis, TN 38134

Prepared by:

INTEX Environmental Group, Inc.
6907A Easton Road
Pipersville, PA 18947

January 31, 2012

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FIGURES AND TABLES

1.0 TECHNICAL APPROACH

INTEX utilized its Sub-Slab Depressurization Pilot Test and support equipment to induce a sub-slab vacuum at each of the following target buildings, TR-18, TR-18s, TR-4 and TR-6. This pilot test was conducted May 17 and 18, 2011. The test equipment is as follows:

5 HP Pilot Test Vacuum Extraction Test Platform

1. 20 KVA generator
2. 4" diameter stainless steel screen(permanent extraction points)
3. Concrete core drill, 4" and 6" diameter core barrels; hammer drill, ½" bits
4. 3/8" stainless steel tubing with Swageloc fittings. (monitoring points)
5. Ultra low vacuum electronic manometer.

At each test site INTEX installed a 4" diameter 0.010 slot stainless steel, wire-wrapped screen to a depth of two feet below the slab as a vacuum extraction point. Each site had test points that were previously installed for vapor monitoring. Additional points were added based on the INTEX site manager's observations of the site conditions.

At each site vacuum was induced at the extraction point at incremental settings and sub-slab vacuum was monitored at regular (15 minute) intervals until the sub-slab readings stabilized at each vacuum setting. The data was recorded and an isopleth plot of the sub-slab concentrations was prepared based on the vacuum setting with the greatest area of influence.

Figure 1 is a site sketch of the locations of the buildings being investigated.

The results for each site are presented below with recommendations and conclusions.

2.0 BUILDING TR-18 TEST RESULTS AND CONCLUSIONS

<u>Results</u>

Building TR-18 is approximately 80 feet deep and 150 feet long. The extraction point was located at the approximate mid-point of the 150 foot wall, near the exterior wall (see Figure 2). Seven monitoring points were included in the pilot test. Four monitoring points were originally installed (P-1 through P-4) and an additional three points were installed to evaluate the effect of extensive cracks in the slab.

The vacuums were 30, 50 and 60 inches of H_2O. Table 1 presents the data collected during the test. As observed from the data, there is no appreciable difference in sub-slab influence between the 50 inch setting and the 60 inch vacuum setting. The effective extent of influence is approximately 50 feet from the extraction point. The connectivity is approximately the same in all directions.

Conclusions and Recommendations

The slab in this building has extensive damage and cracking. If repairs were to be made, the area of influence would be greater. In its current condition a minimum of two additional extraction points will be required to effectively depressure the sub-slab to meet USEPA criteria. Approximate locations for these points are presented on Figure 2.

The target vacuum for the building system will be 50 inches of H_2O vacuum. We estimate that the required blower size will be between 5 and 7.5 hp in the system. A variable frequency drive motor for the blower will be proposed in order to be able to reduce the horsepower draw in the event that repairs are made to the slab.

The bottom floor of the building is not in use and there are no current plans for its use. The badly cracked area is approximately 30' x 30'. A cost-effective solution for the damaged slab can be realized by fastening a 20 - 30 millimeter landfill liner to cover the badly damaged area and crack sealer for the rest of the floor area.

3.0 BUILDING TR-18s TEST RESULTS AND CONCLUSIONS

Results

Building TR-18s is approximately 190 feet by 115 feet. There is a raised floor in the south east quadrant of the building which covered cable races for electronic equipment. This precluded the installation of any monitoring points in that area. The extraction point is located approximately 40' from the west end of the building. This site had two pre-installed monitoring points and INTEX added a third point at the time of the test (see Figure 3). Table 2 presents the field data.

The vacuum settings for this test were 30, 50 and 60 inches H_2O. There was approximately a 30% increase in the induced vacuum between the 50 and the 60 inch setting at monitoring point R-38. The difference between 50 and 60 inches vacuum for PT-1 results in approximately a 40 % increase. It should be noted that the induced vacuums in PT-1 are approximately seven times higher than those recorded at R-38. The connectivity towards the south side of the building is greater than the connectivity along the longitudinal axis.

Conclusions and Recommendations

Based on this test, INTEX recommends that the final system design include three additional extraction points located as shown on Figure 3. Two points are located on the longitudinal axis and one point in the raised floor area, if possible. With the additional extraction points the induced vacuum should be sufficient in the 45 to 50 inches of H_2O range. This will result in a volume flow rate of 300 scfm. A 7.5 hp blower equipped with an inverter motor is recommended. Final design recommendations will be proposed after the extraction point locations are approved and piping layout and blower locations are determined.

4.0 BUILDING TR-6 TEST RESULTS AND CONCLUSIONS

Results

Building TR-6 is approximately100 feet deep and 180 feet long. The extraction point is located approximately 40 feet from the north end of the building adjacent to a brick wall that may have existed as an exterior wall prior to the expansion of the building to its current size. The extraction point is in the newer section of the building. Four monitoring points were installed prior to the test (see Figure 4). One monitoring point is located the in older section of the building. The field data for this test is presented in Table 3.

The vacuum settings for this test were 25, 30 and 45 inches H_2O. There was approximately 40% increase in the induced vacuum between the 30 and the 45 inch setting at monitoring point PT-1. The maximum flow rate achieved at 45 inches H_2O was 144 scfm. This value can be compared to the other sites which resulted in approximately 120 scfm at 60 inches H_2O

.

Conclusions and Recommendations

The connectivity at this site is uniform. The flow data gives the indication that the sub-base beneath the slab is more porous than at other study areas. A higher rate of flow was achieved at a lower induced vacuum. This can either be the result of a more porous sub-base or possible short-circuiting along the brick wall to the outside. There is some concern that there was no monitoring point on the opposite side of the brick wall from the extraction point, however the monitoring point PT-2 is on the opposite side and showed reasonable influence by the induced vacuum.

Based on this test, INTEX recommends that the final system design include two additional extraction points. We further recommend that an abbreviated connectivity test be conducted between the existing extraction point and the east side of the brick wall. If connectivity is impeded by the wall, one of the recommended extraction points will be located as shown in Figure 4. If that is the case, one additional point will be located in the south end of the building. With the additional extraction points the induced vacuum should be sufficient in the 30 to 45 inches of H_2O range. This will result in a volume flow rate of 300 to 350 scfm. A 7.5 hp blower equipped with an inverter motor is recommended. Final design recommendations will made after the extraction points locations are approved and piping layout and blower locations are defined.

5.0 BUILDING TR-4 TEST RESULTS AND CONCLUSIONS

Results

Building TR-4 is approximately 880 feet deep and 200 feet long. The testing was conducted on the west side of the building approximately 350 feet from the southern end. The area tested was approximately 250 feet long and 120 feet deep. The extraction point is adjacent to the western wall of the building. There are three monitoring points that were installed prior to the test (see Figure 5). The field data is presented in Table 4. The vacuum settings for this test were 30 inches H_2O, 45 inches and 60 inches H_2O.

Conclusions and Recommendations

The connectivity at this site appears to be uniform in the area tested. The location of the extraction point immediately adjacent to the exterior wall likely has resulted in vacuum being exerted outside the footprint of building. It is necessary to define the sub-slab area that is targeted for vapor intrusion control. The results of this test demonstrate the radius of influence in this zone of the building.` Therefore, if a design is required for the entire building is should be supported by additional data.

To adequately depressurize an area of approximately 25,000 square feet in the vicinity of the pilot test, INTEX recommends establishing an extraction point approximately 50 feet east of the extraction point used in the pilot test. Based on the radius of influence developed in the pilot test, a five horsepower regenerative blower system operating at a vacuum of 50 inches of water with an extraction rate of 95 scfm at this location will develop a negative sub-slab pressure in line with the NYDEC and NYDOH Vapor Intrusion Guidance over a 25,000 square foot area.

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TABLE 1: BUILDING 18 DATA

Date	5/18/2011	Test Location	Bldg. 18

			TEST POINTS						
			R-18	PT-2	R-38	R-52	PT-1	PT-3	PT-4
RUN #	1	Distance from Extract Pt. (ft)	18	24	38	52	72	48	
Vacuum(in. H_2O)	30"	Time	induced vacuum						
Flow (acfm)	59.25	9:30	0.015	0.002	0.001	nv	nv	nv	nv
		9:45	0.016	0.002	0.001	nv	nv	nv	nv
		10:00	0.016	0.002	0.001	nv	nv	nv	nv
RUN #	2								
Vacuum(in. H_2O)	50"	Time	induced vacuum						
Flow (acfm)	104	10:05	0.032	0.005	0.005	0.001	nv	nv	nv
		10:15	0.032	0.005	0.005	0.001	nv	nv	nv
	103.75	10:30	0.033	0.005	0.005	0.002	0.001	nv	nv
		10:45	0.033	0.005	0.005	0.002	0.001	nv	nv
		10:55	0.033	0.005	0.005	0.002	0.001	nv	nv
RUN #	3								
Vacuum(in. H_2O)	60"	Time	induced vacuum						
Flow (acfm)	118.47	11:05	0.037	0.006	0.006	0.002	0.001	0.0005*	nv
		11:15	0.037	0.006	0.006	0.002	0.001	0.0005*	nv
		11:30	0.037	0.006	0.006	0.002	0.001	0.001	nv
		1:45	0.039	0.007	0.006	0.002	0.001	0.002	nv
		12:00	0.039	0.006	0.006	0.003	0.001	0.002	nv
		12:14	0.039	0.006	0.006	0.003	0.001	0.002	nv
		12:30	0.039	0.006	0.006	0.003	0.001	0.002	nv

nv = no vacuum depressurization produced
* = decrease in a positive pressure measured

TABLE 2: BUILDING 18S DATA

Date	**5/17/2011**	**Test Location**	**Bldg. 18S**

			TEST POINTS		
			R-38	PT-1	PT-2
RUN #	1	Distance from Extract Pt. (ft)	38	48	
Vacuum(in. H_2O)	30"	Time	induced vacuum		
Flow (acfm)	35.5	10:30	0.011	0.073	nv
		10:45	0.012	0.073	nv
		11:00	0.012	0.075	nv
RUN #	2				
Vacuum(in. H_2O)	50"	Time	induced vacuum		
Flow (acfm)	103.75	11:05	0.019	0.123	nv
		11:15	0.019	0.123	nv
		11:30	0.019	0.123	nv
		1:45	0.019	0.123	nv
		11:55	0.019	0.123	nv
RUN #	3				
Vacuum(in. H_2O)	60"	Time	induced vacuum		
Flow (acfm)	118.47	12:00	0.03	0.195	0.0005*
		12:15	0.03	0.202	0.0005*
		12:30	0.031	0.203	0.0005*
		12:45	0.031	0.204	0.0005*

nv = no vacuum depressurization produced

* = decrease in a positive pressure measured

TABLE 3: BUILDING 6 DATA

Date	5/19/2011	Test Location	Bldg. TR-6

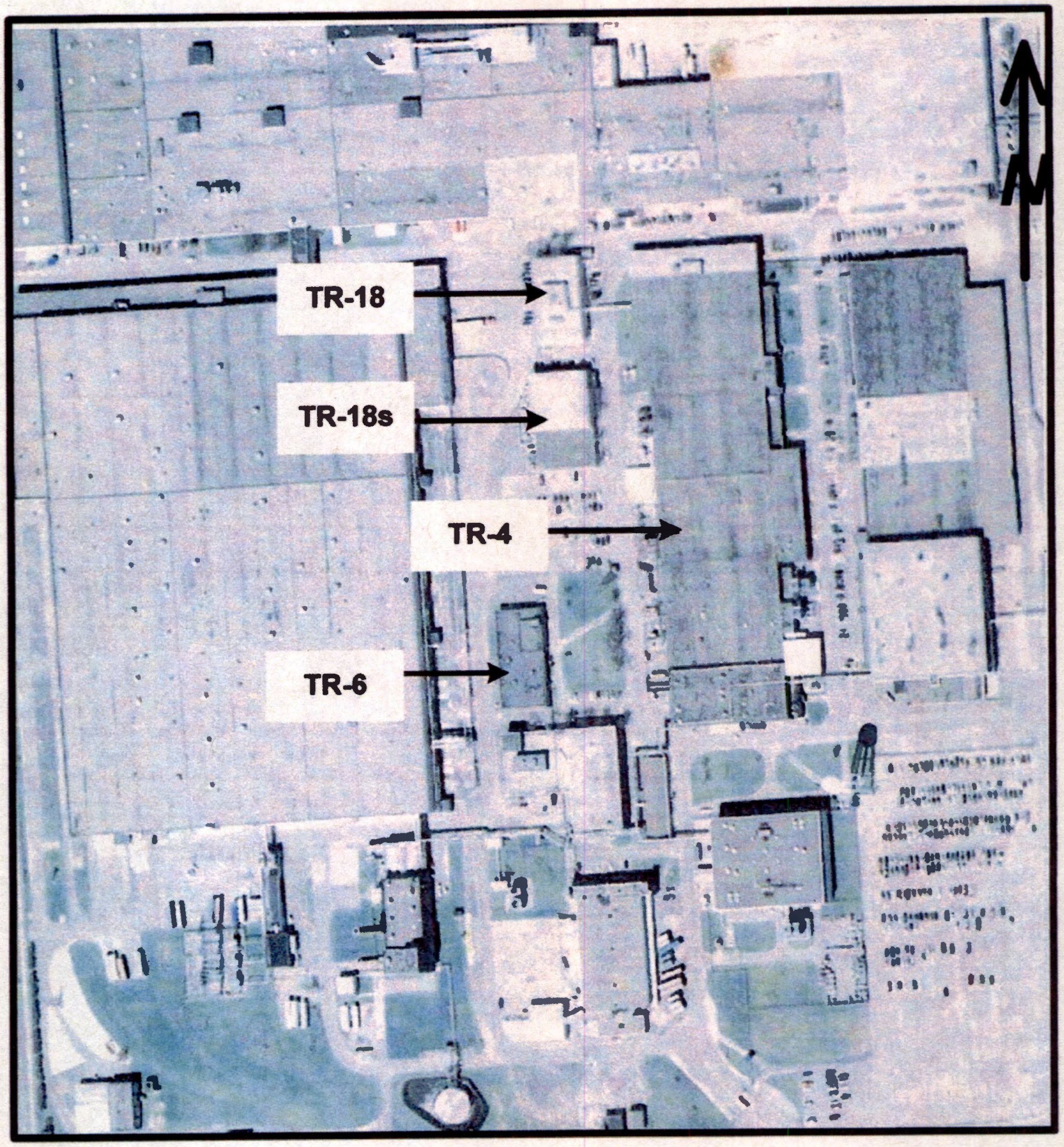
			TEST POINTS			
			PT-1	PT-2	PT-3	PT-4
RUN #	1	Distance from Extract Pt. (ft)	37	85	109	127
Vacuum(in. H_2O)	25"	Time	induced vacuum			
Flow (acfm)	72.24	9:00	0.028	0.002	0.003	nv
	71.96	9:15	0.028	0.003	0.003	nv
		9:30	0.028	0.003	0.004	nv
		9:45	0.028	0.003	0.004	nv
		10:00	0.028	0.003	0.004	nv
RUN #	2					
Vacuum(in. H_2O)	30"	Time	induced vacuum			
Flow (acfm)	89.04	10:05	0.039	0.004	0.005	0.0005*
		10:15	0.039	0.004	0.006	0.0005*
		10:30	0.039	0.004	0.006	0.0005*
		10:45	0.039	0.004	0.007	0.0005*
		11:00	0.040	0.005	0.006	0.0005*
RUN #	3					
Vacuum(in. H_2O)	45"	Time	induced vacuum			
Flow (acfm)	144.8	11:05	0.069	0.007	0.009	0.0005*
		11:15	0.069	0.008	0.010	0.0005*
		11:30	0.068	0.008	0.009	0.0005*
	144.75	1:45	0.068	0.008	0.008	0.0005*
		12:00	0.069	0.008	0.009	0.0005*

nv = no vacuum depressurization produced
* = decrease in a positive pressure measured

TABLE 4: BUILDING 4 DATA

Date	**5/17/2011**	**Test Location**	**Bldg. TR-4**

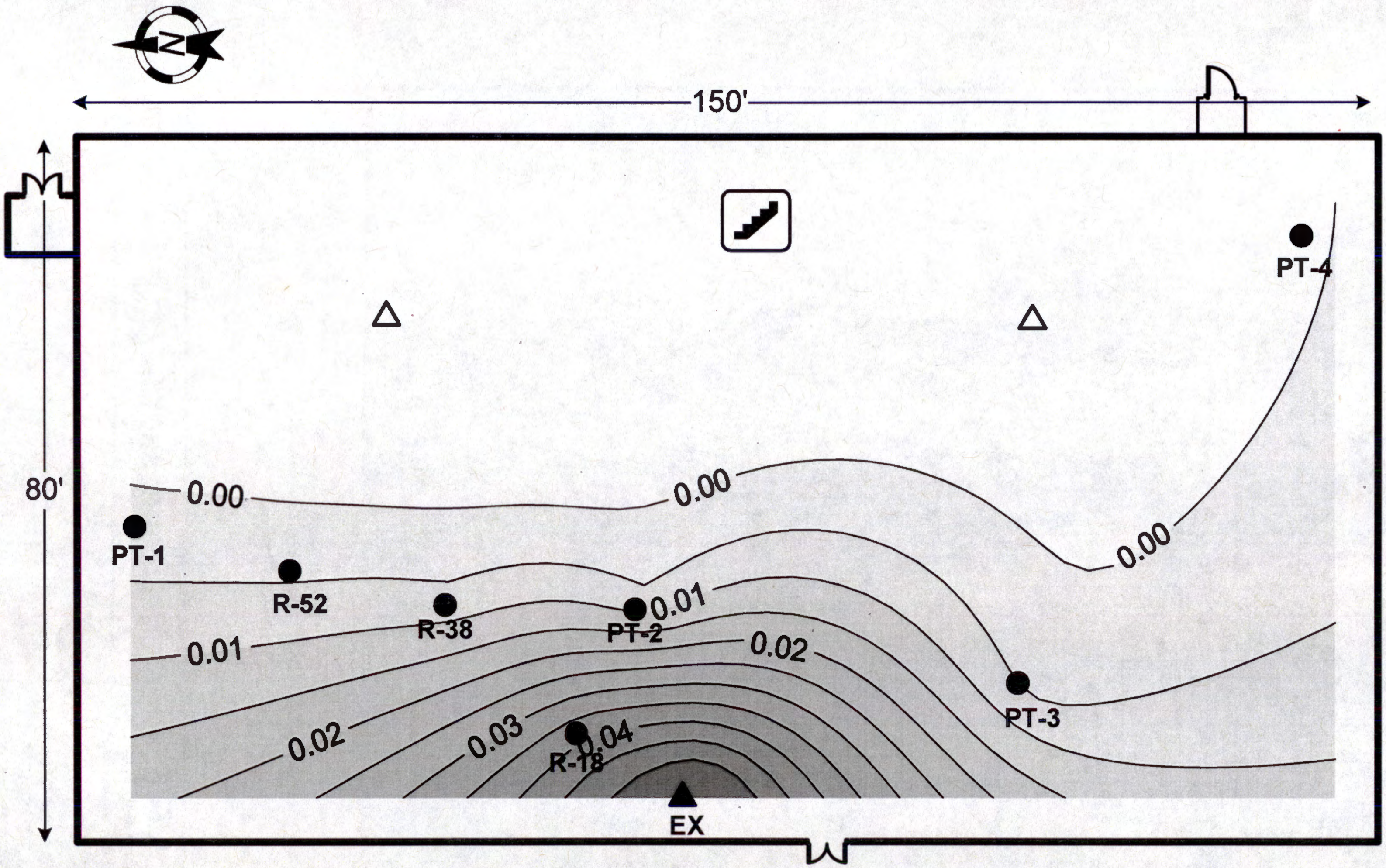
			TEST POINTS		
			PT-1	PT-2	PT-3
RUN #	1	Distance from Extract Pt. (ft)	112	48	95
Vacuum(in. H_2O)	30"	Time	induced vacuum		
Flow (acfm)	60.22	7:45	0.006	0.042	0.006
		8:00	0.006	0.042	0.006
		8:15	0.006	0.042	0.004
		8:30	0.006	0.042	0.004
		8:45	0.006	0.042	0.004
RUN #	2				
Vacuum(in. H_2O)	45"	Time	induced vacuum		
Flow (acfm)	85.24	8:30	0.012	0.073	0.010
		8:45	0.012	0.073	0.009
		9:00	0.012	0.074	0.010
		9:15	0.012	0.074	0.010
		9:30	0.012	0.074	0.011
		9:45	0.012	0.074	0.010
RUN #	3				
Vacuum(in. H_2O)	60"	Time	induced vacuum		
Flow (acfm)	121.47	9:45	0.018	0.102	0.015
		10:00	0.018	0.102	0.015
		10:15	0.018	0.103	0.015
		10:30	0.018	0.103	0.015
		10:45	0.018	0.103	0.014



SCALE
(in feet)

0 275

INTEX Environmental Group, Inc 6907A Easton Road Pipersville, PA 18947 215-766-7230 fax 215-766-9730 info@intexenv.com	SITE SKETCH		
	Carrier Campus		
	MOT	2011	Figure 1



NOTE: DRAWING NOT TO SCALE

▲	EXTRACTION POINT
△	PROPOSED EXTRACTION POINT
●	MONITORING POINT

INTEX Environmental Group, Inc 6907A Easton Road Pipersville, PA 18947 215-766-7230 fax 215-766-9730 info@intexenv.com	**TR-18**		
	Pilot Test Vacuum 60" H_2O		
	MOT	05/18/2011	Figure 2

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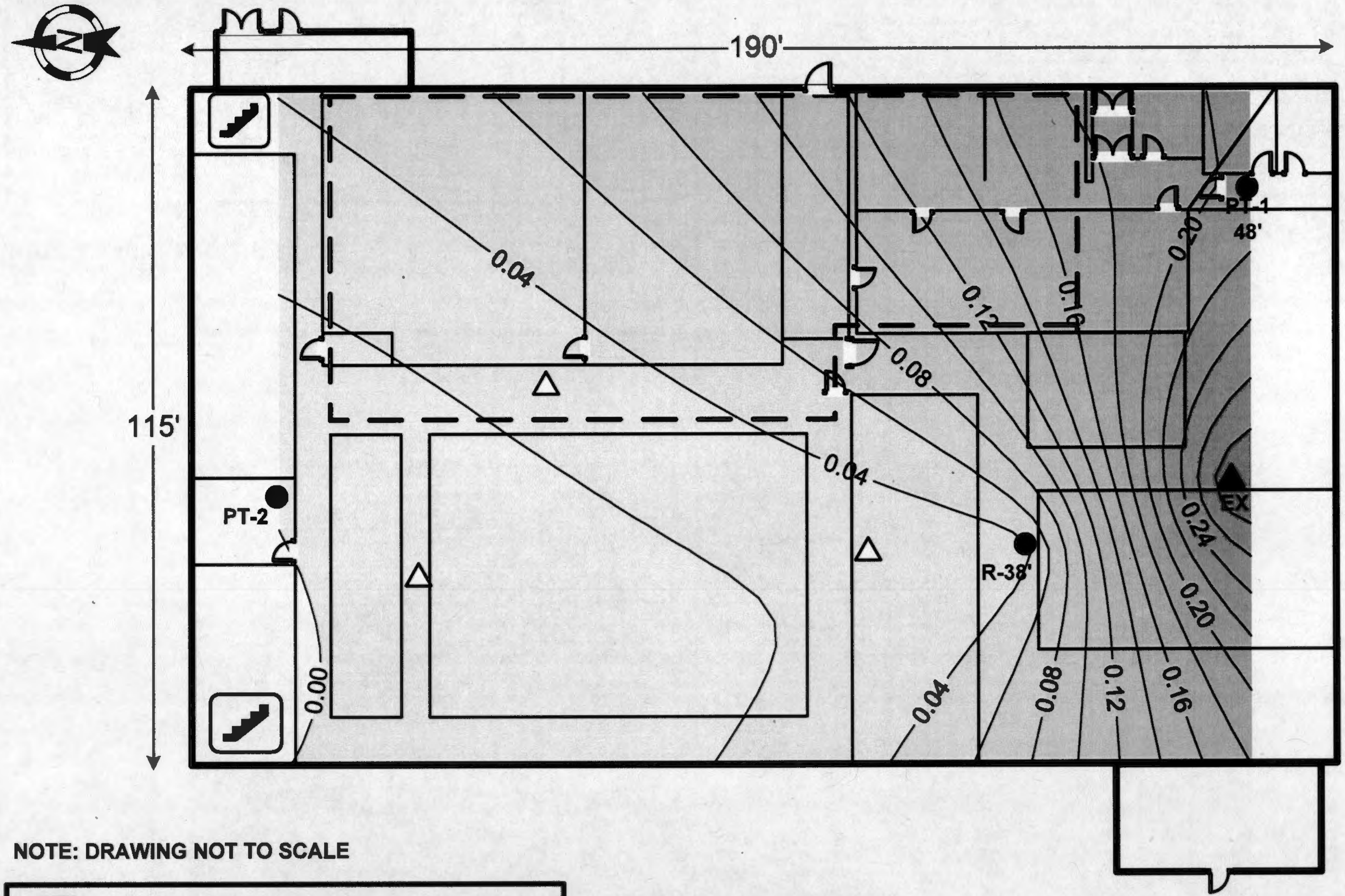

NOTE: DRAWING NOT TO SCALE

COMPUTER ROOMS WITH FALSE FLOOR

▲ EXTRACTION POINT

△ PROPOSED EXTRACTION POINT

● MONITORING POINT

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TR-18S

Pilot Test Vacuum 60" H_2O

MOT	05/17/2011	Figure 3

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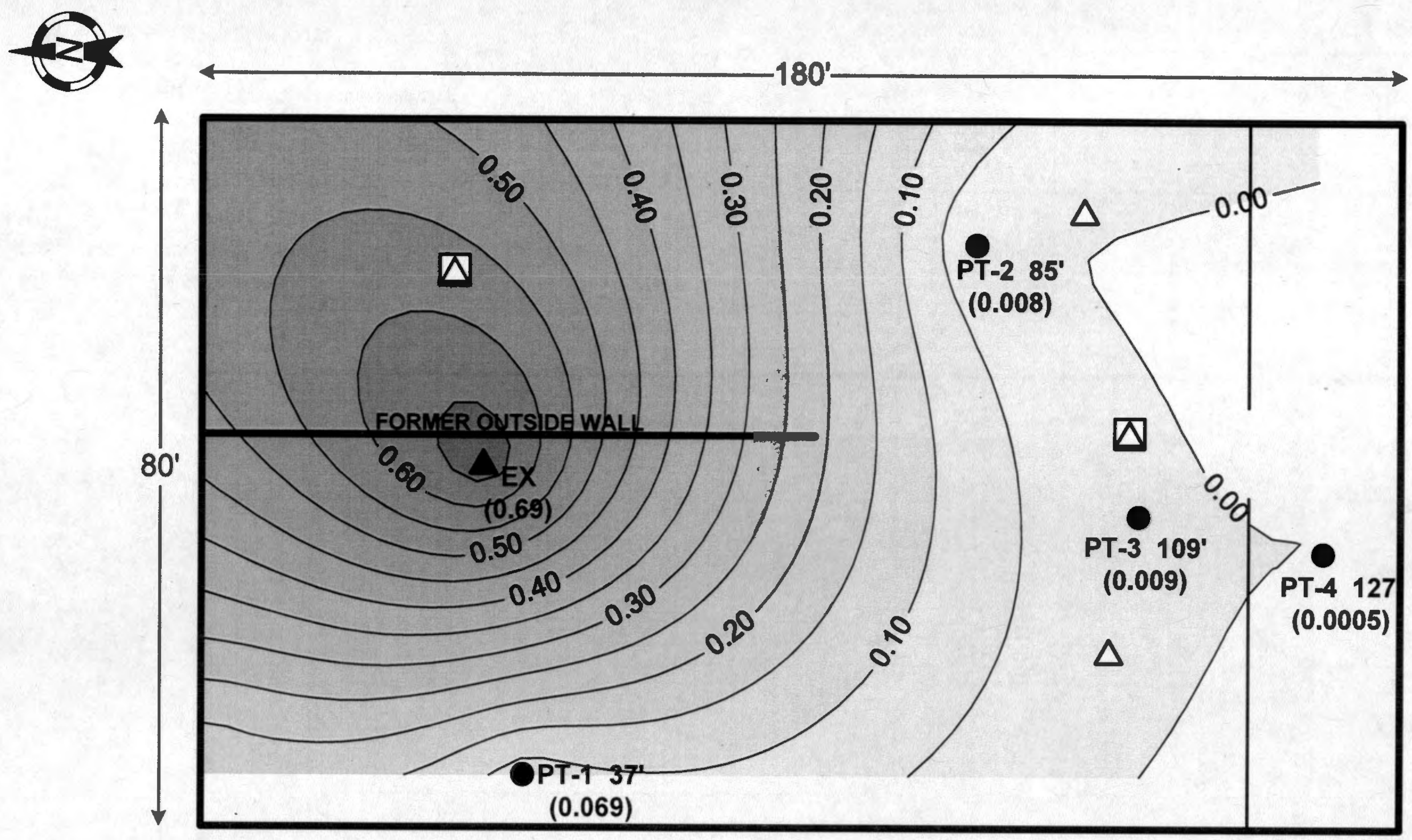

NOTE: DRAWING NOT TO SCALE

▲	EXTRACTION POINT
△	PROPOSED EXTRACTION POINT
●	MONITORING POINT
⊠	ALTERNATIVE EXTRACTION POINT

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TR-6

Pilot Test Vacuum 45" H_2O

MOT	05/19/ 2011	Figure 4

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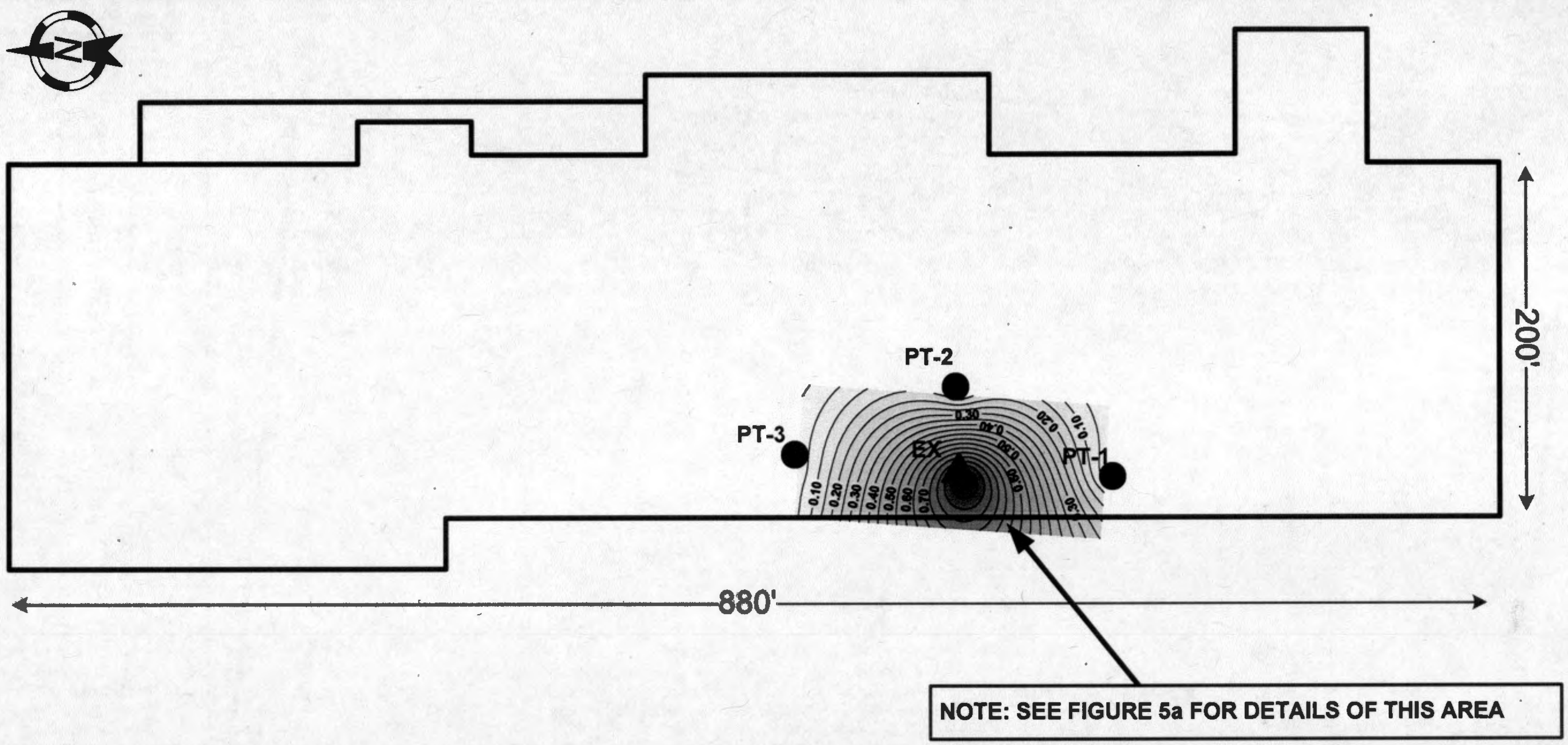

▲ EXTRACTION POINT

● MONITORING POINT

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TR-4		
Pilot Test Vacuum 60" H_2O		
MOT	05/17/2011	Figure 5

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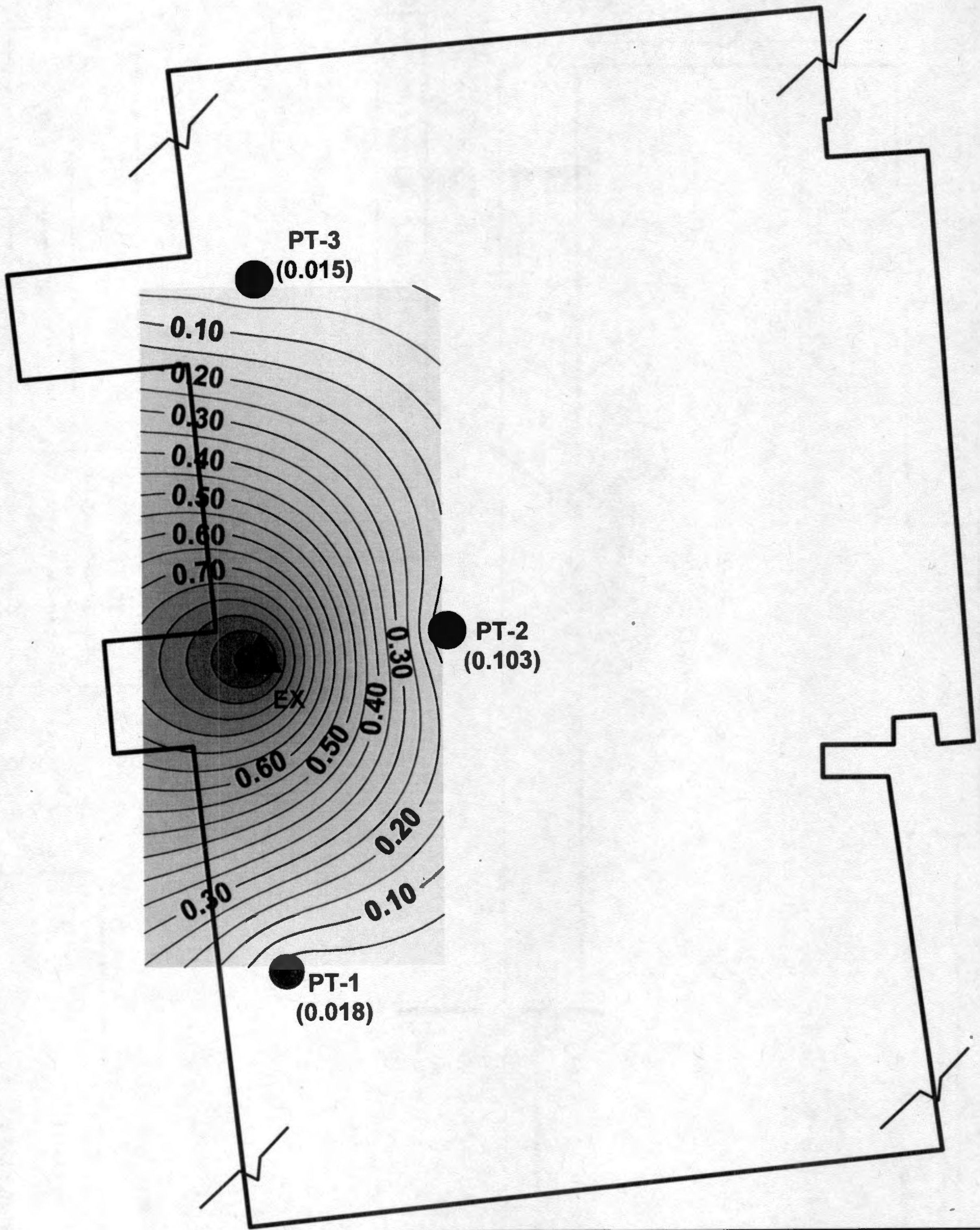

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INTEX Environmental Group, Inc 6907A Easton Road Pipersville, PA 18947 215-766-7230 fax 215-766-9730 info@intexenv.com	**TR-4** **Pilot Test Vacuum 60" H_2O** Drawn by: MOT | 05/17/2011 | Figure 5a

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