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Section No. 1.0: Introduction

J.C. Broderick and Associates, Inc. (JCB) was retained by the Jericho Union Free School District (Jericho) to investigate the potential for volatile vapor intrusion (VVI) from a nearby New York Department of Environmental Conservation (NYSDEC) Brownfield Cleanup Program (BCP) site. JCB performed VVI air sampling within the Cantiague Elementary School and adjacent athletic field. The sampling protocol was performed essentially in accordance with the requirements of the New York State Department of Health (NYSDOH) "Guidance for Evaluating Soil Vapor Intrusion in the State of New York", Final Version, October 2006 and utilizing all applicable updated and amendments.

Section No. 2.0: Site Description and Location

The Subject Site is located at 678 Cantiague Rock Road, Jericho, New York 11753. According to the United States Geological Survey (USGS) *Hicksville, New York, 1992* 7.5 Minute Series Topographical Map, the Subject Site is situated at an approximate elevation of 164 feet (ft.) above mean sea level. The location of the Subject Site is shown on the Site Location Map, Appendix-A Figure-1.

Section No. 3.0: Volatile Vapor Intrusion (VVI) Evaluation

The design scope outlined in the Volatile Vapor Intrusion (VVI) Investigation Work Plan (IWP) was followed during the volatile vapor intrusion evaluations. The following sections describe the procedures taken.

Section No. 3.1: Pre-Work Field Preparations

Prior to setup, a pre-sampling inspection was performed to evaluate the physical layout and conditions of the school building, to specifically determine the location of each sample, identify conditions that may affect or interfere with the proposed sampling and to prepare the building for sampling.

- To document conditions during indoor air sampling and ultimately to aid in the interpretation of the sampling results, the following actions were taken:
  - The storage of volatile chemicals was identified.
  - The use of heating or air conditioning systems during sampling was noted.
  - Floor plan sketches were drawn which include: the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, locations of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, compass orientation (north) and footings that create separate foundation sections. Photographs were taken to accompany the floor plan sketches.
  - Any pertinent observations, including readings from a Photo-Ionization Detector (PID) and other field instrumentation, were recorded.

Section No. 3.2: Sub-Slab Vapor Sample Collection

The following summarizes the manner in which the sub-slab vapor sample was collected. Please refer to Figure No. 2 - Subsurface, Crawlspace and Basement Sample Locations for additional details.

- For the collection of the sub-slab surface vapor sample, a probe was fabricated from ½-inch diameter, threaded brass pipe with a barbed tubing connection. The concrete floor was penetrated by a one (1) inch diameter drilled hole, utilizing a hammer drill into the base material. The pipe was lowered into the hole, but not flush to the bottom and set into place utilizing hydrated bentonite powder and modeling clay, which contains no Volatile Organic Compounds (VOCs). A five (5) gallon plastic container was placed over the top of the vapor point. The container was sealed to the concrete floor utilizing modeling clay. A Teflon-lined, ¼-inch I.D. disposable polyethylene tubing was then utilized to connect the barbed connection of the vapor point to a clean-certified, 6-liter SUMMA® canister, provided by York Analytical Labs, Inc. (York) through a flow controller pre-set for an eight (8) hour long sample duration as per TO-15 sampling protocol. The tubing included a tee connection and valve to a purging vacuum pump calibrated for a flow rate of less than 0.2 liters per minute. The tubing, probe and sub-slab soil vapor was purged of at least one (1) liter prior to the start of sample collection. Upon completion of the sampling, the probe was removed and the hole filled with concrete.

- Helium (He) was introduced into the atmosphere under the pail, as a tracer gas, to assure the viability of the vapor point seals with the atmosphere. The tracer gas was monitored in the purge air before sampling and outside of all seals before, during and after sampling, utilizing a Myron Helium Detector. In addition, Helium (He) was analyzed for in the SUMMA® canister and if detected at more than ten (10) percent, the sample would be considered invalid and retaken.

- On March 28, 2016, one (1) sub-slab vapor sample was collected.

Section No. 3.3: Crawl Space Vapor Sample Collection

The following summarizes the manner in which the crawl space vapor sample was collected. Please refer to Figure No. 2 - Subsurface, Crawlspace and Basement Sample Locations for additional details.

- For the collection of the crawl space vapor sample, a soil vapor point was advanced into the exposed crawl space soil from surface grade to approximately two (2) feet bsg with hand tools utilizing 1.5 inch probe rods. The soil vapor point was constructed of six (6) inches of 0.25 inch inside diameter 0.15 mm pore stainless steel screen connected to 0.25 inch inside diameter solid polyethylene tubing extending to approximately six (6) inches above surface grade. Six (6)-mil polyethylene sheeting was placed over the ground to ensure a proper seal from the atmosphere. A five (5) gallon plastic container was placed on top of the sheeting and above the vapor point. The container was then sealed to the sheeting utilizing modeling clay. The tubing was then connected to a clean-certified, 6-liter SUMMA® canister, provided by York, through a flow controller pre-set for an eight (8) hour long sample duration as per TO-15 sampling protocol. The tubing include a tee connection and valve to a purging vacuum pump calibrated for a flow rate of less than 0.2 liters per minute. The tubing, probe and crawl space soil was purged of at least one (1) liter of vapor prior to the start of sample collection. Upon completion of the sampling, the vapor point was removed and the area returned to pre-sampling condition.

- Helium (He) was introduced into the atmosphere under the pail, as a tracer gas, to assure the viability of the vapor point seals with the atmosphere. The tracer gas was monitored in the purge air before sampling and outside of all seals before, during and after sampling, utilizing a Myron

Helium Detector. In addition, Helium (He) was analyzed for in the SUMMA® canister and if detected at more than ten (10) percent, the sample would be considered invalid and retaken.

- On March 28, 2016, one (1) crawl space vapor sample was collected.

Section No. 3.4: Indoor Air Sample Collection

The following summarizes the manner in which indoor air samples were collected:

- Sample flow rates conformed to the specifications in the sample collection method (less than 0.2 liters per minute) and were consistent with the hours of operation of the school building. Samples were taken from areas where personnel and occupants would not interfere with the sampling. The samples were collected, utilizing conventional sampling methods, in laboratory clean-certified, 6-liter SUMMA® canisters, provided by York equipped with a flow controller pre-set for an eight (8) hour long sample duration. As per the guidance requirements, the samples were collected at a height approximately three (3) to four (4) feet above the floor to represent seated or breathing zone height.

Section No. 3.4.1: Crawl Space/Basement Air Sample Collection

Please refer to Figure No. 2 - Subsurface, Crawlspace and Basement Sample Locations for additional details.

- On March 28, 2016, a total of one (1) crawl space and one (1) basement indoor air samples were collected.

Section No. 3.4.2: 1st Floor Air Sample Collection

Please refer to Figure No. 3 - 1st Floor and Ambient Sample Locations for additional details.

- On March 28, 2016, one (1) first floor air sample was collected.

Section No. 3.5: Outdoor (Ambient) Air Sample Collection

- An outdoor (ambient) air sample was collected simultaneously with sub-slab, crawl space and indoor samples to evaluate the potential influence, if any, of outdoor air on indoor air quality. To obtain a representative sample which meets the data quality objectives, the outdoor air sample was collected in a manner consistent with that for indoor air samples. The sample was collected, utilizing conventional sampling methods, in a laboratory clean-certified, 6-liter SUMMA® canister, provided by York equipped with a flow controller pre-set for an eight (8) hour sample duration. Please refer to Figure No. 3 - 1st Floor and Ambient Sample Locations for additional details.

- On March 28, 2016, one (1) outdoor (ambient) air sample was collected from outside the north entrance of the school building.

- Weather: 45-50º F, occasional rain, light wind out of the east.

Section No. 3.6: Parking lot / Athletic Field Soil Vapor Sample Collection

The following summarizes the manner in which soil vapor samples were collected:

- For the collection of the parking lot and athletic field soil vapor samples, temporary soil vapor points were installed. The exterior soil vapor points were installed to a depth of eight (8) feet below surface grade (bsg) utilizing a truck-mounted Geoprobe® Model 5410 equipped with 1.5 inch probe rods. The soil vapor points were constructed of six (6) inches of 0.25 inch inside diameter 0.15 mm pore stainless steel screen connected to 0.25 inch inside diameter solid polyethylene tubing extending to approximately six (6) inches above surface grade. Six (6)-mil polyethylene sheeting was placed over the ground to ensure a proper seal from the atmosphere. A five (5) gallon plastic container was placed on top of the sheeting and above the vapor point. The container was then sealed to the sheeting utilizing modeling clay. The tubing was then connected to a clean-certified, 6-liter SUMMA® canister, provided York, through a flow controller pre-set for a two (2) hour long sample duration as per TO-15 sampling protocol. The tubing included a tee connection and valve to a purging vacuum pump calibrated for a flow rate of less than 0.2 liters per minute. The tubing, probe and subsurface soil was purged of at least one (1) liter of vapor prior to the start of sample collection. Upon completion of the sampling, the vapor point was removed and the area returned to pre-sampling condition.

- Helium (He) was introduced into the atmosphere under the pail, as a tracer gas, to assure the viability of the vapor point seals with the atmosphere. The tracer gas was monitored in the purge air before sampling and outside of all seals before, during and after sampling, utilizing a Myron Helium Detector. In addition, Helium (He) was analyzed for in the SUMMA® canister and if detected at more than ten (10) percent, the sample would be considered invalid and retaken.

- On March 28, 2016, two (2) soil vapor samples were collected.

    - One (1) soil vapor sample was collected from beneath the northwest side of the north parking lot.

    - One (1) soil vapor sample was collected from beneath the southwest side of the south baseball field.

- Weather: 45-50º F, occasional rain, light wind out of the east.

Section No. 4.0: Laboratory Analytical Summary

The air samples were collected into laboratory supplied, clean-certified, 6-liter SUMMA® canisters, and assigned individual identification numbers. Chain of custody documents were prepared and the samples were then delivered to an independent New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified laboratory for analysis.

York Analytical Laboratories, Inc. provided laboratory analytical services. Copies of York's NYSDOH certifications are available upon request.

Air samples submitted for laboratory analysis were analyzed for Volatile Organic Compounds (VOCs) utilizing the Environmental Protection Agency Toxic Organics 15 (EPA TO-15) list.

The laboratory analysis results for the air samples collected were reviewed and compared to the 90th percentile as listed in Table C1 NYSDOH 2003 Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes of the NYSDOH's "Final NYSDOH CEH BEEI Soil Vapor Intrusion Guidance" dated October 2006 and utilizing all applicable updated and amendments.

The following table summarizes the Air Sampling Analytical Results of All Compounds.

Table No. 1: Volatile Vapor Intrusion Analytical Results of Detected Compounds via EPA Method TO-15									
Client Sample ID	**Background Values**	**Parking Lot Soil Vapor 1**	**Field Soil Vapor 2**	**Outdoor Ambient**	**First Floor Lobby**	**Crawlspace Air Sample**	**Crawlspace Soil Vapor**	**Basement Air Sample**	**Sub-slab Soil Vapo**
TO-15 List	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
1,1,1,2-Tetrachloroethane	NA	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane (TCA)	3.1	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorotrifluoroethane (Freon 113)	1.8	94	ND	1.4	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	<0.25	34	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethylene	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	3.4	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	9.5	11	ND	ND	ND	ND	16	ND	18
1,2-Dibromoethane	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	0.72	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	< 0.25	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorotetrafluoroethane	0.52	ND	ND	ND	ND	ND	ND	ND	ND
1,3,5-Trimethylbenzene	3.6	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Butadiene	NA	51	17	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	0.60	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	NA	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	1.3	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dioxane	NA	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	16	600	500	1.7	0.79	0.69	990	2.9	770
2-Hexanone	NA	ND	ND	ND	ND	ND	ND	ND	ND
3-Chloropropene	NA	ND	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone (MIBK)	2.2	ND	ND	ND	0.61	ND	ND	ND	ND
Acetone	110	1,100	790	6.0	8.7	6.3	2,800	12	1,500
Acrylonitrile	NA	ND	ND	ND	ND	ND	ND	ND	ND
Benzene	15	7.9	ND	0.45	0.47	0.48	ND	0.61	12
Benzyl chloride	NA	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	NA	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	NA	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	0.60	ND	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	NA	ND	ND	ND	ND	ND	ND	ND	ND

Table No. 1:
Volatile Vapor Intrusion Analytical Results of Detected Compounds via EPA Method TO-15

Client Sample ID	Background Values	Parking Lot Soil Vapor 1	Field Soil Vapor 2	Outdoor Ambient	First Floor Lobby	Crawlspace Air Sample	Crawlspace Soil Vapor	Basement Air Sample	Sub-slab Soil Vapo
TO-15 List	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
Carbon Tetrachloride	0.81	ND	ND	0.38	ND	ND	ND	ND	ND
Chlorobenzene	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	< 0.25	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	1.4	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	3.3	ND	ND	1.9	2.0	1.9	ND	2.0	ND
Cis-1,2-Dichloroethylene	<0.25	15	ND	ND	ND	ND	ND	ND	ND
Cis-1,3-Dichloropropylene	<0.25	ND	ND	ND	ND	ND	ND	ND	ND
Cyclohexane	8.1	ND	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	NA	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane (Freon 12)	15	ND	ND	2.1	1.8	2.7	ND	1.9	ND
Ethyl Acetate	NA	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl Benzene	7.4	12	ND	ND	ND	ND	13	ND	15
Hexachlorobutadiene	4.6	ND	ND	ND	ND	ND	ND	ND	ND
Isopropanol	NA	ND	ND	ND	13	4.7	ND	ND	ND
Methyl Methacrylate	0.45	ND	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether (MTBE)	27	ND	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	22	ND	ND	1.9	2.5	3.5	ND	ND	ND
n-Heptane	19	ND	ND	ND	ND	ND	ND	0.46	ND
n-Hexane	18	30	10	ND	0.73	1.2	47	0.59	18
o-Xylene	7.6	12	9.9	ND	ND	ND	14	ND	16
p- & m- Xylenes	12	44	33	ND	ND	ND	48	ND	53
p-Ethyltoluene	NA	ND	ND	ND	ND	ND	13	ND	14
Propylene	NA	270	91	0.74	0.61	0.82	ND	0.67	ND
Styrene	1.3	ND	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethylene (PCE)	2.9	39	14	1.0	ND	0.89	ND	0.91	64
Tetrahydrofuran	3.3	2,700	3,100	**5.4**	ND	ND	6,000	**15**	4,700
Toluene	58	1,400	980	1.6	0.67	0.91	1,700	4.9	1,600
Trans-1,2-Dichloroethylene	NA	ND	ND	ND	ND	ND	ND	ND	ND
Trans-1,3-Dichloropropylene	NA	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene (TCE)	0.48	ND	ND	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane (Freon 11)	17	22	ND	3.0	1.6	7.7	ND	1.6	21
Vinyl acetate	NA	ND	ND	ND	ND	ND	ND	ND	ND

Table No. 1:
Volatile Vapor Intrusion Analytical Results of Detected Compounds via EPA Method TO-15

Client Sample ID	Background Values	Parking Lot Soil Vapor 1	Field Soil Vapor 2	Outdoor Ambient	First Floor Lobby	Crawlspace Air Sample	Crawlspace Soil Vapor	Basement Air Sample	Sub-slab Soil Vapo
TO-15 List	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**	**µg/m³**
Vinyl bromide	NA	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	<0.25	ND	ND	ND	ND	ND	ND	ND	ND

Notes: µg/m³ = parts per billion NA = Background Value Not Established
ND=Not Detected above the laboratory minimum detection limit
Background Values = NYSDOH 2003 Study of Volatile Organic Compounds in Air of Fuel Oil Heated Homes 90th Percentile
[1] The State of New York does not have any standards, criteria, or guidance values for concentrations of volatile chemicals in subsurface vapors
BOLD Indicates Result Above Background Value

Section No. 5.0: Decision Matrices

Decision matrices are risk management tools developed by the NYSDOH to provide guidance on a cases-by-case basis about actions that should be taken to address current and potential exposures related to soil vapor intrusion. The matrices are intended to be used when evaluating the results from buildings with full slab foundations. Due to the presence of polyethylene sheeting covering the crawlspace sand, the structure was deemed to contain a full slab for the purpose of this investigation.

The NYSDOH has currently developed two (2) matrices to use as tools in making decisions when soil vapor may be entering buildings. JCB implemented the matrices and the following table summarizes the results:

Table No. 2:
Volatile Chemicals Utilized in NYSDOH Decision Matrices

Compound	Soil Vapor/Indoor Air Decision Matrix	Result
1,1,1-Trichloroethane (TCA)	Matrix 2	No Further Action
Carbon Tetrachloride	Matrix 1	No Further Action
Tetrachloroethene (PCE)	Matrix 2	No Further Action
Trichloroethene (TCE)	Matrix 1	No Further Action
1,1-Dichloroethene	Matrix 2	No Further Action
Cis-1,2-Dichloroethene	Matrix 2	No Further Action
Vinyl Chloride	Matrix 1	No Further Action

Notes: Only seven (7) chemicals have been assigned to decision matrices by the NYSDOH to date.

The results of the matrices indicate that "No Further Action" is acceptable for all compounds under the decision matrices (1,1,1-Trichloroethane, Carbon Tetrachloride, Tetrachloroethene, Trichloroethene, 1,1-Dichloroethene, cis-1,2-Dichloroethene, and Vinyl Chloride).

Section No. 6.0: Quality Assurance and Quality Control (QA/QC) Procedures

- In order to prevent cross-contamination between sampling locations, all re-usable sampling equipment which came into contact with sample materials was decontaminated prior to each use. Equipment used for sample collection was wiped clean, washed in a solution of Alconox and thoroughly rinsed with potable water. New and dedicated polyethylene tubing was used for collection of each subsurface sample. All sampling personnel wore disposable latex, nylon, or nitrile gloves during sampling events. At a minimum, gloves were changed between locations and before each laboratory sample was collected.

- The field sampling team maintained sampling log sheets summarizing the following:

  - Sample identification;
  - Canister ID Number;
  - Regulator ID Number;
  - Date and time of sample collection;
  - Sampling height;
  - Sampling methods and devices;
  - The volume of air sampled;
  - The vacuum of canisters before and after sample collection;

- Chain of custody protocols and records used to track samples from sampling point to analysis.

- Subsequent to sample collection, the Summa® canisters were labeled with the sampling location, time, and samplers initials.

Section No. 7.0: Findings

Based upon the review of the laboratory analysis results all detectable concentrations observed were reported well below published Occupational Safety and Health Organization (OSHA) guidelines as reported in Table Z-1: Limits for Air Contaminants of 29CFR 1910.1000.

However, the results of the laboratory analysis did reveal one (1) parameter, Tetrahydrofuran, observed in the basement of the building above the background value as reported in Table C1 NYSDOH 2003 Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes of the NYSDOH's "Final NYSDOH CEH BEEI Soil Vapor Intrusion Guidance" dated October 2006 and utilizing all applicable updated and amendments.

Analysis of the NYSDOH Soil Vapor/Indoor Air Matrix 1 and Air Matrix 2 indicated, "No Further Action" as the recommendation for all three (3) interior air samples involved in the study.

Section No. 8.0: Conclusions

A careful evaluation of the indoor air sampling results compared to the subsurface and ambient results did not reveal the presence of a discernible pattern suggesting that the building could be impacted with volatile vapor intrusion from the BCP site.

The concentrations detected in the indoor air sample within the basement is likely due to indoor/outdoor sources rather than soil vapor intrusion given the lack of detection of Tetrahydofuran in the crawlspace vapor sample.

Section No. 9.0: Recommendations

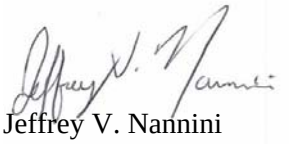
Although the basement is considered an unoccupied space is also recommended that an investigation be performed to identify any possible sources of Tetrahydofuran associated with building operations. Steps should be taken to reduce the presence of any possible contaminates such as, keeping containers tightly capped or storing VOC containing products in ventilated areas.

It is recommended that periodic VVI sampling be performed to monitor site conditions.

Section No. 10.0: Certification

I certify that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the New York State Department of Health (NYSDOH) "Guidance for Evaluating Soil Vapor Intrusion in the State of New York", Final Version, October 2006 and utilizing all applicable updated and amendments, and that all activities were performed in full accordance with the work plan.

Sincerely,
J.C. Broderick & Associates, Inc.



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