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2018 Corrective Action Implementation Summary Report and 2019 Work Plan
The Dow Chemical Company
Midland Plant
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ΔP	differential pressure
%	percent
μg/kg	microgram per kilogram
μg/L	microgram per Liter
$\mu g/m^3$	microgram per cubic meter
<	less than
>	greater than
≥	greater than or equal to
α or AF	attenuation factor
AAC	acceptable air concentration
AC	air conditioning
ACH	air changes per hour
AOC	area of concern
AOI	analyte of interest
BEA	Baseline Environmental Assessment
bgs	below ground surface
CAIP	Corrective Action Implementation Summary Report and Work Plan
CAS	Chemical Abstracts Service
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
cfs	cubic feet per second
cm/sec	centimeter per second
CMI	Corrective Measures Implementation
COC	constituent of concern
COI	constituent of interest
CRREL	Cold Regions Research and Engineering Laboratory
CSM	conceptual site model
CV	coefficient of variation
DC	direct contact
DCB	dichlorobenzene
DCC	direct contact criteria
DCE	dichloroethene
DEQ	Department of Environmental Quality
DNAPL	dense non-aqueous phase liquid
DOS	Dow On-Site
DU	decision unit
EI	Environmental Indicator
EAC	Environmental Analytical Chemistry
EarthCon	EarthCon Consultants, Inc.
EBS	Expedited Building Summary
ECD	electron capture detector
EDB	1,2-dibromoethane

EDC	dichloroethane
EPA	U.S. Environmental Protection Agency
ERDC	Engineer Research and Development Center
EVO	Environmental Operations
EVS	Enterprise Venture Corporation
FID	flame ionization detector
ft	foot, feet
ft^2	square feet
ft/ft	feet per foot
ft/day	feet per day
g	gram
GCL	geosynthetic clay liner
GIS	geographic information system
gpm	gallons per minute
GPS	global positioning system
GSI	groundwater-surface water
HCB	hexachlorobutadiene
HDPE	high-density polyethylene
HPT	hydraulic profiling tool
HSWA	hazardous and solid waste amendment
HVAC	heating, ventilation, and air conditioning
IA	indoor air
ID	Identification
IH	Industrial Hygiene
IM	interim measure
IRA	Interim Response Action
ISGS	in-situ (bio)geochemical stabilization
ISM	incremental sampling methodology
ITRC	Interstate Technology and Regulatory Council
kg	kilogram
L	liter
LEL	lower explosive limit
LTM	long-term monitoring
m^2	square meter
MBS	Midland, Bay City, and Saginaw International Airport
MCL	maximum contaminant level
MDEQ	Michigan Department of Environmental Quality
MDL	method detection limit
MDNR	Michigan Department of Natural Resources
MEK	methyl-ethyl ketone
MiHPT	membrane hydraulic profiling tool
MiOps	Michigan Operations
MIP	membrane interface probe
mg/kg	milligram per kilogram
MIBK	methyl isobutyl ketone

MIOSHA	Michigan Occupational Safety and Health Administration
mL	milliliter
mm	millimeter
NA	not applicable
NAPL	non-aqueous phase liquid
NAVD	North American Vertical Datum
NAVFAC	Naval Facilities Engineering Command
NC	not calculated
ND	non-detect
NEP	Northeast Perimeter
ng/kg	nanogram per kilogram
NPDES	National Pollutant Discharge Elimination System
OA	outdoor air
OEL	occupational exposure limit
O&M	operation and maintenance
OSHA	Occupational Safety & Health Administration
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCOI	potential contaminant of interest
PFOA	perfluorooctanoic acid
PFOS	perfluorooctane sulfonic acid
PID	photoionization detector
PLF	Poseyville Landfill
PMP	Pollution Minimization Program
ppbv	parts per billion by volume
PPE	personal protective equipment
ppm	parts per million
ppmv	parts per million by volume
ppt	parts per thousand
PVC	polyvinyl chloride
RAP	Remedial Action Plan
RCRA	Resource Conservation and Recovery Act
RGIS	Revetment Groundwater Interception System
RFI	RCRA Facility Investigation
RIASL	Recommended Interim Action Screening Levels
RL	reporting limit
RPD	relative percent difference
RSL	regional screening level
RPF	relative potency factor
SAP	Sampling and Analysis Plan
SDF	Sludge Dewatering Facility
SG	soil gas
SL	screening level
SS	sub-slab

SVOC	semivolatile organic compound
SWL	static water level
SWMU	solid waste management unit
TAL	target analyte list
TCB	trichlorobenzene
TCDD	tetrachlorodibenzo-p-dioxin
TCE	trichloroethene
TEC	toxicity equivalent concentration
TEQ	toxic equivalent
TOC	top of casing
TSRIASL	Time-Sensitive Recommended Interim Action Screening Levels
TTCC	Truck Traffic Control Center
USGS	United States Geological Survey
VI	vapor intrusion
VSIC	Volatile Soil Inhalation Criteria
VOC	volatile organic compound
WMU	waste management unit
WWTP	Wastewater Treatment Plant
XSD	halogen-specific detector

EXECUTIVE SUMMARY

This 2018 Annual Corrective Action Implementation Summary Report and 2019 Work Plan is being submitted to summarize the Corrective Action activities that were completed in 2018 and those activities that are planned for 2019, in accordance with the Condition XI.R of the Operating License issued September 25, 2015. Dow intends to achieve the following goals during the current license period (2015-2025):

- Maintain status as "under control" for the Migration of Contaminated Groundwater Environmental Indicator (EI) through on-going operation and maintenance of remediation systems.
- Reach "under control" status for the Human Exposures EI for the Midland Plant.
- By 2025, define and implement remedy as required at areas of concern (AOCs) located along the Midland Plant perimeter not contained by the Revetment Groundwater Interception System (RGIS) including the Former Ash Pond, Overlook Park/Brine Well 13S, Chemical Disposal Well 3, Northeast Perimeter (NEP), Former Diesel Tank Farm, Pure Oil, US-10 Tank Farm and Brine Spill Sites 4M, 32S, and 6 Pond Purge Wells.
- Implement additional Source Control measures where mobile free phase liquids are identified, with priority given to those areas with potential to impact human health and the environment beyond the source area.

In order to achieve these goals, Dow has prioritized corrective action activities, implemented planning, and sampling and remedies in 2018, and has identified the next activities as described in this 2018 Summary Report and Work Plan for 2019.

Sections 1.0 and 2.0 provide introduction and background information. The specific sections of the Work Plan listed below will describe the 2018 priority corrective actions implemented and/or the work planned for 2019:

- Section 3.0 Revetment Groundwater Interception System
- Section 4.0 Midland Plant Facility-Wide Direct Contact to Soil Pathway
- Section 5.0 Midland Plant Facility-Wide Vapor Intrusion Pathway
- Section 6.0 On-Site Outdoor Air Pathway
- Section 7.0 Sludge Dewatering Facility
- Section 8.0 7th Street Purge Wells Area (Fuel Oil Tank Farm)
- Section 9.0 Poseyville Landfill
- Section 10.0 Northeast Perimeter
- Section 11.0 Mark Putnam Road AOC
- Section 12.0 Chemical Disposal Well 3
- Section 13.0 Ash Pond AOC
- Section 14.0 B-Sewer Manhole B108 Area AOC

Investigation activities at Poseyville Landfill (PLF), and Sludge Dewatering Facility (SDF) completed during 2018 support the long-term site goal to maintain the EI status of “under control” for the migration of contaminated groundwater. The corrective actions for both the Direct Contact (DC) to Soil, Vapor Intrusion (VI), and On-Site Outdoor Air Pathways continue to work towards achieving an “under control” status for the Human Exposure EI.

Remediation plans developed for and implemented at the former Ash Pond AOC, 7th Street Purge Wells, Mark Putnam Road AOC, and NEP support the goal to define and implement remedy for AOCs at the Midland Plant perimeter. Continued operation of existing recovery systems and the field-scale pilot study planned for the B-Sewer Manhole B108 AOC will occur in 2019 to maintain source control measures where mobile free phase liquids are identified.

1.0 Introduction

Licensed hazardous waste management facilities are required to conduct corrective action as necessary to protect the public health, safety, welfare, and the environment for all releases of a contaminant from any waste management units (WMUs) at a facility, pursuant to Part 111. The purpose of the Part 111 Corrective Action Program is to address releases of hazardous wastes and hazardous constituents at hazardous waste management facilities in a timely manner. Corrective actions conducted pursuant to Part 111 are designed to be protective of human health and the environment both in the short-term and long-term. Short-term corrective action focuses on the implementation of interim actions to achieve stabilization and to control the source(s) of release to reduce or eliminate, to the extent practicable, further releases of hazardous waste or hazardous constituents that may pose a threat to human health or the environment. To be protective in the long-term, final remedies are designed and implemented to achieve media specific cleanup objectives, either through remediation and/or institutional controls, including identification (ID) of specific points of compliance and monitoring.

For the purposes of Part 111, corrective action applies to areas or units described as WMUs or areas of concern (AOCs). WMUs are defined as any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at the Midland Plant at which solid wastes have been routinely and systematically released. AOCs are areas where hazardous waste, hazardous constituents, or hazardous substances may have been released to the environment on a non-routine basis, which may present an unacceptable risk to public health, safety, welfare, or the environment, and are subject to the corrective action requirements of Part 111 of Act 451 and the remediation requirements of Part 201 of Act 451.

The Michigan Operations Midland Plant is a large industrial site located in Midland, Michigan with an operating history of over 115 years and multiple historical sources of contamination. The site location is identified in Figure 1-1. The entire Midland Plant is designated as a WMU and within the Midland Plant; there are a number of individual WMUs and AOCs. The locations of the WMUs and AOCs at the Midland Plant are shown in Figures 1-2 and 1-3, respectively. A summary of each unit/area is provided on the updated Summary of Actual or Potential Sources of Contamination (Table 1-1). At the Midland Plant, corrective action is performed in a phased approach that focuses on areas that represent the greatest short-term risk to human health and/or the environment, which is consistent with site corrective action objectives.

Corrective action at the Midland Plant focused on five main priorities:

- Site-Wide Containment;
- Worker Exposure Control Program;
- Monitored Natural Attenuation;
- Contaminant Mass Reduction; and
- Off-site Corrective Action.

The goal of these activities and programs has been to achieve stabilization of the WMUs, meet the Groundwater Contained EI, manage worker exposure, and address off-site releases. The next phase of corrective action emphasizes meeting the Human Exposure EI.

This 2018 Annual Corrective Action Implementation Summary Report and 2019 Work Plan (2018 CAIP) is being submitted to summarize the Corrective Action activities completed in 2018 and those that are planned for 2019, in accordance with the Condition XI.R of the Operating License issued September 25,

2015. The comprehensive schedule for the current license period (2015 to 2025) is summarized in the updated Corrective Action Implementation Plan High Level Overview (Figure 1-4).

2.0 Background

Dow intends to achieve the following goals during the license period:

- Maintain status as “under control” for the Migration of Contaminated Groundwater EI through on-going operation and maintenance (O&M) of remediation systems.
- Reach “under control” status for the Human Exposures EI for the Midland Plant.
- By 2025, define and implement remedy as required at AOCs located along the Midland Plant perimeter not contained by the Revetment Groundwater Interception System (RGIS) including, the Northeast Perimeter (NEP), US-10 Tank Farm, Former Diesel Tank Farm, Ash Pond, Chemical Disposal Well 3, Pure Oil, Overlook Park and Brine Spill Site 13S, and Brine Spill Sites 4M, 32S and 6 Pond Purge Wells.
- Implement additional Source Control measures where mobile free phase liquids are identified, with priority given to those areas with potential to impact human health and the environment beyond the source area.

Each of the goals is discussed further below.

2.1 Sustain Control of Contaminated Groundwater

To maintain the status as “under control” for the Migration of Contaminated Groundwater EI, corrective action includes activities such as maintaining RGIS and other corrective action systems, completing system upgrades as necessary, monitoring groundwater, investigation and other remedial actions to address increasing trends in contaminants or indicator parameters identified during environmental monitoring. Based on age, design, and current operating conditions, a project to upgrade the RGIS from Lift Station #4 to Lift Station #5 is planned for future construction and discussed in Section 3.0.

Additional investigation was conducted in the northwestern portion of the closed Sludge Dewatering Facility (SDF) during 2018, within and adjacent to Cell 1. Engineering and operational evaluations of these systems are on-going and discussed in Section 7.0.

Work also continued at Poseyville Landfill (PLF) to contain contaminated groundwater. In 2018, approximately 2,300 feet (ft) of the leachate collection tile system was upgraded in the southern portion of the landfill. It is anticipated that construction activities for this southern perimeter upgrade will be completd in early 2019. The Purge Well Pilot Optimization study also continued in 2019 to better manage the plume in the northeast corner of the landfill. Greater detail regarding work at PLF is provided in Section 9.0. At locations where engineering controls are not in place, such as NEP and Chemical Disposal Well 3, additional corrective actions may be required to stabilize migration of contaminated groundwater or demonstrate that the area of contamination is not expanding.

2.2 Achieve Control of Human Exposures

As part of the License Reapplication, Dow completed the Resource Conservation and Recovery Act (RCRA) EIs for Human Health for the Midland Facility. Based on the conclusions of the EI, the following exposure pathways warrant further evaluation to achieve “under control” status under the EI:

- Soil Direct Contact (DC);
- Indoor Air; and
- On-Site Outdoor Air.

The conclusions of the EI found that soils (surface and subsurface soils) were known to be contaminated above appropriately protective risk-based levels. The EI conclusions indicated that it was unknown whether or not indoor air due to vapor intrusion (VI) was contaminated above appropriately protective risk-based levels. Based on the ongoing ambient air monitoring program, no significant impact has been identified at the facility; however, Dow will continue to evaluate the ambient air pathway (on-site outdoor air) as data is collected for the DC and VI assessments.

The following subsections present further discussion on the soil DC, indoor air and on-site outdoor air exposure pathways and an overview of how Dow plans to achieve "under control" status for each of these medium.

2.2.1 Soil Direct Contact

Surface soil (< 2 ft deep) contamination is generally present throughout the Facility as a result of historical releases from former combustion units and manufacturing units and largely contains persistent compounds with low solubility that are strongly sorbed to soil particles. Subsurface soil (> 2 ft deep) contamination is generally present throughout the Facility as a result of historical releases from manufacturing or WMUs and may also include volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and metals, in addition to the persistent compounds also found in surface soil.

The soil DC pathway includes exposure via long-term dermal contact with and ingestion of soils throughout the soil column, regardless of depth. For potential on-site receptors, this exposure pathway is complete. Aerial dispersion, wind-blown dust, and operations of the facility over time have yielded some detected soil concentrations near or at the surface that are greater than the soil DC non-residential generic criteria. Exposure to soils at depth is not reasonably expected to be significant since the exposure routes are managed by the required use of personal protective equipment (PPE) specified in the Worker Exposure Control Plan.

Dow has placed surface cover to prevent exposure via the DC pathway for surface soils (Figure 2-1). The covers include clean top soil and vegetation, gravel, and/or asphalt. In order to achieve "under control" status for the EI, Dow is evaluating the site in a phased approach and will continue to complete surface improvements in the remaining areas of the facility, as necessary. Section 4.0 summarizes the work that was completed in 2018 and presents the work that will be completed in 2019.

2.2.2 Indoor Air

Indoor air at the facility is primarily evaluated through the industrial hygiene (IH) program. The IH program evaluates and measures those analytes that are relevant for occupational industrial exposure; however, the specific potential influence of VI on the indoor air is not determined through the IH program. VI can occur from groundwater volatilization to indoor air and soil volatilization to indoor air. In order to achieve "under control" status for the EI, Dow is evaluating VI at the facility in a phased approach. Section 5.0 presents the work that was completed in 2018 and presents the work that will be completed in 2019.

The groundwater volatilization to indoor air exposure pathway addresses vapors emanating from groundwater that could move through the soil vadose zone and migrate to indoor air at the Midland Plant, and is only applicable to volatile compounds. The soil volatilization to indoor air exposure pathway addresses vapors that could move through the soil vadose zone and migrate to indoor air in buildings at the facility. This exposure pathway is potentially complete for on-site workers through the inhalation of vapors in indoor air of buildings where they work or routinely visit. On-site worker protection and compliance with Michigan Occupational Safety and Health Administration (MIOSHA) standards is monitored through plant specific IH monitoring programs.

2.2.3 On-Site Outdoor Air

In order to achieve "under control" status for the EI, Dow will maintain current ambient air and fugitive dust monitoring programs. The soil volatilization to ambient air and particulate soil inhalation pathways will be considered as relevant data is collected to support the DC pathway evaluation during this license period (2015-2025).

2.2.3.1 Soil Volatilization to Ambient Air

The soil volatilization to ambient air exposure pathway applies to all land uses where hazardous substance vapors may emit from soils to ambient air. The outdoor air at the facility is monitored by the Ambient Air Monitoring Program (Attachment 16 of the License). Dow will continue to monitor and review ambient air as part of future corrective action efforts (Appendix G of Attachment 19 of the License).

Construction workers can potentially encounter vapors when working with subsurface soils or in a trench scenario; however, exposure is not reasonably expected to be significant since the exposure routes are managed by the required use of PPE and air monitoring specified in the Worker Exposure Control Plan, Appendix C of Attachment 19 of the License.

2.2.3.2 Particulate Soil Inhalation

The particulate soil inhalation exposure pathway addresses the emission and dispersion of contaminated soil particles into the ambient air (inhalation of fugitive dust particles). Exhaust constituents from process vents, power generation, and thermal incineration processes may have deposited onto plant soils. During dry periods, these soils may have been disturbed by equipment or vehicles and blown by the wind, resulting in fugitive dust emissions.

Fugitive dust control has been in progress at the Midland Plant since 1986. Dow is currently required by the 2015 Operating License and its Renewable Operating Permit (Section 1, IX.5) to provide and regularly update an operating program to control fugitive dust sources or emissions. The current fugitive dust control program requires semi-annual review and updates. In addition, fugitive dust emissions from the facility are monitored for dioxin emissions on an ongoing basis along the plant perimeter pursuant to the "Soil Box Data Evaluation Plan," approved by Michigan Department of Environmental Quality (MDEQ) on September 25, 2015. Monitoring began in 2002 and continues to show the fugitive dust control program for the facility is effective.

In order to limit the generation of fugitive dust and particulates, Dow has placed surface cover on surface soil in certain areas of the facility. The covers include clean top soil and vegetation, gravel, and/or asphalt. Existing covers are managed and maintained. Based on current conditions, this pathway is likely to be adequately controlled.

2.3 Remedy Implementation for AOCs

By 2025, Dow intends to define and implement remedy as required at AOCs located along the Midland Plant perimeter not contained by the RGIS including, the Former Ash Pond, Overlook Park/Brine Well 13S, Chemical Disposal Well 3, NEP, 7th Street Purge Wells (Former Fuel Oil Tank Farm), Pure Oil, US-10 Tank Farm and Brine Spill Sites 4M, 32S and 6 Pond Purge Wells. Background information on each of these AOCs can be found in the 2016 Corrective Action Implementation Work Plan (12/30/2015).

During 2018, corrective actions were conducted at the following sites:

- SDF;
- NEP;

- PLF;
- Former Ash Pond;
- Chemical Disposal Well 3; and
- 7th Street Purge Wells (Former Fuel Oil Tank Farm).

Additional actions are planned during 2019 for these sites as well as:

- Mark Putnam AOC.

Work at the remaining AOCs will be completed according to the updated Corrective Action Implementation Plan High Level Overview (Figure 1-4).

2.4 Additional Source Control Measures for Mobile Free Phase Liquids

Dow has identified 17 areas of free product, consistent with the Compliance Schedule H-8 of the 2003 Operating License. In 2014, Dow installed a free-product recovery system in lower explosive limit (LEL) III. Since installation, approximately 28,689 gallons of free product were recovered through the end of September 2018. Manual recovery operations conducted at an additional location recovered approximately 10 gallons of dense non-aqueous phase liquid (DNAPL) in 2018.

During 2019, work will consist of on-going operation of the manual recovery and free product recovery system installed in LEL III. Additionally, in 2019 work will continue at the B-Sewer Manhole (MH) B108 AOC to stabilize the non-aqueous phase liquid (NAPL)-impacted area as further described in Section 14.0.

2.5 Priority Actions Completed in 2018

Dow completed the following priority activities during 2018:

<u>On-site Outdoor Air Pathway</u>

- Completed Soil Volatilization to Ambient Air evaluation for DC Zones 1, 2, and 3; and
- Completed Particulate Soil Inhalation evaluation for DC Zones 1, 2, and 3.

<u>SDF</u>

- Developed a conceptual site model (CSM) for Cell 1;
- Modeled intended pilot design in MODFLOW to demonstrate effectiveness;
- Obtained approval from Department of Environmental Quality (DEQ) for disturbance of the final cover at Cell 1 in order to construct the pilot; and
- Completed the installation of the pilot tile drain system at Cell 1.

DC to Soil Pathway

- Performed Interim Response Actions (IRAs) in DC Zones 1, 2, and 3 to address elevated concentrations of dioxins and furans;
- Conducted soil sampling of identified decision units (DUs) in Zone 3;
- Conducted replicate sampling for specific DUs and tested in triplicate using U.S. Environmental Protection Agency (EPA) Method 1613b; and
- Evaluated results and identified a path forward based on the results.

VI Pathway

- Defined areas of the facility for the phased approach and began work within Zone 3;
- Conducted building structure, use, and occupancy assessments to categorize structures in Zone 3;
- Performed building surveys for priority buildings identified for sampling (Categories 1 and 2) in Zone 3;
- Created a sampling plan for each priority building to be sampled in Zone 3;
- Conducted soil-gas, indoor air and outdoor air sampling at the Category 1 and 2 buildings within Zone 3 Phase 1;
- Conducted seasonal confirmation sampling for VI Path Forward Groups 2 and 4 buildings in Zones 1 and 2;
- Submitted the Revised VI Workplan; 2018 VI Rescreen; and Expedited Building Summaries for five buildings in August 2018; and
- Implemented interim actions at Zone 2 Phase 1 Building 941.

7th Street Purge Wells Area (Fuel Oil Tank Farm)

- Performed pilot shutdown of purge wells 5, 6, and 7;
- Conducted analysis of pilot purge well shutdown to demonstrate performance criteria; and
- Developed work plan to address groundwater-surface water (GSI) exceedances at MW-18.

Poseyville Landfill

- Conducted plume analytics to help provide a better understanding and delineation of the northeast plume;
- Modified pump rates in response to observed environmental conditions;
- Redeveloped Purge Wells 2690A and 2917 in Q3 2018;
- Began additional monitoring of wells 2549, 5924, and 5923 to support plume modeling;

- Began increased well monitoring program to ensure proper well conditions in 2690A and 2917; and
- Analyzed pump and chemical data to assist in optimization 2690A and 2917.

CD3

- Collected additional groundwater samples from both shallow and deep wells to assist in site characterization;
- Collected static water levels (SWLs) from wells and completed a topographic survey to evaluate off-site flow; and
- Completed slugs tests at four shallow well locations.

B-Sewer Manhole B108 Area

- Completed initial investigation including soil and groundwater sampling;
- Characterized DNAPL impacted source area;
- Conducted bench study to demonstrate Provect-GS® is effective in reducting hydraulic conductivity and encapsulating DNAPL; and
- Sumbitted Groundwater Discharge Permit Exemption Request to DEQ for approval to conduct field-scale pilot application.

Dow has prioritized the following corrective action activities for continued efforts to achieve the long-term goals described in this work plan for 2019. The following sections will describe the work conducted in 2018 and planned 2019 priority corrective actions that will be implemented, as well as the next planned upgrades to the RGIS:

- Section 3.0 Revetment Groundwater Interception System
- Section 4.0 Midland Plant Facility-Wide Direct Contact to Soil Pathway
- Section 5.0 Midland Plant Facility-Wide Vapor Intrusion Pathway
- Section 6.0 On-Site Outdoor Air Pathway
- Section 7.0 Sludge Dewatering Facility
- Section 8.0 7th Street Purge Wells Area (Fuel Oil Tank Farm)
- Section 9.0 Poseyville Landfill
- Section 10.0 Northeast Perimeter
- Section 11.0 Mark Putnam Road AOC
- Section 12.0 Chemical Disposal Well 3

- Section 13.0 Ash Pond AOC
- Section 14.0 B-Sewer Manhole B108 Area AOC

3.0 Revetment Groundwater Interception System

The RGIS was originally installed between 1980 and 1992 along the banks of the Tittabawassee River and around the Tertiary Pond in Midland Plant. Starting in 1994, sections of RGIS were upgraded to enhance performance and extend their operational life. The last upgrade was in 2016 and included tile replacement between LS#13 and MH3A as well as river bank capping from LS#102 through the area of tile replacement.

3.1 RGIS Upgrades

The next planned upgrade project is designated as the RGIS LS #104 to LS #105 Tile Upgrade Project (see Figure 3-1). Dow currently anticipates construction during 2020 and 2021; however, that is dependent upon other projects and the construction schedule may be adjusted.

Major tasks to support this work were completed in 2016 to support the design and planning of these construction activities including a hydrogeological soils investigation and chemical characterization of soils. Chemical characterization data was also collected and submitted in previous quarterly environmental reports. Soils were investigated by completing 10 geotechnical soil borings ranging in depth from 18 to 38 ft below ground surface (bgs). A field geologist identified the soils by logging with continuous split-spoon sampling. Soil boring logs were included in the *2017 Annual Corrective Action Implementation Summary Report and 2018 Work Plan* (2017 CAIP). Twenty-three soil samples were obtained using split-spoon liners and tested for index properties to establish ranges of key design parameters.

In general, all work will be performed in accordance with the detailed specifications that have been used and approved by the MDEQ on past RGIS upgrade projects, as well as Appendix A of Attachment 19 of the Operating License issued September 25, 2015.

The major scope items proposed for this project include:

- Installation of a new concrete sump/lift station to replace existing Lift Station #105;
- Installing just under 2,300 ft of new 8-inch diameter, SDR 21, perforated, high-density polyethylene (HDPE) pipe and drainage media;
- Constructing four new piezometer clusters, including automated primary piezometers;
- Installation of a composite cap and access roadway over the drainage media; and
- Use of a temporary gravel construction roadway outboard the existing sheet piling for access during construction.

Dow currently anticipates completing this work over two construction seasons. The first year will likely include installation of the new lift station and approximately 30% of the drainage media and perforated pipe, composite cap and relevant piezometer clusters. The second year of construction will complete the installation of the drainage media, composite cap and relevant piezometer clusters. At both the end of the first construction season and the end of the project, the site will be restored prior to the winter.

The Project Site is located along the Eastern bank of the Tittabawassee River, approximately 940 ft downstream of the Dow Dam in Section 28 of Midland Township (T14N, R2E), Michigan (Figure 3-1). The Site includes an approximately 2,277-foot (ft) excavation beginning roughly at existing LS #104 and extending southeast to new LS #105, being the new proposed downstream leg for LS #104 and upstream leg for LS #105. The site ranges in elevation from 595 to 598 ft (referenced to North American Vertical

Datum [NAVD] 29). This project will help prevent upland groundwater from migrating to the Tittabawassee River.

A new groundwater collection tile and permeable cutoff wall (french drain) will be installed by excavating an approximately 30-inch wide trench and installing filter stone (drainage media) and an 8-inch perforated HDPE collection pipe (tile). The upper portion of the trench will be backfilled with natural soils that were excavated and stockpiled from the trench. The natural soils backfill portion of the system will be isolated from the drainage media by a geosynthetic clay liner (GCL). Design drawings were previously included in the 2017 CAIP.

4.0 Midland Plant Facility-Wide Direct Contact to Soil Pathway

Dow completed the RCRA Corrective Action EI Form for Human Health as part of the License Reapplication. It was determined at that time, that in order to achieve an "under control" status for the EI for DC to surface soil, further evaluation was necessary. Soil DC is an exposure pathway that includes exposure via long-term dermal contact with and ingestion of soils throughout the soil column, regardless of depth. The focus of this on-site investigation is to evaluate the potential shallow surface soil DC exposure pathway for Dow employees and contractors.

The Dow Midland Facility is a 1,900-acre industrial facility. The facility's land use is non-residential and includes nearly 400 acres of industrial ponds. The surface cover at the site currently includes approximately 600 acres of buildings and pavement. Roughly 220 acres of the Midland Plant are vegetated final cover installed from 1980 to 1989 for closed WMUs. Nearly 70 acres of new topsoil and vegetative cover have been placed on areas of the plant as part of Phase I Enhanced Exposure Control activities and other greenbelt enhancements. An additional 100 acres of vegetative stormwater detention areas have been constructed from 2009 to 2011.

While significant work has been completed to date to improve surface cover at the Midland Plant, there are still areas that are eligible for assessment in order to determine if surface improvements are warranted. Approximately 430 acres, or just over 23 percent (%) of the Midland Plant area, includes gravel or grass-covered areas that have been included in the area to evaluate for the need for enhanced surface cover. In order to conduct this evaluation for the DC pathway, the site was split up into manageable areas, primarily referred to as Zones (Figure 4-1).

Ongoing efforts to address worker exposure to impacted soil on site at the Midland Plant are implemented under the on-site Worker Exposure Control Plan, Appendix C of Attachment 19 of the License. The objective of the Worker Exposure Control Plan is to describe the implementation of various interim measures (IMs) at the Midland Plant designed to address potential exposure pathways to on-site workers as part of final corrective action, in compliance with Part 111 of Michigan Public Act 451. The Worker Exposure Control Plan will continue to be updated and utilized.

The Surface Soil Exposure Control Program, a component of the Worker Exposure Control Plan, is designed to specifically address DC exposure to surface soils located at the Midland Plant. The goal of the Surface Soil Exposure Control Program and focus of on-going efforts is the elimination of unacceptable DC exposure to surface soils by 2020 in order to achieve "under control" status for DC with soils on the Midland Plant EI. The Surface Soil Exposure Control Program currently limits fugitive dust controls by street cleaning, applying dust suppressant to gravel roadways and appropriately managing soil stockpiles during excavations. DC management includes PPE and air monitoring requirements during excavation activities and specifies clean cover shall be placed over areas disturbed by excavation. In addition, the Worker Exposure Control Plan will be modified as appropriate in the future to include monitoring and O&M obligations related to maintenance of any surface cover.

Soils relocated within the Midland Plant and from areas of the Tittabawassee River Floodplain are managed in specific areas within the Midland Plant. A listing of these relevant soil relocation activities is provided in Tables 4-1 and 4-2.

4.1 Direct Contact Exposure Characterization

A CSM for DC to the on-site soil at the Midland facility is presented in Figure 4-2. This CSM identifies the potential soil exposure pathways and types of sources for the on-site properties. The initial step for each phase of this project is to determine the types of surface cover in the area to be evaluated and to identify the gravel or grass-covered areas that have not been assessed or recently covered during Dow's surface cover enhancements. In addition to determining the types of surface cover, an evaluation is performed considering historical use in each of the areas to be assessed, as well as the present use and maintenance required to evaluate the types of potential exposure that could occur (e.g., land use and

activities that occur on or near those areas). Figure 4-3 presents the Dow Midland Facility Direct Contact Category Flowchart. The flowchart categorizes and describes the property types present possible sources, exposure types, use (e.g., frequency of activity), and the path forward for sampling.

Exposure and current use are evaluated for each property type in the area to be assessed. Exposure categories include intermittent event-based exposure with regular use, limited exposure with regular to low frequency use, limited access with low frequency use, and limited access or no access with very low frequency use. The combination of property type, possible sources, exposure, and use led to the development of seven categories for DC sampling and evaluation at the Dow Midland Facility. These seven categories are presented in the Table 4-3 below. The recommended sampling density is also included in the table below.

Table 4-3: Direct Contact Land Use Categories

Category	Property Type	Sampling Density
1	Laydown Area, Gravel Areas (Historical Process Area)*	DC Sampling Proposed
2	Gravel Areas, Historic Grass Area, Campus Area, Greenbelt Prior to 2000	While Exposure is Limited, DC Sampling Proposed
3	Greenbelt 2000 – Present	Limited Confirmation Sampling Proposed
4	Relocated Soil Covered with Imported Topsoil	Limited Confirmation Sampling Proposed
5	Stormwater Basin	Limited Confirmation Sampling Proposed
6	Vegetated Cap, Closed by Dow	Limited Confirmation Sampling Proposed
7	Vegetated Cap Closed with MDEQ or EPA Oversight, Limited Access, Paved/Buildings/Process Areas	Limited Confirmation Sampling Proposed
N/A	Rail Yard and Electrical Substation	Defer and/or sample when possible

*Note: Gravel areas, such as parking lots, process areas, road shoulders, and vacant land that have a history of process operations based on review of historical aerials, are more prevalent in Zone 3 than laydown areas.

No sampling is proposed for areas with restricted access (limited to very infrequent maintenance, including the wastewater treatment tanks and dike areas), and areas where pavement or building footprint and slab areas under process areas impede exposure to soil via DC. The Rail Yard and Electrical Substation will be evaluated as individual, complete areas and are deferred to a later date. Access to each of these areas is limited by either train activity or fencing. Evaluating these areas will involve strict safety considerations.

4.2 Target Analyte Lists and Sampling Density

Four possible general sources of impacts were identified for the Midland Facility. These include aerial dispersion, imported soils, leachate breakout, and other sources (e.g., point source release, historic area operations). These sources of impacts were used to establish the target analyte lists (TALs) for the property types listed in Section 4.1 and are described in more detail below:

- Aerial dispersion includes areas potentially impacted by the historical aerial release.
- Imported soils are soils brought on-site as final cover for excavations or where site soils were relocated. Soils were imported from regional agricultural areas and may not have been tested when acquired.
- Leachate breakout determined from RGIS detections for vegetated landfill caps,

- Other sources (e.g. point source release and historic area operations) apply to the laydown areas. The laydown areas serve as storage for equipment that may be reused or demolished. These areas may also have seasonal construction projects and have activity preparing equipment for reuse or cutting for disposal.

The aerial dispersion TAL includes dioxins and furans and arsenic. All areas classified as Category 1 and 2 are sampled for this TAL. Areas classified as Categories 5 and 6 warrant limited confirmation sampling based on exposure and use; therefore, at least 20% of the area within these categories is sampled for the aerial dispersion TAL.

The TAL for imported soils includes metals, herbicides, and pesticides. Confirmation sampling for this TAL is proposed for areas covered by imported soils and sampling density was based on category. All areas classified as Category 3 are sampled for this TAL. Due to limited exposure and use, 50% of area classified as Category 4 is sampled and at least 20% of the area within Categories 5 and 6 are sampled for this TAL.

The leachate breakout TAL was determined based on RGIS detections. The TAL includes detected metals, herbicides, pesticides, SVOCs, VOCs, and dioxins and furans. Limited confirmation sampling for this TAL is proposed for those areas covered by landfill cap. Category 6 areas are sampled at a frequency of at least 20%.

The TAL for other sources was determined based on detections from the 2005-2006 Dow On-Site (DOS) sampling effort and the 2010-2015 Worker Exposure Control Program sampling efforts. The other sources TAL includes detected metals, herbicides, pesticides, SVOCs, VOCs, polychlorinated biphenyls (PCBs), and dioxins and furans. All Category 1 areas are sampled for this TAL. Due to limited exposure and use, Category 6 areas are sampled for this TAL at a frequency of at least 20%, and Category 7 areas are generally not sampled; however, specific areas found on vegetated caps closed with MDEQ or EPA Oversight and Limited Access have been sampled at the request of DEQ as detailed in Section 4.5.1.

Table 4-4 summarizes the possible sources of impacts, the determination and TALs for each source, and the applicable exposure category for each TAL.

Table 4-4: TAL for Direct Contact Sources

Source	TAL Analytes	TAL Determination	Applicable
Aerial Dispersion	Dioxins and furans and arsenic	Based on Midland Area Soils	Categories 1, 2, 5, 6
Imported Soils - Historical Agriculture	Metals, herbicides, pesticides	Analytes commonly detected in agricultural area soils	Categories 3, 4, 5, and 6
Leachate Breakout	Metals, herbicides, pesticides, SVOCs, VOCs, dioxins and furans	RGIS Leachate Detections	Category 6
Other Sources (e.g. relocated soils, imported soil, point sources)	Metals, herbicides, pesticides, SVOCs and VOCs, PCBs, dioxins and furans	E-1225 Detections, DOS Detections, Area history/Aerial Photo Evaluation, Chemicals used On-Site	Category 1, 6*, 7*

*Categories 6 and 7 do not include PCB analysis.

4.3 Sampling Methodology

Due to the anthropogenic deposition of the constituents of concern (COCs) within the sampling areas, a heterogeneous distribution throughout the DC sampling areas is likely. Studies have shown that sampling heterogeneous populations, with individual particles that are likely to have different concentrations of COCs through conventional sampling methods (e.g., discrete or standard composite

sampling) inadequately represent the average COC concentration of that population (EPA 2012; Engineer Research and Development Center [ERDC]/Cold Regions Research and Engineering Laboratory [CRREL] 2009; Jenkins et al. 2005). Therefore, an incremental sampling methodology (ISM) is employed throughout the DC sampling areas to provide a more unbiased and reproducible estimate of the mean concentrations of analytes in heterogeneous sample populations.

4.3.1 Incremental Sampling Methodology

ISM is a structured sampling and analytical methodology developed to address the problems associated with collecting representative samples from volumes of particulate material with high compositional and distributional heterogeneity by identifying and minimizing types of sampling and analytical errors. Essentially, ISM is a more robust and ordered type of composite sampling that combines uniform, spatially representative grab samples or "increments" to produce a sample result for an area and depth of soil, or, that is representative of the average concentration of COC of that population sampled. ISM is also more appropriate than conventional discrete sampling for comparison with risk-based screening values and for evaluating concentrations relative to background concentrations.

ISM describes both the field sample collection and laboratory processing methods necessary to obtain samples that contain the COC in the same proportions as the sampled population. Some of the primary differences between ISM and conventional composite or grab sampling are as follows:

- The need to define the spatial boundaries of the DUs;
- A sample mass much larger than required by most analytical methods;
- The number of increments that will be collected in each sample;
- The spacing and distribution of the increments to be collected; and
- The laboratory preparation procedures (ERDC, 2013).

4.3.2 Decision Unit Determination

The evaluation of a zone/sub-zone is begun by overlaying a satellite aerial of the area to be evaluated with a 2-acre grid, which represents a non-residential DU. Each of the grids are evaluated for property type and current/historical use. Using this aerial/grid map together with the flowchart presented on Figure 4-2, a rationale is developed for whether or not sampling is proposed for each grid. If sampling is not proposed, justification for no sampling is documented. For example, areas that are covered by pavement, buildings, or process areas are not proposed for DC sampling. DUs are then delineated throughout the target sampling areas based on site characteristics and historical land use. DUs range from less than 1 acre up to approximately 2 acres. A small percentage of DUs may slightly exceed 2 acres. However, these larger DUs are not further divided due to the site-specific conditions such as the contiguous nature of the land and/or common past and present land use. In each DU, 10-30 increments are collected, dependent on the acreage of the DU:

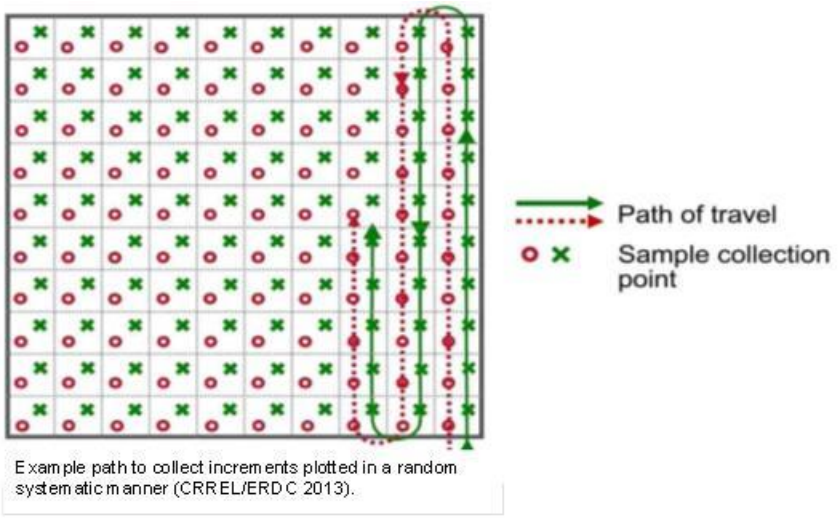
- DUs less than 0.5-acre contained 10 increment sampling locations;
- DUs greater than 0.5-acre and less than 1 acre contained 20 increment sampling locations; and/or
- DUs greater than 1 acre contained 30 increment sampling locations.

Increment locations are generated using a systematic random sampling approach. The increments were laid out by selecting a random starting point and generating evenly spaced increments based on that starting point using a geographic information system (GIS) program for each DU.

4.3.3 Sample Collection

Maps and global positioning system (GPS) units containing the increment locations within each DU are provided to each sampling team for sample collection. Field teams either first mark all increment locations with a flag prior to collection or work as a team to navigate up and down the rows of sample locations collecting the increments and tracking collection via the GPS device (see Figure 4-4 below).

Figure 4-4: Example Incremental Collection Plot



Ideally, each increment serves as an equivalent portion of the overall sample, which represents the DU as a whole. The ability to take uniform increments at a consistent depth, each representative of a portion of the sample and contributing equally to a representative sample of the entire DU, is greatly dependent on the sampling tool and proper sampling methods.

Generally, increments in most DUs, for all analyses except VOCs, are collected using stainless steel push samplers or Enterprise Venture Corporation (EVS) Incremental Sampling tools in order to ensure that each increment was collected at the same depth and volume. Each increment is collected using a 1-inch diameter coring device to a depth of 6 inches bgs. Once an increment is collected in the device, it is extruded into a bucket lined with a 3 millimeter (mm)-thick 24-inch x 30-inch zip-close plastic bag to create a resulting composite sample with a target mass of between 1 to 3 kilograms (kg).

In areas where the stainless steel push samplers/EVS Incremental Sampling tools cannot advance to the desired depth, such as in heavily compacted gravel areas, an AMS gas-powered core sampler is used. This sampling device consists of a portable gas-powered hammer and hollow stainless steel drive rods capable of driving a 1.5-inch diameter polyvinyl chloride (PVC) liner equipped with a PVC soil catcher to collect a sample. Each increment is collected by driving the rods to a depth of 6 inches bgs. Once an increment is collected (or multiple increments as the PVC liner is capable of collecting up to four increments prior to its contents needing to be extruded), it is extruded into a bucket to result in a composite sample in the same manner as the stainless steel push samplers/EVS incremental sampling tools

For DUs with non-volatile COCs being sent to different laboratories for analyses field replicates are collected for each laboratory so that the entire sample mass is sent to each laboratory for analysis and

errors due to splitting samples would be eliminated. Two increment cores are collected approximately 6-12 inches apart and each core went into a different bucket. A 12-inch x 12-inch custom made PVC grid is used to ensure that replicates are collected in the same manner with respect to the primary increment sample location. At each primary increment collection location, the corner of the marked corner of the PVC grid marker is lined up with the increment collection location identified on the GPS. Then an increment is collected from approximately the center of each cell in the grid as necessary to create field replicates. Increment collection is not biased to avoid vegetation. However, vegetation is not included in the analysis of the soil sample. Vegetation included with the collection of the increment remains with the sample until processing either by the field team prior to delivery to the laboratory for the dioxins/furans analyses or by the laboratory for all other analyses.

As VOCs can be quickly lost from an exposed surface additional measures are employed in order to collect a representative sample for DUs that include VOCs on their TAL (Interstate Technology and Regulatory Council [ITRC] 2012; Hewitt, Jenkins, and Grant 1995). For samples collected for VOC analysis, individual increments are collected as 5-gram (g) plugs at the desired core depth and immediately preserved in methanol. A Terra Core® is used to collect a 5-g aliquot from approximately 3 inches bgs from the side of the augered hole and then is extruded into a 1-liter (L) amber jug containing 150 milliliters (mL) of methanol for field preservation.

Each composite sample is assigned a unique sample ID number, which includes the DU designation. Each DU also has a unique ID that corresponds to its category and TAL.

4.3.4 Field Documentation

Each field team is provided with a detailed daily assignment log of sampling units and samples to be collected within each sampling unit. Each field team is responsible for supplying the required information on the form upon sample collection. The sample form includes time of sample collection, date of sample collection, any unusual field conditions or mechanical issues encountered and initial each sample collection line item to verify the entry. At the end of each field day, the Field Team Leader collected all team logs and conducted a quality control check of all samples delivered from the daily activities.

4.3.5 Equipment Decontamination

Solid materials samplers and soil processing equipment, including stainless steel sieves and bowls, are decontaminated according to the following procedures:

A. Scrub the equipment to remove visible contamination, using appropriate brush(es), approved water, and non-phosphate laboratory detergent.

B. Rinse with tap water.

C. Rinse with solvent (acetone).

D. Rinse with deionized water.

E. Allow equipment to air dry or wipe dry with paper towels prior to reuse.

All cleaned sampling equipment is stored in a clean environment and covered in aluminum foil or clean plastic sheeting for protection between uses. All decontamination solutions are properly disposed of according to Dow site policies.

4.3.6 Sample Processing and Laboratory Analysis

Collected samples are brought back to a clean designated workspace for further processing or to be packaged directly for shipment to the laboratory. Soils collected for dioxin/furan analyses are sieved

through a 2 mm (US Standard #10 mesh) sieve prior to delivery to the Dow Environmental Analytical Chemistry (EAC) lab. During sieving, any vegetation in the composite sample is broken in smaller pieces to release any trapped soil particles and is subsequently extracted from the soil sample; therefore, vegetation is not part of the sieved subsample extracted for analysis. Once the soils for dioxin/furan analysis are sieved, all samples are packed for immediate delivery to the Dow EAC laboratory. Sieved samples are double bagged into Ziploc bags and are labeled in accordance with sample labeling procedures. For soils collected for all other analysis, excluding VOCs, the soils are doubly rebagged in Ziploc bags and labeled in accordance with sample labeling procedures. Soil samples collected for VOC analysis are field-preserved as described in Section 4.3.3.

Samples are then placed in coolers with chain-of-custody forms and are immediately shipped or hand-delivered using standard chain-of-custody procedures. Environmental soil samples are analyzed for the TALs for each category listed in Section 4.2. The table below shows which laboratories and which analyses are used for each analyte or analyte group.

Upon receipt, laboratories then air dry each composite sample, disaggregate the entire volume using rotary hammers, and sieve the resultant matrix. Once the samples are dried and sieved, a statistical subsampling procedure is performed to sub-aliquot sample volume for use in the analyses. Moisture samples for field preserved VOC samples are removed from the ISM samples prior to any drying.

Soil samples collected for VOC analysis are field-preserved as described in Section 4.3.3 and are prepped for analysis upon receipt by the lab in accordance with U.S. EPA Method 5035. Table 4-5 lists the laboratories and methods below.

Table 4-5: Laboratories and Methods Used to Analyze for Target Analytes

Analyte/Analyte Group	Laboratory	Method
Dioxins/Furans	Dow EAC Laboratory	Midland Fast Analysis
Metals	TestAmerica Canton	EPA 6010B
Chromium	TestAmerica Canton	EPA 7196A
Mercury	TestAmerica Canton	EPA 7471A
Herbicides	TestAmerica Canton	EPA 8151A
Pesticides	TestAmerica Canton	EPA 8081A
Semi-volatiles	TestAmerica Canton	EPA 8270C
Volatiles	TestAmerica Canton	EPA 8260C
Arochlors	TestAmerica Canton	EPA 8082A

4.4 Statistical Evaluation and Screening of Data

Basic summary statistics are prepared for the soil results from DUs located in the same geographic zone/sub-zone and/or sampling event. These tables include common statistical parameters such as mean, standard deviation, minimum and maximum detected values, and minimum and maximum reporting limits (RLs) of non-detects (NDs). The number of samples and detection rates are also included to provide information regarding sample size and detection frequency. Additionally, these summary statistic tables present the results of the screening comparison to relevant criteria.

A screening-level evaluation of the data is performed by comparing each data point to non-residential DC criteria (DCC) for soil. MDEQ Part 201 December 30, 2013 non-residential DCC for soil are selected whenever available (MDEQ, 2013). EPA Regional Screening Levels (RSLs) for industrial soil are selected whenever MDEQ screening criteria are not available (document release date: May 2016) (EPA, 2016).

MDEQ State-wide default background values are used as an initial screen for metals, when available. MDEQ also developed and provided a regional background and modified urban background for some metals during the Midland Area Soil project, which are used as a secondary screen.

For the evaluation of analytes that exist in several isomer forms, the isomer-specific concentrations are summed before being compared to the appropriate screening criteria. These classes of analytes include chlordanes, endosulfans, methylphenols (cresols), polynuclear aromatic hydrocarbons (PAHs), PCBs, and xylenes and are summarized in Table 4-6 below:

Table 4-6: Summed Isomer Specific Analytes

Total Analyte	Isomer Analytes included in Total	If Sample Has A Total Result/Detection	If Sample Result Non-Detect
Chlordanes	Alpha-chlordane Gamma-chlordane	If Total result is available for the noted isomer analyte group, the total value is used.	If a sample result is not detected, one-half the RL is assumed in the total value
Endosulfans	Endosulfan I Endosulfan II Endosulfan sulfate		
Xylenes	m&p-Xylenes o-Xylene		
Endrins	Endrin Endrin aldehyde Endrin ketone		
Methylphenols	2- Methylphenol 3- Methylphenol 4-Methylphenol		
PAHs	The seven carcinogenic PAHs: Benzo(a)pyrene Benz(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene)	These PAHS are multiplied by their respective relative potency factor (RPF), and then summed to achieve the PAH total toxicity equivalent (TEQ) (EPA, 1993).The sample TEQ is compared to the non-residential DCC for benzo(a)pyrene to determine if the result exceeded the criteria.	
PCBs	PCB-1016 PCB-1221 PCB-1232 PCB-1242 PCB-1248 PCB-1254 PCB-1260 PCB-1268	For Total PCBs, based on Footnote (T) in the Part 201 December 2013 criteria, the non-residential screening value of 16,000 micrograms per kilogram (μg/kg) is used for comparison	

4.5 Zone 1, Campus Area, and Greenbelt Areas Direct Contact to Soil Pathway Summary

Zone 1 represents approximately 300 acres that were evaluated by ISM soil sampling in 2016. Zone 1 encompasses sites such as the 1925 Landfill, LELs II and III, and borders the river (Figure 4-1). The Campus Area and Greenbelt Areas were also included for evaluation in Year 1 in order to expedite sampling in those areas. The following land use categories were sampled in Zone 1, the Campus Area, and the Greenbelt Areas (Figures 4-5 through 4-9):

- Category 1, Laydown Area, Gravel Areas (Historical Process Area) – 11 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Gravel Areas, Historic Grass Area, Campus Area, Greenbelt Prior to 2000 – 58 DUs for Aerial Dispersion TAL; 6 of the 58 DUs were in Zone 1, 31 of the 58 DUs were in the Campus Area; 21 of the 58 DUs were Greenbelt Areas;

- Category 3; Greenbelt Areas established after 2000 – 27 DUs for Imported Soil TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 3 DUs for Imported Soils TAL;
- Category 5, Stormwater Basins – 6 DUs for Imported Soils, Aerial Dispersion via Run-off TALs; and
- Category 6, Vegetated Cap Closed by Dow – 9 DUs for Aerial Dispersion, Leachate Breakout, and Imported Soil TALs.

Areas approved and closed under MDEQ and/or EPA oversight were not initially sampled. These areas include the approved RGIS Construction and Upgrade Project, LEL II, Waste Storage Area IIA, Open Waste Water Conduits, 703 Incinerator Area, and the Closed Diversion Basin. Subsequently, DEQ requested specific areas be investigated and limited samples were collected as detailed in Section 4.5.1.

All non-dioxin results in the Campus Area, Greenbelt Areas, and Zone 1 are below non-residential DCC. All dioxins and furans total TEQ results for the Campus and Greenbelt Areas are below the non-residential DCC. Therefore, no further action is proposed at this time for the Campus Area and Greenbelt Areas.

Out of the 32 DUs sampled for dioxins and furans in Zone 1, 17 DUs had dioxins and furans TEQ results below the non-residential DCC (990 parts per thousand [ppt]). Therefore, no further action is proposed for those 17 DUs (Figure 4-10). Based on the DUs with elevated dioxins and furans TEQ results, the following DUs were identified for further evaluation:

- Category 1, Laydown Area, Gravel Areas (Historical Process Area) – Seven DUs were identified with elevated dioxins and furans related to historic Aerial Dispersion (1A-2 through 1A-8);
- Category 2, Gravel Areas, Historic Grass Areas – Elevated dioxins and furans were identified in one DU (2D);

4.5.1 Additional Zone 1 Characterization Requested by MDEQ

MDEQ requested that additional Zone 1 areas be sampled, including:

- LEL II Final cover;
- Additional evaluation of former fire training area on 1925 Landfill;
- An additional DU from the 8Pond Final Cover; and
- Low-lying areas adjacent to the Wastewater Treatment Plant (WWTP).

In addition to these areas requested by the DEQ, a few additional DUs were sampled to evaluate areas found downgradient of DUs with reported dioxins and furans TEQ higher than 990 ppt. These DUs were sampled in 2018.

One of the areas requested by MDEQ includes a former fire training area and will include characterization of soil for Perfluorooctane sulfonic acid and Perfluorooctanoic acid (referred to as PFOS/PFOA) which are common components in certain fire-fighting foaming agents. These emerging contaminants are also contained in a number of common products, and additional sampling precautions must be taken to prevent inadvertent contamination of environmental samples. In addition, laboratory analytical techniques have not been uniformly adopted for soil; therefore, a specific proposal for this area including the

sampling and analytical procedures is in process and will be provided to MDEQ prior to sampling according to the schedule in Section 13.0.

These additional characterization samples were obtained from the 17 DUs identified in Figure 4-11 during 2018. The DU maps for these DUs are included in Appendix A. The DC data are presented in Appendix B.

These additional Zone 1 DUs sampled in 2018 included Category 1, 4, 5, 6, and 7 property types, which were sampled and analyzed based on the TAL determination provided in Section 4.2.

The results are presented by category below. Table 4-7 presents the summary statistics for dioxins and furans TEQ and then Table 4-8 presents the dioxins and furans TEQ results by DU. The dioxins and furans TEQ results are also shown on Figure 4-11. Metals results compared to background levels and totals evaluation are presented on Tables 4-9 and 4-10, respectively.

4.5.1.1 Category 1 – Laydown Areas and Historical Area Operations (Gravel Areas)

For Category 1, four additional DUs were identified, sampled, and analyzed for the Aerial Dispersion, Point Source Release and Historic Area Operations TALs. Table 4-11 presents the summary statistics for the non-dioxin results. All non-dioxin results were below the non-residential DCC in Category 1. As shown in Tables 4-9 and 4-10, two out of the four DUs sampled in Category 1 had dioxins and furans TEQ results greater than the non-residential DCC of 990 ppt.

4.5.1.2 Category 4 – Relocated Soils Covered with Imported Top Soil

As shown on Figure 4-11, two DUs were sampled for Category 4 and the samples were analyzed for the Imported Soil TAL (metals, herbicides, and pesticides). Table 4-12 presents the summary statistics for Category 4. All results are less than non-residential DCC. Therefore, no further action is proposed at this time for the additional Zone 1 Category 4 DUs sampled in 2018.

4.5.1.3 Category 5 – Stormwater Basin

Two DUs were sampled for Category 5, as shown on Figure 4-11. The samples were analyzed for Imported Soils and Aerial Dispersion via Run-off TALs. Table 4-13 presents the summary statistics for non-dioxin analytes for Category 5. All non-dioxin results are less than non-residential DCC. As shown in Tables 4-9 and 4-10 one of the two DUs sampled in Category 5 had a dioxins and furans TEQ result greater than the non-residential DCC of 990 ppt.

4.5.1.4 Category 6- Vegetated Cap, Closed by Dow

Three DUs were sampled for Category 6, as shown on Figure 4-11. The samples were analyzed for the Imported Soils and Aerial Dispersion via Run-off TALs. Table 4-14 presents the summary statistics for non-dioxin analytes for Category 6. All non-dioxin results are less than non-residential DCC. As shown in Tables 4-9 and 4-10, all dioxins and furans TEQ results are less than the non-residential DCC of 990 ppt. Therefore, no further action is proposed at this time for the additional Zone 1 Category 6 DUs sampled in 2018.

4.5.1.5 Category 7 – Vegetated Cap, Closed with DEQ or EPA Oversight

Six DUs were sampled for Category 7, as shown on Figure 4-11. The samples were analyzed for the Imported Soils and Aerial Dispersion via Run-off TALs. Table 4-15 presents the summary statistics for non-dioxin analytes for Category 7. All non-dioxin results are less than non-residential DCC. As shown in Tables 4-9 and 4-10, all dioxins and furans TEQ results are less than the non-residential DCC of 990 ppt. Therefore, no further action is proposed at this time for the Zone 1 Category 7 DUs sampled in 2018.

4.5.1.6 Results Evaluation for Zone 1 MDEQ Requested DUs

For the Zone 1 MDEQ requested DUs, as discussed in the sections above, the Category 1 Laydown Areas and Gravel Areas (Historical Process Areas) were defined as the areas with the most potential DC exposure. All non-dioxin results were less than non-residential DCC in all of the sampled DUs (across Categories 1, 4, 5, 6, and 7.

Among the Zone 1 MDEQ-requested DUs, there were three dioxins and furans TEQ results that exceeded the non-residential DCC of 990 ppt. Figure 4-11 presents the dioxins and furans TEQ results by DU.

Out of the five property category types sampled as part of the MDEQ-requested DUs in Zone 1, four were analyzed for dioxins and furans TEQ. Only two of the categories had a DU with an exceedance of the non-residential DCC, Categories 1 and 5. Category 1 Laydown Areas and Gravel Areas (Historical Process Areas) demonstrated the highest dioxins and furans TEQ results ranging from 829 ppt to 3,530 ppt, with only two exceedances of the non-residential DCC (1,120 ppt and 3,530 ppt). Out of the two Category 5 Stormwater Basin DUs, only one of the results observed was above the non-residential DCC (1,190 ppt). Categories 6 and 7 did not have any dioxins and furans TEQ results that exceeded the non-residential DCC.

For the three DUs that exceeded the dioxins and furans TEQ non-residential DCC, the development of a site-specific DCC will be evaluated to address the exceedances observed at these DUs.

4.5.2 Zone 1 Interim Measures

As noted above, the dioxins and furans TEQ results at some DUs sampled in Zone 1 in 2016 warranted further evaluation to complete design work for IMs or follow-up work in adjacent or similar DUs (Figure 4-10).

- DUs in the Pallet Yard Area (1A-2 and 1A-8);
- Stormwater basin DUs that receive stormwater runoff from the Pallet Yard Area (5E-1, 5E-2, 5E-4, 5E-5, and 5E-6);
- Category 1 Laydown Area DUs (1A-9 through 1A-10) near the Pallet Yard Area; and
- DU 2D and an additional nearby DU (4C).

The additional stormwater basins and laydown areas sampled are also shown on Figure 4-12.

The following sections summarize these additional sampling measures along with IMs that have been implemented or will be implemented in the near future. Table 4-16 summarizes the Zone 1 interim actions at these DUs as well as those described in Sections 4.6.1 and 4.7.5 for Zones 2 and 3, respectively.

4.5.2.1 Pallet Yard Area (DUs 1A-2 through 1A-8)

Access was restricted to the area covered by DUs 1A-2 through 1A-8 by using signage and fencing (Figure 4-13) beginning in 2016. Depth-discrete sampling was completed at DUs in the Pallet Yard Area (1A-2 and 1A-8) in 2017 to facilitate design work for a long-term barrier. Results and hazard information was provided to the workers in nearby areas. Operations located within the area, including metal recycling and wood pallet grinding and loading were all re-located to other locations within the plant site. In cases where access to the areas was necessary, additional PPE for workers who must enter and work in the area and the means for proper disposal of PPE after use were implemented.

Depth-discrete samples down to 12 inches bgs were collected in 2017 from DUs 1A-2 through 1A-8 to evaluate the thickness of the impacted soil layer. The results of the sampling, presented in the *2017 Corrective Action Implementation Summary Report and 2018 Work Plan*, confirm that over approximately half of the area impacts are within the upper 12 inches. The results from DUs 1A-2, 1A-4, 1A-7, and 1A-8 indicated greater than 12 inches of impacted soils.

Work Completed in 2018:

In May 2018, Dow provided MDEQ with drawings of a long-term barrier for DUs 1A-2 through 1A-8. These drawings depicted the placement of a non-woven geotextile visible marker layer covered with six inches of clean gravel. Included with the submittal of these drawings was a soil management and dust track-out plan as some of the existing soil material may needed to be stripped prior to placement of the marker layer and final cover to ensure appropriate sloping and stormwater drainage at the site after installation of the cover. However, during a site walk completed after the submittal of these plans and drawings, Dow identified asbestos on the ground surface and in the soils on part of the area covered by DUs 1A-2 through 1A-8.

Dow reevaluated the approach and the plans were modified to leave the existing soil in place and cover it with a geotextile and a minimum of six inches of gravel placed on top of the geotextile. Dow provided the updated plans to MDEQ in September 2018 and MDEQ accepted the changes within the same month. Work in the pallet yard area commenced in early November 2018 and is projected to be completed by the end of 2018.

Work to be Completed in 2019:

A set of as-built drawings will be provided to MDEQ in 2019, which will identify the final dimensions of corrective actions, marker layer layout, and thickness and makeup of the final cover layer within each DU.

4.5.2.2 Additional Stormwater and Category 1 DUs Near Pallet Yard Area

There were a number of stormwater areas identified as receiving stormwater runoff from the Pallet Yard Area (see Figure 4-12). One portion of these stormwater areas (DU 5E-3) was sampled among the DUs sampled in 2016, but samples were collected from an additional four DUs that received runoff from the laydown areas (5E-1, 5E-2, 5E-4, and 5E-5). Samples from additional DU 5E-6 were also collected, although a berm separates the noted basin from runoff from the Category 1 areas.

Additional Category 1 DUs 1A-9 through 1A-12 were also defined and sampled in areas adjacent to the Pallet Yard. Six-inch surficial incremental composite samples were collected from each DU during late 2017. The dioxins and furans TEQ results for the additional stormwater basin and additional laydown DUs sampled in 2017 are listed below in Table 4-17.

Table 4-17: Additional Stormwater and Category 1 DU Results

DU	0-6” Sample TEQ (ppt)
5E-1	398
5E-2	394
5E-4	86
5E-5	382
5E-6	138
1A-9	1420
1A-10	7240
1A-11	2570
1A-12	1370

Work Completed in 2018:

The dioxins and furans TEQ results from DU 1A-10 indicate the need for an IM to be put in place to cover existing soil at the DU. Planning for the long-term barrier was initiated in 2018 and will include the removal of the top six inches of existing soil, followed by the placement of a non-woven geotextile visible marker layer to be covered by six inches of clean gravel. The intention of the soil removal is to ensure appropriate sloping and stormwater drainage in these areas after installation of the cover.

Work to be Completed in 2019:

The long-term barrier will be put place at DU 1A-10 in 2019. Construction drawings will be provided to MDEQ prior to start of work will according to the schedule in Section 13.0. The soil management plan and dust-track out control plan submitted and approved in September 2018 will be implemented during this work. A set of as-built drawings will be provided to MDEQ upon completion, which will identify the final dimensions of corrective actions, marker layer layout, and thickness and makeup of the final cover layer within each DU.

For DUs 1A-9, 1A-11, and 1A-12, the development of a site-specific DCC will be evaluated to address the exceedances observed at these 13 DUs.

4.5.2.3 Additional Design Sampling for DU 2D and 4C

Higher than expected dioxins and furans TEQ results identified at DU 2D in 2016 were suspected to be from placement of an inadequate thickness of clean topsoil (less than six inches). As such, an additional 0-3-inch ISM soil sample was collected from this DU. A nearby DU (4C) also included soil from similar work as that found at 2D (see Figure 4-12). As such, ISM soil samples from 0-3-inch and 0-6-inch were also collected from DU 4C. Based on results of the sampling, which were presented in the *2017 Corrective Action Implementation Summary Report and 2018 Work Plan*, an IM will be put in place for these two DUs.

Work Completed in 2018:

Planning for the IMs in these DUs was initiated in 2018. Due to the slope and non-existent use of these areas, the IM will include a barrier and signage to limit exposure to these DUs.

Work to be Completed in 2019:

The IMs for these two DUs will be completed in early 2019 in accordance with the milestone schedule in Section 13.0.

4.6 Zone 2 Direct Contact to Soil Pathway Summary

Zone 2 (Figure 4-14) covers approximately 280 total acres and encompasses an area in the east (approximately 245 acres) and a small area in the west of the facility (approximately 35 acres). Zone 2 DUs were sampled in 2017. The following land use categories were sampled in Zone 2:

- Category 1, Laydown Areas and Gravel Areas (Historical Process Areas) – 54 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Gravel Areas, Historic Grass Areas – 16 DUs for Aerial Dispersion TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 6 DUs for Imported Soils TAL; and
- Category 5, Stormwater Basins – 19 DUs for Imported Soils, Aerial Dispersion via Run-off TALs.

In Zone 2, out of the 95 DUs sampled, the dioxins and furans TEQ results were below the non-residential DCC (990 ppt) in 78 DUs. Therefore, no further action is proposed for those 78 DUs. Based on dioxins

and furans TEQ and arsenic results, the following were identified for implementation of IMs and/or additional design sampling to facilitate the construction of long-term barriers:

- Category 1, Laydown Area, Gravel Areas (Historical Process Areas) – Eleven (11) DUs were identified with elevated dioxins and furans related to historic Aerial Dispersion;

- Category 2, Historic Grass and Gravel Areas – One arsenic result was greater than the non-residential DCC. Dioxins and furans TEQ was elevated in that same DU and in an additional five DUs.

4.6.1 Zone 2 Category 1 Railroad DUs

Railroad property adjacent to proposed IMs for the Zone 2 Laydown Yard was evaluated by ISM soil sampling in October/November 2017. These DUs were categorized as a Category 1 property type and were sampled for the aerial dispersion and other sources TALs per Section 4.2. Figure 4-15 presents the Railroad DUs along with their respective dioxins and furans TEQ result. The DC data are presented in Appendix B.

Table 4-18 presents the summary statistics for dioxins and furans TEQ results and Table 4-19 presents the dioxins and furans TEQ results by DU. Metals results compared to background levels and the totals evaluation are presented on Tables 4-20 and 4-21, respectively.

For the eight Category 1 Railroad DUs, Table 4-22 presents the summary statistics for the non-dioxin results. All non-dioxin results were below the non-residential DCC in Category 1. As shown in Tables 4-19 and 4-20, six out of the eight Zone 2 Railroad DUs sampled had dioxins and furans TEQ results greater than the non-residential DCC of 990 ppt. The dioxins and furans TEQ results ranged from 304 ppt – 52,100 ppt. The next highest result was 3,830 ppt.

The Railroad DU 1B1 (with a dioxins and furans TEQ result of 52,100 ppt) will be addressed at the same time as the IMs planned for the eastern Zone 2 IM Area, which are discussed in Section 4.6.3.2.

The development of a site-specific DCC will be evaluated to address the exceedances observed at the five other DUs that exceeded the dioxins and furans TEQ non-residential DCC.

4.6.2 Zone 2 Dioxin and Furan Confirmation Sampling

DUs from Zone 2 were selected at an approximate frequency of 10% for triplicate sampling and tested by EPA Method 1613b. DUs for this evaluation were selected with concentrations closest to the non-residential DCC. The locations of the Zone 2 DUs selected are shown in Figure 4-16. For the DUs selected, the original sample was retained and two additional replicates were obtained from each of the original increment locations. The original sample and two replicates were then analyzed by EPA Method 1613b. Results for the Zone 2 confirmation sampling are summarized in Table 4-23. Note that similar confirmation sampling was completed in Zone 1 in 2017 and the results were presented in the *2017 Corrective Action Implementation Summary Report and 2018 Work Plan.*

Based on results of replicate sampling for dioxins and furans TEQ to date, Dow will continue to work with MDEQ to implement sampling techniques and analyses to better characterize variability within the DC assessment for the Dow Midland Facility. Confirmation sampling will be completed for Zone 3 in 2019 (see Section 13.0 for schedule).

4.6.3 Zone 2 Interim Measures

4.6.3.1 Western Zone 2 Interim Measures

A small number of DUs in the western portions of Zone 2 (2C, 2H and 2G) were identified with elevated dioxins and furans TEQ results, as well as one DU (2A) that included both a dioxins and furans TEQ result and a concentration of arsenic above the non-residential DCC (Figure 4-17).

Work Completed in 2018:

Results and hazard information was provided to the workers in nearby areas. In cases where access to the areas was necessary, the proper use and disposal of PPE to mitigate exposure via ingestion for workers who must enter and work in these areas was also discussed. These measures were initiated in late October 2018.

Work to be Completed in 2019:

DUs 2C and 2H will be addressed during 2019 by removing approximately 10-12 inches of gravel/soil at both DUs followed by the completion of 3-8 inches of a permable pavement surface. The permeable pavement surface will be installed over a 4-6-inch thick stabilizing course, which will be underlain by approximately six inches of a subbase/stone reservoir and a non-woven geotextile visible marker layer.

The intention of the soil removal is to ensure appropriate sloping and stormwater drainage in these areas after installation of the cover. The permeable pavement surface will provide a cleanable surface that will not contribute additional overland flow during storm events. Construction drawings for these areas will be provided to MDEQ prior to implementation. The soil management plan and dust-track out control plan submitted and approved in September 2018 will be implemented during this work. A set of as-built drawings will be provided to MDEQ upon completion, which will identify the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU. The schedule for this work is provided in Section 13.0.

The development of site-specific DCC will be evaluated to address the exceedances observed at 2G and 2A.

4.6.3.2 Eastern Zone 2 Interim Measures (499 Area)

Depth-discrete dioxin and furan ISM soil sampling was completed at the 11 DUs around 499 Building (Figure 4-18) that had elevated dioxins and furans TEQ results in 2017. These depth-discrete samples were collected to support design work and the results were presented in the *2017 Corrective Action Implementation Summary Report and 2018 Work Plan*. The results confirmed that impacts continue to be present at a depth of at least 3 ft below the existing grade over most of the area covered by the noted DUs.

After the sampling was completed, barricades were placed around one of the DUs (1S3). Contact with the existing soil at DUs 1S1, 1S2, 1S3, and 1S5 through 1S8 was mitigated by placing six inches of new stone and/or gravel cover over the existing soil. For DUs 1S1, 1S2, 1S3, 1S5, 1S6 and 1S8, a stone mix aggregate, which included a significant fine fraction, was utilized and the cover was compacted to approximately four inches to protect the cover to allow for traffic and vehicle use. For DU 1S7, a stone aggregate was used to prevent contact with the existing soil; however, it was not compacted as little to no vehicle traffic or parking is anticipated in that area. These actions were also completed in August of 2017.

Work Completed in 2018:

Planning for the remaining work at these DUs was completed in 2018. A long-term barrier consisting of a non-woven geotextile visible marker layer covered by six inches of clean gravel is planned for this area. The clean compacted gravel placed in 2017 at the DUs noted above, along with six inches of the underlying pre-existing gravel, will be removed in order to maintain the existing grade. At the other four DUs where no gravel was placed in 2017 (1S4, 1T1 through 1T3), only six inches of pre-existing gravel will be removed. Once the gravel is removed, the marker layer and six inches of compacted clean gravel will be placed. Of note, a small area in the western portion of 1S4 will be covered with a parking lot for the occupants in 499 Building in lieu of the gravel cover being used for the rest of the DU.

The Railroad DU 1B1 (with a dioxins and furans TEQ result of 52,100 ppt) will be addressed at the same time as the IMs planned for the eastern Zone 2 IM Area. A construction drawing for 1B1 was provided to MDEQ in December 2018 with the construction drawings for the eastern Zone 2 IM DUs. The soil management plan and dust-track out control plan submitted and approved in September 2018 will be implemented during this work.

Work to be Completed in 2019:

Construction activities will be completed for the remaining work in 2019 in accordance with the milestone schedule provided in Section 13.0. A set of as-built drawings will be provided to MDEQ upon completion, which will identify the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU.

The development of a site-specific DCC will be evaluated to address the exceedances observed at the five other DUs that exceeded the dioxins and furans TEQ non-residential DCC.

4.7 Zone 3 Direct Contact to Soil Pathway

For Year 3 of the DC assessment, Zone 3 was evaluated and covers approximately 284 total acres (see Figure 4-1). The following sections discuss the exposure characterization, target analytes, sampling methods and activities, analytical results, and the path forward determined for Zone 3.

4.7.1 Zone 3 Characterization

Figure 4-19 presents the Zone 3 aerial/grid map created per Section 4.3.2. Each of the grids were evaluated for property type, current/historical use, and site conditions. If sampling was not proposed for a grid, justification for not sampling was documented and is provided in Table 4-24. DUs were then delineated as described in Section 4.3.2. Individual sample plans were developed for each DU and are included in Appendix A.

Figure 4-20 shows the DUs and Table 4-25 presents the overview of Zone 3, including shading according to property type category. The following land use categories were identified in Zone 3:

- Category 1, Laydown Areas and Gravel Areas (Historical Process Area) – 37 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Historic Grass Areas – 19 DUs for Aerial Dispersion TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 12 DUs for Imported Soils TAL; and
- Category 5, Stormwater Basins – 70 DUs for Imported Soils, Aerial Dispersion via Run-off TALs.

Three possible sources were identified in Zone 3. These include aerial dispersion, imported soils, and other sources (e.g., point source release, historic area operations). The prescribed TALs for each exposure category described in Section 4.2 were implemented for the 2018 sampling of Zone 3.

Table 4-26 presents those DUs with increments moved due to obstructions and a list of DUs with documentation for why the DU was not be sampled.

4.7.2 2018 Zone 3 Direct Contact Sampling Results and Evaluation

For Zone 3, ISM soil sampling activities were conducted in May through July 2018 for 138 DUs in areas immediately within the Michigan Operations facility. The results are presented by category below. Table 4-27 presents the summary statistics for dioxins and furans TEQ for Categories 1, 2, and 5; and Table 4-28 presents the dioxins and furans TEQ results by DU. Metals results compared to background levels and totals evaluation are presented on Tables 4-29 and 4-30, respectively. The DC data are presented in Appendix B.

4.7.2.1 Category 1 – Laydown Areas and Historical Areas Operations (Gravel Areas)

For Category 1, 37 DUs were sampled and analyzed for the Aerial Dispersion and Other Source TALs. Table 4-31 presents the summary statistics for the non-dioxin results for Category 1 DUs. All non-dioxin results were below the non-residential DCC in Category 1. As shown in Tables 4-27 and 4-28, 12 out of the 37 DUs sampled in Category 1 had dioxins and furans TEQ results greater than the non-residential DCC of 990 ppt.

4.7.2.2 Category 2 – Historic Grass and Gravel Areas

A total of 19 Category 2 DUs were sampled and analyzed for the aerial dispersion TAL. Table 4-32 presents the summary statistics for arsenic for Category 2 DUs. All arsenic results were well below the non-residential DCC (37 ppt). As shown in Tables 4-27 and 4-28, two of the 19 DUs had dioxins and furans TEQ results greater than 990 ppt.

4.7.2.3 Category 4 – Relocated Soils Covered with Imported Top Soil

Twelve Category 4 DUs were sampled for Category 4 and the samples were analyzed for the Imported Soil TAL (metals, herbicides, and pesticides). Table 4-33 presents the summary statistics for Category 4. All results are less than non-residential DCC. Therefore, no further action is proposed at this time for Zone 3 Category 4 DUs.

4.7.2.4 Category 5 – Stormwater Basin

Seventy Category 5 DUs were sampled and analyzed for the Imported Soils and Aerial Dispersion via Run-off TALs. Table 4-34 presents the summary statistics for non-dioxin analytes for Category 5. All non-dioxin results, with the exception of two arsenic results, are less than non-residential DCC. In DUs 5EE and 5HH1, arsenic was detected at concentrations (360 milligrams per kilogram [mg/kg] and 53 mg/kg, respectively) greater than the non-residential DCC (37 mg/kg). As shown in Tables 4-27 and 4-28, four of the 70 DUs had dioxins and furans TEQ results greater than 990 ppt.

4.7.3 Zone 3 Results Evaluation

None of the non-dioxin results from Zone 3 Category 1, Category 2, and Category 4 DUs sampled in 2018 exceeded non-residential DCC. Arsenic was the only non-dioxin analyte with results greater than its respective non-residential DCC (37 mg/kg). In Zone 3 Category 5, two DUs (5EE (360 mg/kg) and 5HH1 (53 mg/kg)) exceeded the Arsenic DCC (Figure 4-21). Category 1 and Category 2 had arsenic concentrations that ranged from 1.7 – 30 mg/kg and 1.4 – 16 mg/kg, respectively. Zone 3 Category 4 DUs had the lowest arsenic results, which ranged from 1.5 – 6.8 mg/kg.

In Zone 3, Category 1, 2, and 5 DUs were sampled and analyzed for dioxins and furans TEQ. Figure 4-22 presents the dioxins and furans TEQ results by DU. All three property type categories sampled and analyzed for dioxins and furans TEQ had DUs with exceedances of the respective non-residential DCC (990 ppt). Of the three categories sampled and analyzed in Zone 3 for dioxins and furans TEQ, Category 1 Laydown Areas and Gravel Areas (Historical Process Areas) demonstrated the highest dioxins and furans TEQ results ranging from 48.4 ppt – 14,100 ppt. The next highest dioxins and furans TEQ result in Category 1 was 5,270 ppt. Category 2 results ranged from 22.3 ppt to 2,260 ppt and there were exceedances in 2 out of 19 Category 2 DUs sampled. For Category 5, results ranged from 6.89 ppt – 5,090 ppt. Results in four out of the 70 Category 5 DUs sampled exceeded 990 ppt.

The area with the DUs exhibiting the highest concentrations of dioxins and furans TEQ will be addressed through IMs and those activities are discussed in Section 4.7.5.

4.7.4 Zone 3 Summary and Recommendations

All non-dioxin results in Categories 1, 2 and 4 are below non-residential DC and ambient air criteria. Therefore, no further action is proposed at this time to address non-dioxin analytes in Categories 1, 2 and 4. For Category 5, all non-dioxin results, with the exception of two arsenic results, are less than non-residential DCC. In DUs 5EE and 5HH1, arsenic was detected at concentrations (360 mg/kg and 53 mg/kg, respectively) greater than the non-residential DCC (37 mg/kg). Based on these results, these two DUs may warrant further evaluation and/or implementation of IMs.

In Zone 3, out of the 126 DUs sampled and analyzed for dioxins and furans TEQ, results were below the non-residential DCC (990 ppt) in 108 DUs. Therefore, no further action is proposed for those 108 DUs (Figure 4-23).

Based on dioxins and furans TEQ results, IMs have been implemented at the following five Zone 3 DUs: 1G, 1Q, 1U1, 1U2, and 5KK. Section 4.7.5 presents the IM activities completed to date and IMs to be undertaken in 2019 to address these DUs. The anticipated schedule for the 2019 IMs is included in Section 13.0. In addition, Dow will continue to work with MDEQ to implement sampling techniques and analyses to characterize variability within Zone 3.

For the other 13 DUs with exceedances of the dioxins and furans TEQ DCC, the development of a site-specific DCC will be evaluated in 2019 to address the exceedances observed at those 13 DUs.

4.7.5 Zone 3 Interim Measures

As described above, analysis of samples from DUs 1G, 1Q, 1U1, 1U2, and 5KK for dioxins and furans TEQ yielded concentrations ranging from 4,510 – 14,100 ppt TEQ (Figure 4-23). Additionally, DUs 5EE and 5HH1 yielded arsenic concentrations greater than the non-residential DCC.

Work Completed in 2018:

The results and hazards for the DUs exceeding the dioxins and furans TEQ non-residential DCC were communicated to workers in the noted areas. Access was restricted to DUs 1G, 1Q, and 5KK by placing temporary barricades and signage. In cases where continued access to the areas is necessary, such as 1U1 and 1U2, the proper use and disposal of PPE to mitigate exposure via ingestion for workers who must enter and work in the area was also discussed. These actions were completed in October 2018.

The present use of the area covered by DUs 1U1 and 1U2 along with the grade of the existing soil in relation to berms/dikes in the area renders the use of barricading or placement of a temporary layer of gravel not practicable. Therefore, after communicating with the workers in the area and emphasizing the need for proper use and disposal of PPE to mitigate exposure via ingestion in these areas, construction drawings were assembled to show the planned removal of the top six inches of gravel/soil at these DUs. The removal of the gravel/soil would then be followed by the laying of a non-woven geotextile visible

marker layer cover to be covered by six inches of clean gravel cover. These drawings were supplied to MDEQ in December 2018. The soil management plan and dust-track out control plan submitted and approved in September 2018 will be implemented during this work.

Similar measures of removing the top six inches of soil; followed by the laying of a non-woven geotextile visible marker layer covered with six inches of clean, compacted of gravel; will be implemented at DUs 1G and 1Q. However, since part of 1G is a stormwater swale and 5KK is a stormwater basin in its entirety, a compactable soil fill that can accommodate sod growth will be placed over the geotextile marker layer in lieu of placing six inches of clean compacted gravel over the geotextile marker layer. Additionally, the sides of the basins will be seeded/blanketed.

Work to be Completed in 2019:

Construction activities to complete the planned work at DUs will be completed in 2019 in accordance with the milestone schedule provided in Section 13.0. A set of as-built drawings will also be provided to MDEQ upon completion which will identify the final dimensions of the corrective actions, marker layer layout, thickness, and makeup of the final cover layers within each DU.

Confirmation sampling at DUs 5EE and 5HH1 will be completed in 2019 to confirm the arsenic exceedances observed in 2018. If the confirmation sampling reveals similar results, these DUs will be mitigated in a similar manner as 1G and 5KK.

4.8 Year 4 Direct Contact Goals

Figure 4-24 presents the location of Zone 4 within the facility. Zone 4 covers approximately 424 acres within the facility complex. The Year 4, Zone 4 DC pathway evaluation will follow the same approach as the previous years' evaluations which includes a review of historical information on practices and use in Zone 4; ID of land use categories and verification of TALs that are applicable for those land uses; organization of Zone 4 areas into specific land use categories; DC sampling utilizing the established methods, and results review and recommendations on the path forward.

5.0 Midland Plant Facility-Wide Vapor Intrusion Pathway

The intent of the VI evaluation process is to achieve the human exposures control EI determination. A "Current Human Exposure Under Control" determination is a means of evaluating the acceptability of current site conditions and interim milestones met, and does not address whether corrective action is complete at the site, whether remedial long-term goals are met or whether site conditions will be protective if land uses change in the future. Furthermore, this evaluation process determines if the VI pathway is considered "complete" for each building. If the evaluation process concludes that there is a complete VI pathway for a building, further analysis is conducted to access potential human exposure to determine whether there is a basis for undertaking a response action.

As the Midland Plant site is an active chemical production facility with many chemicals stored and/or routinely used in the buildings, it is anticipated that in many cases concentrations of vapor-forming chemicals present in the indoor environment may be due to the active occupational setting. If it is determined that the chemical concentrations of vapor-forming chemicals present in the indoor environment are due to use or storage within the building or facility, then the Michigan Compiled Laws Section 324.20120a(18) is appropriate to demonstrate compliance with indoor air inhalation criteria. Under these circumstances, the Dow IH Occupational Exposure Limits (OELs) are the appropriate risk based levels to assess potential human exposure and Dow will comply with MIOSHA requirements.

If it is determined that the presence of the chemical is related to a historic environmental release, then the VI evaluation process will utilize the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels and/or the June 22, 2018, draft project-specific screening levels provided by MDEQ to further assess potential human exposure to that concentration.

Currently, the facility has approximately 700 buildings and structures on-site. Indoor air at the facility is being evaluated in a phased approach by zone using a building categorization procedure to consider a worst case approach to prioritize buildings for investigation and using a weight of evidence framework for assessing the VI pathway. The zones identified to date are shown on Figure 5-1. The building categorization flowchart is presented on Figure 5-2. The 2018 Revised VI Workplan (August 2018) documented the general sampling and evaluation methodology.

In response to the June 6, 2018 approval letter for The Dow Chemical Company's facility in Midland, MI 2017 CAIP and based on clarifications requested by MDEQ and subsequent communications regarding these topics, Dow submitted the following reports on August 24, 2018:

- Response to Comments in the MDEQ June 6, 2018 CAIP Approval Letter;
- 2018 Revised Vapor Intrusion Workplan;
- 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Buildings; and
- Five Expedited Building Summaries.

On September 26, 2018, Dow provided a response to a September 10, 2018 MDEQ email that further clarified VI path forward building groupings and VI reporting and notification requirements. The updated process for evaluating VI and determination of path forward flowchart is presented on Figure 5-3. The reporting and notification requirements are provided on Table 5-1.

A Site-Specific Chemical Facility Potential Features CSM is provided as Figure 5-4. This figure illustrates general features that are specific to an active industrial chemical facility, such as potential upwind emission sources and a potential pathway from the chemical waste sewer. Detailed building-specific CSMs were developed for buildings that have completed VI seasonal confirmation sampling and are referenced within the building-specific report sections.

The following table summarizes the Status Path Forward Building Group for all Zone 1, Zone 2, and Zone 3 buildings evaluated in this report.

Status Summary for Zone 1, Zone 2 Phase 1, Zone 2 Phase 2 and Zone 3 Phase 1 Buildings

Category	Building	VI Path Forward Group	Report Section	Status
Zone 1				
Category 1	1078	1	5.1.1	NFA at this time
Category 1	1100	1	5.1.1	NFA at this time
Category 1	1358	1	5.1.1	NFA at this time
Category 1	3303	1	5.1.1	NFA at this time
Category 1	34	2	5.1.2	Four rounds of seasonal confirmation sampling completed. Path forward recommendations include the implementation of an interim monitoring plan and the collection of differential pressure measurements and continued indoor air monitoring.
Category 1	1335	2	5.1.3	Four rounds of seasonal confirmation sampling completed. Path forward recommendations include the implementation of an interim monitoring plan and the collection of differential pressure measurements and continued indoor air monitoring.
Category 2	T1561	1	5.1.1	NFA at this time
Category 2	462	2	5.1.4	Four rounds of seasonal confirmation sampling completed. Path forward recommendations include the implementation of an interim monitoring plan and the collection of differential pressure measurements and continued indoor air monitoring.
Category 2	680	4B	5.1.5	Four rounds of seasonal confirmation sampling completed. Path forward recommendations include the implementation of an interim action plan that includes the collection of differential pressure measurements; installation of four additional sampling locations; additional building survey and chemical inventory, indoor air screening with portable instrument to collect real-time analyte-specific data; and continued seasonal confirmation sampling.
Category 2	838	2	5.1.6	Four rounds of seasonal confirmation sampling completed. Path forward recommendations include the implementation of an interim monitoring plan and the collection of differential pressure measurements and continued indoor air monitoring.
Category 2	1098	2	5.1.7	Based on the results of the 2018 Rescreen, Building 1098 was categorized as a VI Path Forward Group 2 and has been added to seasonal confirmation sampling.
Category 2	1159	3	5.1.8	EBS submitted in August 2018. No evidence of VI. Routine workplace chemical use likely source of indoor air concentrations. Further investigation into an indoor air source will be conducted.
Zone 2 Phase 1				
Category 1	1	1	5.2.1	NFA at this time
Category 1	972	1	5.2.1	NFA at this time
Category 1	833	3	5.2.2	No evidence of VI. Routine workplace chemical use likely source of indoor air concentrations. Further investigation into indoor air sources will be conducted.
Category 1	941	4B	5.2.3	EBS submitted in August 2018. Air purification unit installed, weekly air purification filter monitoring and PID measurements collected at floor drains. Seasonal confirmation sampling continues. Notification and reporting following Table 5-1 will occur, as necessary.
Category 1	1028	2	5.2.6	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.

Status Summary for Zone 1, Zone 2 Phase 1, Zone 2 Phase 2 and Zone 3 Phase 1 Buildings (Continued)

Category	Building	VI Path Forward Group	Report Section	Status
Zone 2 Phase 1 (Continued)				
Category 1	1233	2	5.2.7	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 1	827	4A	5.2.9	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	477	1	5.2.1	NFA at this time
Category 2	489	1	5.2.1	NFA at this time
Category 2	934	1	5.2.1	NFA at this time
Category 2	948	4A	5.2.4	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary based on E4 sampling results.
Category 2	1025	2	5.2.5	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	768	2	5.2.8	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	849	2	5.2.10	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results; Full evaluation and path forward recommendations will be included in the 2019 CAIP.
Category 2	858	4A	5.2.11	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	969	2	5.2.12	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results; Full evaluation and path forward recommendations will be included in the 2019 CAIP.
Category 2	1222	2	5.2.13	Three rounds of seasonal confirmation sampling evaluated. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	1377	3	5.2.14	No evidence of VI. Routine workplace chemical use likely source of indoor air concentrations. Further investigation into indoor air sources will be conducted.
Zone 2 Phase 2				
Category 1	1130	1	5.3.11	NFA at this time
Category 1	1215	2	5.3.12	Seasonal confirmation sampling ongoing. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	1255	4B	5.3.13	Building added to seasonal confirmation sampling due to Rescreen (August 2018). Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	1314	1	5.3.15	NFA at this time
Category 2	304	4A	5.3.1	Three rounds of seasonal confirmation sampling completed. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	388	1	5.3.2	NFA at this time

Status Summary for Zone 1, Zone 2 Phase 1, Zone 2 Phase 2 and Zone 3 Phase 1 Buildings (Continued)

Category	Building	VI Path Forward Group	Report Section	Status
Zone 2 Phase 2 (Continued)				
Category 2	499	4A	5.3.6	EBS submitted in August 2018 based on results from E1 & E2; results notification via email (October 25, 2018) based on E3 results. Lack of correlation between SSSG and IA results suggest VI is not the main source of indoor air detections. Seasonal sampling continues; Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	593	4A	5.3.3	EBS submitted in August 2018; Building added to seasonal confirmation sampling. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	779	1	5.3.7	NFA at this time
Category 2	826/494	2	5.3.8	Seasonal confirmation sampling ongoing. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	921	3	5.3.9	No evidence of VI. Routine workplace chemical use likely source of indoor air concentrations. Further investigation into indoor air sources will be conducted.
Category 2	922	1	5.3.10	NFA at this time
Category 2	923	4A	5.3.4	Three rounds of seasonal confirmation sampling completed. Notification and reporting following Table 5-1 will occur, as necessary, based on E4 sampling results.
Category 2	935	2	5.3.5	Seasonal confirmation sampling; full evaluation and path forward recommendations will be included in the 2019 CAIP.
Category 2	1312	1	5.3.14	NFA at this time
Zone 3 Phase 1				
Category 1	800	TBD	5.4.4.1	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	887	TBD	5.4.4.2	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	954	TBD	5.4.4.3	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	1038	TBD	5.4.4.4	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 1	1131	TBD	5.4.4.5	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	100	TBD	5.4.5.1	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	881	TBD	5.4.5.2	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	1037	TBD	5.4.5.3	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	1042	TBD	5.4.5.4	Samples collected. Notification and reporting following Table 5-1 will occur, as necessary, based on results.
Category 2	564	4A	5.4.3	EBS submitted August 2018; Added to Seasonal Confirmation Sampling. Full evaluation and path forward recommendations in 2019 CAIP.

5.1 Zone 1 Evaluations

The Zone 1 buildings were evaluated in the 2017 CAIP (December 2017) and again in the 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report (August 2018). The Zone 1 VI sampling results are presented in the following subsections as follows:

VI Path Forward Group 1 Buildings

- Section 5.1.1 Buildings 1078, 1100, 1358, 3303, and T-1561

VI Path Forward Group 2, 3, and 4A/4B Buildings

- Section 5.1.2 Building 34
- Section 5.1.3 Building 1335
- Section 5.1.4 Building 462
- Section 5.1.5 Building 680
- Section 5.1.6 Building 838
- Section 5.1.7 Building 1098
- Section 5.1.8 Building 1159

5.1.1 Zone 1 Group 1 Buildings

Group 1 is a designation for buildings that do not have screening level exceedances in sub-slab soil gas or indoor air. The following Zone 1 buildings were identified as VI Path Forward Building Group 1 in the 2017 CAIP:

- Building 1078;
- Building 1100;
- Building 1358;
- Building 3303; and
- Building T-1561.

The 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report dated August 2018 presented the results of the comparison of the analytical results presented in the 2017 CAIP to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values, and acceptable air concentrations (AACs) (draft project-specific $RIASL_{12}$), and the Dow OELs. The findings of the rescreen supported the conclusions of the 2017 CAIP for the Zone 1 Group 1 buildings since all detected results of analytes in sub-slab soil gas and indoor air were less than the draft project-specific $RIASL_{12}$.

The table below presents the Zone 1 buildings that remain in VI Path Forward Building Group 1.

Zone 1 Group 1 Building Summary

Building#	Building Name	Occupancy Category#	2017 CAIP		2018 Rescreen		Path Forward
			Section#	Conclusion	Section#	Conclusion	
1078	Environmental Operations Laboratory	1	5.2.2	Group 1	2.2	Group 1	No further VI evaluation is warranted at this time.

Zone 1 Group 1 Building Summary (Continued)

Building#	Building Name	Occupancy Category#	2017 CAIP		2018 Rescreen		Path Forward
			Section#	Conclusion	Section#	Conclusion	
1100	Security and Emergency Services Building	1	5.2.3	Group 1	2.3	Group 1	No further VI evaluation is warranted at this time.
1358	Environmental Operations Maintenance Building	1	5.2.5	Group 1	2.5	Group 1	No further VI evaluation is warranted at this time.
3303	1159 Breakroom	1	5.2.6	Group 1	2.6	Group 1	No further VI evaluation is warranted at this time.
T-1561	T-1561	2	5.2.11	Group 1	2.11	Group 1	No further VI evaluation is warranted at this time.

5.1.1.1 Building 1078

Building 1078 is a Category 1 building in Zone 1 and was evaluated in Section 5.2.2 of the 2017 CAIP. It is a large, single story building that includes both office and laboratory space. It is known as the Environmental Operations (EVO) Lab and is located within the southern-most portion of the facility designated as Zone 1. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1078 is an insignificant exposure pathway based on current use. Building 1078 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.1.1-A and indoor and outdoor air on Table 5.1.1.1-B.

The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air are less than the draft project-specific $RIASL_{12}$. Therefore, Building 1078 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.1.1.2 Building 1100

Building 1100 is a Category 1 building in Zone 1 and was evaluated in Section 5.2.3 of the 2017 CAIP. It is a large building that includes a large garage for housing emergency vehicles, office space, and locker rooms. It is known as the Security and Emergency Services building. The building is located to the northwest of the WWTP within the southern portion of the facility designated as Zone 1. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1100 is an insignificant

exposure pathway based on current use. Building 1100 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.1.2-A and indoor and outdoor air on Table 5.1.1.2-B.

The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air are less than the draft project-specific $RIASL_{12}$. Therefore, Building 1100 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.1.1.3 Building 1358

Building 1358 is a Category 1 building in Zone 1 and was evaluated in Section 5.2.5 of the 2017 CAIP. It is a small single-story metal frame building that includes limited office space and a lunch room. It is known as the EVO Maintenance building and is located within the southeast portion of the facility designated as Zone 1. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1358 is an insignificant exposure pathway based on current use. Building 1358 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. The sampling locations are shown on Figure 5.1.1.3-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.1.3-A and indoor and outdoor air on Table 5.1.1.3-B.

Building 1358 is only approximately 300 square feet (ft^2) in size. Two sub-slab soil gas samples and two indoor air samples were collected (along with one outdoor air sample) in November 2016. Table 1358-1 presents the summary of sub-slab soil gas detections for chlorofluorocarbon (CFC)-12, the only analyte that exceeds a screening level.

Table 1358-1. Summary of Sub-Slab Soil Gas Detects for Building 1358

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
CFC-12	100%	540,000 - 700,000	100%	34,000

* Screening level provided is the draft project-specific $RIASL_{12}$.

While CFC-12 was detected in both sub-slab soil gas samples, it was ND in indoor air or outdoor air, as shown on Table 1358-2. Furthermore, the two indoor air sample results had RLs well below the screening level.

Table 1358-2. Vapor Intrusion Evaluation for Building 1358

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
CFC-12	0%	<8.5 - <16	1,020	<1.95

*MDEQ draft project-specific AACs.
< - ND at the RL provided.

While CFC-12 was ND in indoor air, the highest ND RL was 16 μg/m^3. If the maximum RL is assumed to be a detected result, at the most the indoor air concentration would be less than (<) 2% of the indoor air screening level. The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP. Building 1358 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.1.1.4 Building 3303

Building 3303 is a Category 1 building in Zone 1 and was evaluated in Section 5.2.6 in the 2017 CAIP. It is a small building that includes a lunch room and a small office. It is known as the 1159 Breakroom and is located within the southeast portion of the facility designated as Zone 1. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 3303 is an insignificant exposure pathway based on current use. Building 3303 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific RIASL$_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for underneath the building, indoor and outdoor air on Table 5.1.1.4.

The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP. All detected results of analytes from underneath the building and indoor air were less than the draft project-specific RIASL$_{12}$. Therefore, Building 3303 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.1.1.5 Building T-1561

Building T-1561, which is primarily used for office space, is a Category 2 office trailer in Zone 1 and was evaluated in Section 5.2.11 in the 2017 CAIP. It is a temporary building with extensive crawl space between the ground surface and the floor of the building and is located within the southeast portion of the facility designated as Zone 1. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building T-1561 is an insignificant exposure pathway based on current use. Building T-1561 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific RIASL$_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for samples collected under the trailer and outdoor air on Table 5.1.1.5.

The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP. All detected results of analytes in the air samples collected under the trailer were less than the RIASL$_{12}$. Therefore, Building T-1561 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.1.2 VI Seasonal Confirmation Sampling Results Evaluation for Building 34

INTRODUCTION

Building 34 is a Category 1 building located within the southwest portion of the facility designated as Zone 1. It is known as the Rotary Kiln Incinerator Admin /Control Room.

The initial evaluation in the 2017 CAIP concluded that based on current use and the indoor air results, the VI pathway at Building 34 is an insignificant exposure pathway However, based on the sub-slab soil gas results, Building 34 was determined to have the potential for future VI, and it was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas analytes of interest (AOIs), but where initial indoor air results were all less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) and the seasonal confirmation sampling event (E2) were evaluated in the 2017 CAIP. The remaining two seasonal events (E3 & E4) were completed and the results of all four of these sampling events were included in the 2018 Rescreen.

Building 34	
Initial Sampling Event	**Completed**
E1	Nov 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	Aug 2017 (Summer)
E3	Feb 2018 (Winter)
E4	May 2018 (Spring)

The findings of the 2018 Rescreen supported the conclusions of the 2017 CAIP, and Building 34 remained a Group 2 building. Based on the rescreen, no indoor air analytes were detected above screening levels during any of the sampling events at Building 34. The sub-slab soil gas AOIs are trichloroethene (TCE), 1,2,4-trichlorobenzene (1,2,4-TCB), 1,3-dichlorobenzene (1,3-DCB), 1,4-DCB, hexachlorobutadiene (HCB), and naphthalene due to exceedances of the draft project-specific $RIASL_{12}$. 1,2,4-TCB also exceeded the $TSRIASL_{12}$ in sub-slab soil gas.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 34. The CSM is illustrated in Figure 5.1.2-1.

Building 34 is one-story tall and contains a control room with office space and is connected to process areas. The building is slab-on-grade construction with a footprint of approximately 15,400 ft^2 (1,430 square meters [m^2]). The building has central air conditioning (AC) with the air intake located at roof level.

There are no large bay doors or garage doors. The only underground utilities are the sewer lines. Penetrations of the slab include about one dozen floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The building is currently occupied 24 hours/day. There are three work shifts, with up to 30 people in the building during the day shift. The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was performed on September 21, 2016. Drains and other openings were screened with a photoionization detector (PID) and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the primary chemicals identified were bleach and various

household cleaning products (e.g., disinfectant wipes, air freshener, glass cleaner, and toilet bowl cleaner).

Based on Department of Environmental Quality (DEQ) guidance and the square footage of the building, indoor air and sub-slab soil gas samples were collected at nine locations within the building (see Figure 5.1.2-2) and concurrent outdoor air samples were collected at one or two locations.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 34. The sampling events encompass more than one year of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.2-A and indoor and outdoor air or Table 5.1.2-B. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors (α) were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil-gas at concentrations that exceeded draft project-specific screening levels;

b) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) Tetrachloroethene (PCE) and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the draft project-specific screening levels were TCE, 1,2,4-TCB, 1,3-DCB, 1,4-DCB, HCB, and naphthalene. The other analytes detected at concentrations $\geq$1,000 µg/m^3 in soil gas were PCE, 1,2-DCB, hexane, heptane, and toluene. While naphthalene is an AOI in sub-slab soil gas, it is not included in this evaluation due to its low detection frequency. It was only detected in sub-slab soil gas in two of nine samples during E1, and was not detected during any other sampling events. Other petroleum hydrocarbons (i.e., hexane, heptane, and toluene) were given relatively low priority in this evaluation due to their low detection frequency. Sample results for these analytes are provided in the following data tables.

Summary of Results for Tetrachloroethene (PCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<5.7	0.82	0.22	1.7
	34-OA-02	<5.8	--	--	---
Indoor Air	34-IA-01	<5.5	9.8	<0.27	2.1
	34-IA-02	<4.8	<0.25	0.24	1.7
	34-IA-03	<5.7	<0.22	<0.25	1.7
	34-IA-04	<5.8	<0.23	<0.24	1.7
	34-IA-05	<5.7	<0.23	<0.22	1.7
	34-IA-06	<5.0	<0.21	<0.21	1.6
	34-IA-07	<5.6	0.24	0.71	1.8
	34-IA-08	<6.0	0.76	0.43	1.6
	34-IA-09	<5.8	<0.23	<0.22	1.5
Sub-Slab Soil Gas	34-SS-01	1,500	670	470	230
	34-SS-02	110	330	100	95
	34-SS-03	14	60	12	14
	34-SS-04	20	23	13	11
	34-SS-05	19	66	34	36
	34-SS-06	26	18	35	<5.8
	34-SS-07	<15	43	5.6	30
	34-SS-08	12	16	26	38
	34-SS-09	27	28	13	23

Screening level for indoor air is 82 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 2,700 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for Trichloroethene (TCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<4.5	<0.19	<0.17	0.28
	34-OA-02	<4.6	--	--	---
Indoor Air	34-IA-01	<4.4	<0.18	<0.22	<0.19
	34-IA-02	<3.8	0.53	<0.18	1.3
	34-IA-03	<4.5	<0.17	<0.20	<0.18
	34-IA-04	<4.6	<0.18	<0.19	<0.18
	34-IA-05	<4.5	<0.18	<0.18	<0.18
	34-IA-06	<4.0	<0.17	<0.17	<0.18
	34-IA-07	<4.4	0.18	<0.23	<0.20
	34-IA-08	<4.7	<0.20	<0.18	<0.17
	34-IA-09	<4.6	<0.18	<0.18	<0.19
Sub-Slab Soil Gas	34-SS-01	260	150	120	63
	34-SS-02	37	120	27	30
	34-SS-03	<4.2	18	<3.9	<4.1
	34-SS-04	<4.6	<4.1	<4.5	<4.4
	34-SS-05	<4.9	5.7	<4.0	4.6
	34-SS-06	18	29	55	17
	34-SS-07	<12	19	<4.4	<4.3
	34-SS-08	<4.2	<4.4	4.5	7.4
	34-SS-09	<5.6	5.1	4.4	5.5

Screening levels for indoor air are 4 µg/m³ ($RIASL_{12}$) and 12 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 130 µg/m³ ($RIASL_{12}$) and 400 µg/m³ ($TSRIASL_{12}$)

Summary of Results for 1,2,4-Trichlorobenzene (1,2,4-TCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<25	<6.6	<6.0	<6.8
	34-OA-02	<25	--	--	--
Indoor Air	34-IA-01	<24	<6.0	<7.5	<6.5
	34-IA-02	<21	<6.9	<6.1	<6.3
	34-IA-03	<25	<6.0	<6.8	<6.3
	34-IA-04	<25	<6.2	<6.4	<6.2
	34-IA-05	<25	<6.3	<6.2	<6.1
	34-IA-06	<22	<5.9	<5.8	<6.2
	34-IA-07	<24	<5.9	<7.9	<6.8
	34-IA-08	<26	<6.8	<6.2	<6.0
	34-IA-09	<25	<6.4	<6.1	<6.5
Sub-Slab Soil Gas	34-SS-01	8,600	4,800	240	<23
	34-SS-02	13,000	19,000	1,000	190
	34-SS-03	53	<24	<21	<23
	34-SS-04	<25	<23	<25	<24
	34-SS-05	<27	<25	<22	<22
	34-SS-06	1,500	<24	<46	<25
	34-SS-07	<64	<24	<24	<24
	34-SS-08	<23	<24	<21	<23
	34-SS-09	<31	<21	<23	24

Screening levels for indoor air are 6.2 µg/m³ ($RIASL_{12}$) and 19 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 200 µg/m³ ($RIASL_{12}$) and 610 µg/m³ ($TSRIASL_{12}$)

Summary of Results for 1,2-Dichlorobenzene (1,2-DCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<5.0	<1.1	<0.97	<1.1
	34-OA-02	<5.1	--	--	--
Indoor Air	34-IA-01	<4.9	<0.98	<1.2	<1.0
	34-IA-02	<4.3	<1.1	<0.99	<1.0
	34-IA-03	<5.1	<0.97	<1.1	<1.0
	34-IA-04	<5.1	<1.0	<1.0	<1.0
	34-IA-05	<5.1	<1.0	<1.0	<0.99
	34-IA-06	<4.4	<0.95	<0.94	<1.0
	34-IA-07	<4.9	<0.95	<1.3	<1.1
	34-IA-08	<5.3	<1.1	<1.0	<0.97
	34-IA-09	<5.1	<1.0	<0.99	<1.0
Sub-Slab Soil Gas	34-SS-01	4,800	34	<4.6	<4.7
	34-SS-02	140	320	<4.3	7.0
	34-SS-03	<4.7	<4.8	<4.3	<4.6
	34-SS-04	<5.1	<4.6	<5.0	<4.9
	34-SS-05	<5.5	<5.1	<4.4	<4.5
	34-SS-06	6.6	<4.8	<9.4	<5.1
	34-SS-07	<13	<4.9	<4.9	<4.8
	34-SS-08	<4.7	<5.0	<4.2	<4.7
	34-SS-09	<6.2	<4.3	5.2	<4.9

Screening level for indoor air is 920 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 31,000 µg/m³ ($RIASL_{12}$)

Summary of Results for 1,3-Dichlorobenzene (1,3-DCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<5.0	<1.1	<0.97	1.1
	34-OA-02	<5.1	--	--	---
Indoor Air	34-IA-01	<4.9	<0.98	<1.2	<1.0
	34-IA-02	<4.3	<1.1	<0.99	<1.0
	34-IA-03	<5.1	<0.97	<1.1	<1.0
	34-IA-04	<5.1	<1.0	<1.0	<1.0
	34-IA-05	<5.1	<1.0	<1.0	<0.99
	34-IA-06	<4.4	<0.95	<0.94	<1.0
	34-IA-07	<4.9	<0.95	<1.3	<1.1
	34-IA-08	<5.3	<1.1	<1.0	<0.97
	34-IA-09	<5.1	<1.0	<0.99	<1.0
Sub-Slab Soil Gas	34-SS-01	400	26	8.1	<4.7
	34-SS-02	67	250	8.5	10
	34-SS-03	<4.8	<4.8	6.8	<4.6
	34-SS-04	<5.1	<4.6	6.7	<4.9
	34-SS-05	<5.5	<5.1	6.9	<4.5
	34-SS-06	5.9	<4.8	<9.4	<5.1
	34-SS-07	<13	6.7	7.1	<4.8
	34-SS-08	<4.7	<5.0	9.6	<4.7
	34-SS-09	<6.2	<4.3	7.2	<4.9

Screening levels for indoor air are 9.2 µg/m³ ($RIASL_{12}$) and 28 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 310 µg/m³ ($RIASL_{12}$) and 920 µg/m³ ($TSRIASL_{12}$)

Summary of Results for 1,4-Dichlorobenzene (1,4-DCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<5.0	<0.21	<0.19	0.55
	34-OA-02	<5.1	--	--	--
Indoor Air	34-IA-01	<4.9	0.21	<0.24	0.51
	34-IA-02	<4.3	<0.22	<0.20	0.49
	34-IA-03	<5.1	<0.19	<0.22	0.54
	34-IA-04	<5.1	<0.20	<0.21	0.47
	34-IA-05	<5.1	<0.20	<0.20	0.55
	34-IA-06	<4.4	<0.19	<0.19	0.51
	34-IA-07	<4.9	<0.19	<0.26	0.53
	34-IA-08	<5.3	<0.22	<0.20	0.56
	34-IA-09	<5.1	<0.21	<0.20	0.57
Sub-Slab Soil Gas	34-SS-01	2,000	270	23	4.8
	34-SS-02	890	1,400	42	56
	34-SS-03	<4.8	<4.8	<4.3	<4.6
	34-SS-04	<5.1	<4.6	<5.0	<4.9
	34-SS-05	<5.5	<5.1	<4.4	<4.5
	34-SS-06	64	<4.8	<9.4	<5.1
	34-SS-07	<13	11	<4.9	<4.8
	34-SS-08	<4.7	<5.0	4.9	5.2
	34-SS-09	<6.2	<4.3	<4.7	7.1

Screening levels for indoor air are 30 µg/m³ ($RIASL_{12}$) and 300 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 1,000 µg/m³ ($RIASL_{12}$) and 10,000 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Hexachlorobutadiene (HCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<36	<9.4	<8.6	<9.8
	34-OA-02	<36	--	--	---
Indoor Air	34-IA-01	<35	<8.7	<11	<9.3
	34-IA-02	<30	<10	<8.8	<9.1
	34-IA-03	<36	<8.6	<9.8	<9.1
	34-IA-04	<36	<9.0	<9.3	<9.0
	34-IA-05	<36	<9.1	<8.8	<8.7
	34-IA-06	<32	<8.4	<8.4	<9.0
	34-IA-07	<35	<8.4	<11	<9.8
	34-IA-08	<38	<9.7	<8.9	<8.6
	34-IA-09	<36	<9.2	<8.7	<9.3
Sub-Slab Soil Gas	34-SS-01	280	<100	38	<33
	34-SS-02	<270	<340	<30	<36
	34-SS-03	<34	<34	<31	<33
	34-SS-04	<36	<33	<35	<34
	34-SS-05	<39	<36	<31	<32
	34-SS-06	<41	<34	<66	<36
	34-SS-07	<92	<34	<35	<34
	34-SS-08	<33	<35	<30	<33
	34-SS-09	<44	<31	<33	<35

Screening level for indoor air is 5.4 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 180 µg/m³ ($RIASL_{12}$)

Summary of Results for Naphthalene

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<8.8	<0.46	<0.42	<0.48
	34-OA-02	<9.0	--	--	---
Indoor Air	34-IA-01	<8.5	<0.43	<0.53	<0.46
	34-IA-02	<7.4	<0.49	<0.43	<0.45
	34-IA-03	<8.8	<0.42	<0.48	<0.45
	34-IA-04	<9.0	<0.44	<0.46	<0.44
	34-IA-05	<8.8	<0.44	<0.44	<0.43
	34-IA-06	<7.8	<0.41	<0.41	<0.44
	34-IA-07	<8.6	<0.41	<0.56	<0.48
	34-IA-08	<9.2	<0.48	<0.44	<0.42
	34-IA-09	<9.0	0.49	<0.43	<0.46
Sub-Slab Soil Gas	34-SS-01	300	<26	<8.0	<8.2
	34-SS-02	<67	<83	<7.5	<8.8
	34-SS-03	<8.3	<8.4	<7.5	<8.1
	34-SS-04	<8.9	<8.1	<8.7	<8.5
	34-SS-05	<9.6	<8.8	<7.7	<7.8
	34-SS-06	10	<8.3	<16	<8.9
	34-SS-07	<23	<8.5	<8.5	<8.4
	34-SS-08	<8.2	<8.6	<7.4	<8.2
	34-SS-09	<11	<7.5	<8.2	<8.5

Screening level for indoor air is 3.6 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 120 µg/m³ ($RIASL_{12}$)

Summary of Results for Hexane

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<2.9	<0.62	<0.57	<0.64
	34-OA-02	<3.0	--	--	---
Indoor Air	34-IA-01	<2.9	0.55	<0.71	<0.62
	34-IA-02	<2.5	1.8	1.0	0.90
	34-IA-03	<3.0	0.73	1.3	<0.60
	34-IA-04	<3.0	<0.59	<0.61	<0.59
	34-IA-05	<3.0	0.61	0.67	<0.58
	34-IA-06	<2.6	<0.56	0.77	<0.59
	34-IA-07	2.9	<0.56	<0.75	<0.64
	34-IA-08	<3.1	1.2	<0.59	<0.57
	34-IA-09	<3.0	0.81	<0.58	<0.62
Sub-Slab Soil Gas	34-SS-01	80	41	13	22
	34-SS-02	<22	<28	8.4	8.2
	34-SS-03	12	18	3.0	6.2
	34-SS-04	16	27	6.2	9.1
	34-SS-05	13	5.2	<2.6	<2.6
	34-SS-06	520	240	1,400	700
	34-SS-07	540	92	330	560
	34-SS-08	8.6	10	11	5.5
	34-SS-09	46	48	5.9	38

Screening levels for indoor air are 2,200 µg/m³ ($RIASL_{12}$) and 6,600 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 72,000 µg/m³ ($RIASL_{12}$) and 210,000 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Heptane

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<3.4	<0.72	<0.66	<0.75
	34-OA-02	<3.5	--	--	---
Indoor Air	34-IA-01	<3.3	<0.67	<0.83	0.94
	34-IA-02	<2.9	0.96	0.75	1.1
	34-IA-03	<3.5	<0.66	1.4	0.79
	34-IA-04	<3.5	<0.69	<0.71	0.93
	34-IA-05	<3.5	<0.70	0.69	0.80
	34-IA-06	<3.0	<0.65	0.83	<0.69
	34-IA-07	<3.4	<0.65	<0.88	0.74
	34-IA-08	<3.6	0.90	<0.68	0.81
	34-IA-09	<3.5	<0.71	<0.67	<0.72
Sub-Slab Soil Gas	34-SS-01	98	27	9.5	22
	34-SS-02	<26	<32	6.6	9.8
	34-SS-03	8.7	12	4.3	5.1
	34-SS-04	12	13	6.9	7.4
	34-SS-05	9.6	<3.5	<3.0	<3.0
	34-SS-06	450	160	1,100	600
	34-SS-07	340	51	320	530
	34-SS-08	5.4	6.9	8.2	4.6
	34-SS-09	40	33	7.7	37

Screening level for indoor air is 10,800 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 360,000 µg/m³ ($RIASL_{12}$)

Summary of Results for Toluene

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Nov. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	34-OA-01	<3.1	0.88	0.9	1.9
	34-OA-02	<3.2	--	--	---
Indoor Air	34-IA-01	<3.1	0.94	0.60	2.0
	34-IA-02	<2.7	0.98	1.6	8.6
	34-IA-03	<3.2	0.94	1.4	2.0
	34-IA-04	<3.2	0.94	1.2	2.1
	34-IA-05	<3.2	0.93	0.80	2.0
	34-IA-06	4.9	0.89	0.78	2.0
	34-IA-07	5.4	1.8	0.92	3.5
	34-IA-08	3.8	1.2	0.53	1.9
	34-IA-09	<3.2	1.6	0.45	2.0
Sub-Slab Soil Gas	34-SS-01	130	39	44	150
	34-SS-02	<24	37	20	60
	34-SS-03	7.8	19	35	33
	34-SS-04	13	13	23	59
	34-SS-05	14	7.2	3.6	7.7
	34-SS-06	560	170	1,000	540
	34-SS-07	420	89	470	590
	34-SS-08	12	11	8.9	9.4
	34-SS-09	58	48	15	46

Screening level for indoor air is 7,500 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 250,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

	RIASL12 Exceedance
	TSRIASL12 Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 34 are discussed below for both `sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

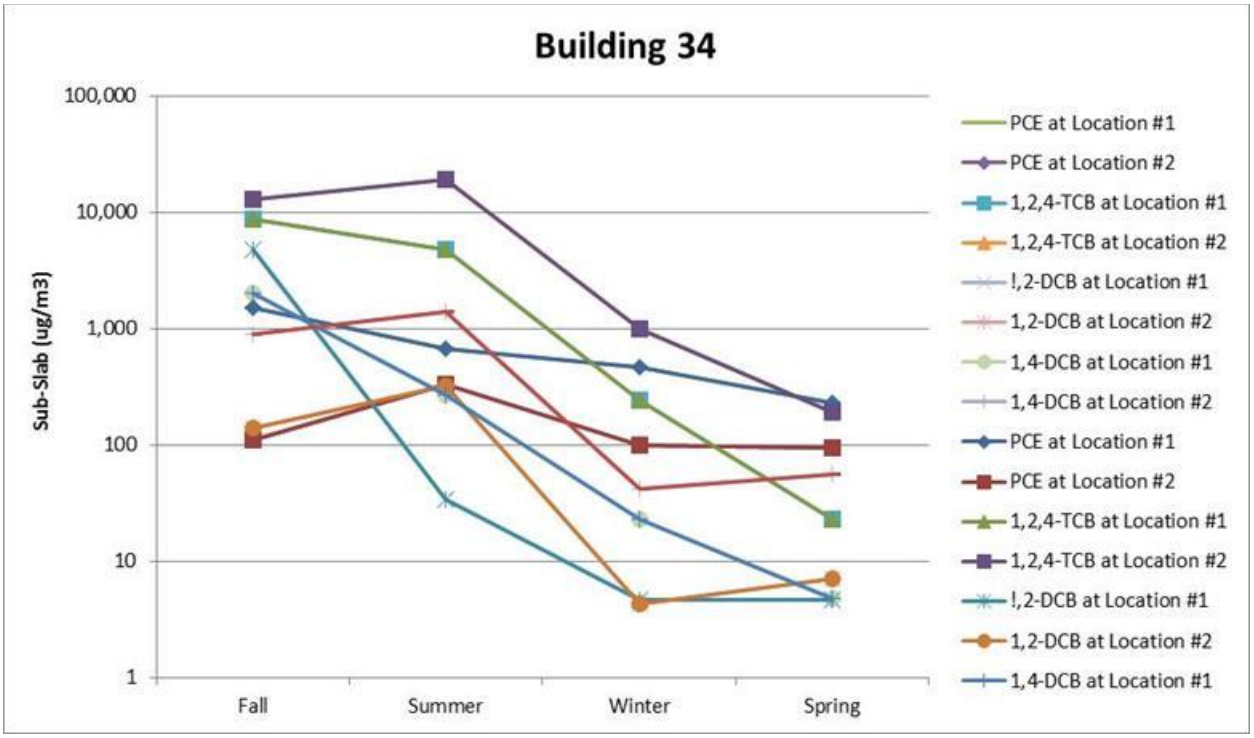
The variability across all locations over all sampling events is the total variability. This encompasses various types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability. The comparison of two data values is typically expressed as a relative percent difference (RPD). The comparison of three of more data values is typically expressed as the coefficient of variation (%CV), which is the standard deviation divided by the mean.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits up to three orders of magnitude of spatial variability. For example, sub-slab soil gas detections of 1,2,4-TCB vary from <21 to 19,000 µg/m³ (log of max./min. = 3.0) across all nine locations for E2. Sub-slab detections of 1,2-DCB vary from <4.7 to 4,800 µg/m³ (log of max./min. = 3.0) across all nine locations for E1. The spatial variability approaches three orders of magnitude for other compounds detected at concentrations >1,000 µg/m³, such as PCE; 1,4-DCB; hexane; heptane; and toluene. The spatial variability is closer to two orders of magnitude for compounds detected at lower concentrations, such as TCE; 1,3-DCB; HCB; and toluene.

Temporal Variability of Soil Gas – The soil gas exhibits up to three orders of magnitude of temporal variability. For example, sub-slab soil gas concentrations of 1,2-DCB vary from 4,800 to <4.6 µg/m^3 at location 34-SS-01 (log max/min = 3.0). Sub-slab concentrations of 1,2,4-TCB vary from 19,000 to 190 µg/m^3 at location #2 (log max/min = 2.0). Based on this evaluation, the temporal variability is nearly as large as the spatial variability, which is contrary to expectations. However, the data set, is dominated by ND values (e.g., TCE at 42% ND and 1,2,4-TCB at 72% ND), which may obscure underlying data trends.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the sub-slab soil gas data exhibits a clear downward trend over the course of the four sampling events. This is illustrated in the graph below, which shows results for two locations with the highest concentrations for the four analytes detected at the highest concentrations (i.e., 34-SS-01 and 34-SS-02). Note that the y-axis is a log scale. So, while there is a time dependence, there does not appear to be a seasonal dependence.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For PCE, TCE, 1,2-DCB, 1,3-DCB, 1,4-DCB, and naphthalene, the maximum sub-slab soil gas concentration was obtained during E1. For 1,2,4-TCB at location 34-SS-02, the sub-slab soil gas concentration was highest during E2. The value increased from 13,000 µg/m^3 during E1 to 19,000 µg/m^3 during E2. If only the first sampling event had been performed, a negative bias of 46% would have been introduced (i.e., the value for E2 was 46% higher than the value for E1).

The highest sub-slab soil gas concentrations for hexane, heptane, and toluene occurred at location 34-SS-06 during E3. The negative bias ranged from 79% to 169% would have been introduced if only the first sampling event had been performed.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits relatively little spatial variability for any given sampling event. For example, PCE was detected in all nine indoor air samples during E4 and varied from 1.5 to 2.1 µg/m^3 (CV] = 9%). During that same event, 1,4-DCB was detected in all nine indoor air

samples and varied from 0.47 to 0.57 µg/m^3 (CV = 6%). This suggests that the air within the building is well-mixed and/or the chemicals of interest are not extensively used within the building. For other analytes and for other sampling events, the large number of ND values in the indoor air data set generally limits what trends can be evaluated. For example, TCE was ND in 33 of the 36 indoor air samples (92%).

During E2, a relatively high value for PCE was measured at 34-IA-01. For PCE during that sampling event, the detected indoor air concentrations vary from 0.24 to 9.8 µg/m^3 (log of max./min. = 1.6).

Temporal Variability of Indoor Air – There are not enough detected values in indoor air to fully evaluate the temporal variability. PCE was detected three times at location 34-IA-07 (0.24, 0.71, and 1.8 µg/m^3) and three times at location 34-IA-08 (0.76, 0.43, and 1.6 µg/m^3). Based on that limited data, there is less than one order of magnitude of variability. When the outdoor air concentrations are taken into account, these PCE results would be zero or close to zero, and the actual temporal variability is likely far less than one order of magnitude. This degree of temporal variability is considered to be small.

Hexane and heptane were detected in the indoor air at some locations during E2, E3, and E4. These analytes exhibited about a factor of two variability across these events. Toluene was detected at most locations during E2, E3, and E4 and exhibited temporal variability of up to one order of magnitude (i.e., at IA-34-02).

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas data also exhibit greater temporal variability than the indoor air data set, which is contrary to expectations. This suggests that the AOIs are not currently in regular use in these buildings. The comparisons, however, are limited by the large percentage of ND values in both the sub-slab soil gas and the indoor air data sets.

Seasonal Effects – The sub-slab soil gas data exhibit some time dependence, as the most recent samples (winter and spring) have the lowest concentrations. This change over time is likely not related to seasonal changes and, if part of a long-term downward trend, serves to obscure any seasonal effects. The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentration was measured in August (1,2,4-TCB at location 34-SS-02). Similarly, the highest indoor air concentration for PCE was also measured in August.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum values. The best estimate of attenuation factor for this building is 3.6E-04, based on the maximum sub-slab soil gas and maximum indoor air results for 1,2,4-TCB during E2 (<6.9/19,000 = <3.6E-04). The calculated event-specific attenuation factors are shown in Table 1. No meaningful evaluation of the temporal variability in attenuation factor was possible given the limitations of the data set (i.e., ND values and the difficulty of determining the contribution of outdoor air).

Table 1. Comparison of Building-Specific Attenuation Factors by Event

	E1 (Fall)	E2 (Summer)	E3 (Winter)	E4 (Spring)
Maximum Values				
1,2,4-TCB in Sub-Slab Soil Gas (µg/m^3)	13,000	19,000	1,000	190
1,2,4-TCB in Indoor Air (µg/m^3)	<26	<6.9	<7.9	<6.8
Attenuation Factor	<2.0E-03	<3.6E-04	<7.9E-03	<0.036

NON-DETECT EVALUATION

There have been no detections of 1,2,4-TCB in indoor air, but the ND RLs often exceed the draft project-specific RIASL$_{12}$ for 1,2,4-TCB (6.2 µg/m^3). As shown in Table 2, using the selected building-specific

attenuation factor, indoor air concentrations due to VI were estimated based on the maximum detected sub-slab soil gas concentration for each event.

Table 2. Evaluation of Estimated Indoor Air Concentrations

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value for 1,2,4-TCB				
Maximum Detection of 1,2,4-TCB in Sub-Slab Soil Gas (μg/m^3)	13,000	19,000	1,000	190
Predicted Indoor Air Impacts (μg/m^3)[a]	<4.7	<6.9	<0.36	<0.07
Exceedance of Screening Level of 6.2 μg/m^3?	No	Unlikely[b]	No	No
Evaluation Based on Maximum Detection Limit for HCB				
Maximum Detection of HCB in Sub-Slab Soil Gas (μg/m^3)	<280	<340	No SL exceedances	No SL exceedances
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.10	<0.12	NA	NA
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for EDB				
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	<49	<61	<12	No SL exceedances
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.02	<0.004	NA
Exceedance of Screening Level of 0.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,1,2-TCA				
Maximum Detection of 1,1,2-TCA in Sub-Slab Soil Gas (μg/m^3)	<35	<43	No SL exceedances	No SL exceedances
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.01	<0.02	NA	NA
Exceedance of Screening Level of 0.62 μg/m^3?	No	No	No	No

[a] – Based on the selected building-specific attenuation factor of <3.6E-04.
[b] – Outdoor air sample was <6.6 μg/m^3, so outdoor air may account for most of any indoor level

As shown in Table 2, the ND evaluation demonstrates that the estimated indoor air concentrations for 1,2,4-TCB attributable to VI are below the draft project-specific $RIASL_{12}$ for three of the four sampling events.

A similar calculation was performed for TCE, where relatively high detection limits for indoor air for E1 exceeded screening levels. For TCE, the highest sub-slab value of 260 μg/m^3 results in an indoor air impact of only 0.09 μg/m^3 when the building-specific attenuation factor is applied, which is well below the $RIASL_{12}$ of 4 μg/m^3..

Three analytes (HCB, 1,2-dibromoethane [EDB], and 1,1,2-trichloroethane [1,1,2-TCA]) have one or more NDs that exceed the draft project-specific screening levels in sub-slab soil gas. Also, these three analytes each have one or more ND values in indoor air that exceed the relevant indoor air screening levels. As shown in Table 2, using the selected building-specific attenuation factor, indoor air concentrations attributable to VI were estimated based on the maximum detection limit for sub-slab soil gas for each event.

The ND evaluation demonstrates that the estimated indoor air concentrations for these analytes attributable to VI are below the draft project-specific screening levels for each analyte.

A summary of all VI data trends and findings is presented in Table 3.

Table 3. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	Up to three orders of magnitude	1,2,4-TCB during E2 ranged from <21 to 19,000 μg/m^3, log max./min. = 3.0 1,2-DCB during E1 ranged from <4.7 to 4,800 μg/m^3, log max./min. = 3.0
Temporal Variability of Soil Gas	Up to three orders of magnitude	1,2,4-TCB at location 34-SS-02 ranged from 190 to 19,000 μg/m^3, log max./min. = 2.0
Seasonal Trend Analysis	Seasonal sampling is appropriate	>85% reduction in soil gas concentrations over 18 months, but no seasonal dependence
Spatial Variability of Indoor Air	Generally very little variability during any event	PCE during E4 had CV = 9%. 1,4-DCB during E4 had CV = 6%. Detected PCE during E2 varied from 0.24 to 9.8 μg/m^3, log max./min. = 1.6
Temporal Variability of Indoor Air	Less than one order of magnitude	Data trends difficult to determine given large percentage of ND values and potential contribution from outdoor air.
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. More temporal variability in soil gas than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas > indoor air
Seasonal Effects	Winter and spring had the lowest concentrations.	Data did not support the hypothesis that wintertime should have the highest indoor air impacts.
Best Estimate of Attenuation Factor	3.6E-04 (0.00036)	Most conservative value based on maximum detected sub-slab soil gas results during E2
Temporal Variability in Attenuation Factor	No finding	Numerous ND values and large decrease in soil gas concentrations over time obscure any trends.
Overall Summary	Strong time dependence of sub-slab soil gas values. No increase in impacts during wintertime.	Summertime sampling event had highest sub-slab soil gas concentration of 1,2,4-TCB. Summertime sampling event had highest indoor air concentration of PCE.

WEIGHT-OF-EVIDENCE SUMMARY

Building 34 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the draft project-specific $RIASL_{12}$ and/or $TSRIASL_{12}$, if available. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 34:

- No exceedances of draft project-specific screening levels in indoor air.
- With one exception (1,2,4-TCB), no exceedances of draft project-specific $TSRIASL_{12}$ in sub-slab soil gas.
- The majority of the building appears to have sub-slab soil gas concentrations below the draft project-specific $RIASL_{12}$ with the exception of very localized areas of relatively high concentrations.
- The sub-slab soil gas data set exhibits a strong time dependence, whereas the indoor air data does not.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the summer (e.g., 1,2,4-TCB at locations 34-SS-01 and 34-SS-02). Similarly, the highest indoor air concentration for PCE also was measured in the summer.

- The indoor air data exhibit relatively little spatial variability.
- As shown in the table below, the building-specific attenuation factor yields estimated indoor air concentrations well below screening levels.

Parameters	TCE	1,2,4-TCB	1,3-DCB	1,4-DCB	HCB	Naphtha.
Building-specific AF	3.6E-04	3.6E-04	3.6E-04	3.6E-04	3.6E-04	3.6E-04
Maximum detected concentration in SSSG	260	19,000	400	2,000	280	300
Maximum ND RL in SSSG	<12	<64	<13	<13	<340	<83
Estimated Indoor Air Concentration - Detected	**0.09**	**6.8**	**0.14**	**0.72**	**0.10**	**0.11**
Estimated Indoor Air Concentration - ND	**<0.004**	**<0.02**	**<0.005**	**<0.005**	**<0.12**	**<0.03**
Indoor Air $RIASL_{12}$	4	6.2	9.2	30	5.4	3.6
Indoor Air $TSRIASL_{12}$	12	19	28	300	180	NA

Based on the CSM for Building 34, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 34 and the sub-slab soil gas results have demonstrated a decrease in concentrations over time. There is no evidence of increasing concentrations over time for any of the chlorinated hydrocarbons. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, long-term monitoring (LTM) is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow will implement an interim monitoring plan at Building 34 until a revised program or more permanent corrective action plan is developed for the site.

Differential pressure (ΔP) measurements will be made at Building 34 to provide another line of evidence in support that VI is insignificant at this building. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). Measurements will be collected at Sample Location 34-xx-01. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., Midland, Bay City, and Saginaw International Airport [MBS]) or Dow Midland Facility meteorological station, if available.

Indoor air will be monitored at location 34-IA-01. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for TCE, 1,2,4-TCB, 1,3-DCB, 1,4-DCB, HCB, and naphthalene. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, MDEQ will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air

results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.1.3 VI Seasonal Confirmation Sampling Results Evaluation for Building 1335

INTRODUCTION

Building 1335 is a Category 1 building located within the southeast portion of the facility designated as Zone 1. It is known as the 23 Gatehouse or Contractor Gate and is a small building that includes space utilized by security personnel and visitors checking into the facility.

The initial evaluation in the 2017 CAIP concluded that based on current use and the indoor air results, the VI pathway at Building 1335 is an insignificant exposure pathway However, based on the sub-slab soil gas results, Building 1335 was determined to have the potential for future VI, and it was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) and the seasonal confirmation sampling event (E2) were evaluated in the 2017 CAIP. The remaining two seasonal events (E3 & E4) were completed and the results of all four of these sampling events were included in the 2018 Rescreen.

Building 1335	
Initial Sampling Event	**Completed**
E1	Nov 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	Aug 2017 (Summer)
E3	Feb 2018 (Winter)
E4	Apr 2018 (Spring)

The findings of the 2018 Rescreen supported the conclusions of the 2017 CAIP, and Building 1335 remained a Group 2 building. Based on the rescreen, no indoor air analytes were detected above screening levels during any of the sampling events at Building 1335. The sub-slab soil gas AOIs are dichlorodifluoromethane (CFC-12), HCB, and TCE due to exceedances of the draft project-specific $RIASL_{12}$. There were no sub-slab soil gas results above the $TSRIASL_{12}$ at Building 1335.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 1335. The CSM is illustrated in Figure 5.1.3-1.

Building 1335 is one-story tall and contains desk space for security personnel and a small lobby used by visitors checking in to the facility. The building is slab-on-grade construction with a footprint of approximately 630 ft^2 (59 m^2). The building has central AC and steam heat. The AC air intake is located

at the back of the building. The air handling unit has a 1,500 cubic ft per minute fan. Assuming 10-ft ceilings and 15% fresh make-up air, the building has an estimated 2.1 air changes per hour (ACH).

There are no large bay doors or garage doors. The only underground utilities are the sewer lines. Penetrations of the slab include two floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest. Building 1335 was constructed around 1990. Any impacts to the groundwater or soils beneath the building are believed to pre-date construction of the building. Therefore, the source of any vapors beneath the building is unrelated to building operation.

Building 1335 is an active gatehouse and is currently occupied from 6am to 6pm Monday through Friday. The typical parameters for non-residential exposures are assumed to apply to the various security personnel stationed during rotating work shifts at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was performed on September 28, 2016. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the only chemicals identified were various household cleaning products (e.g., disinfectant, glass cleaner, drain cleaner, cinnamon air freshener).

Based on DEQ guidance and the square footage of the building, indoor air and sub-slab soil gas samples were collected at two locations within the building (see Figure 5.1.3-2) and concurrent outdoor air samples were collected at one location.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 1335. The sampling events encompass more than one year of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.3-A and indoor and outdoor air or Table 5.1.3-B. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil gas at concentrations that exceeded draft project-specific screening levels;

b) Analytes detected in sub-slab soil gas at concentrations of 1,000 micrograms per cubic meter ($\mu g/m^3$) or greater in one or more samples. Data for analytes detected above 1,000 $\mu g/m^3$ should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the draft project-specific screening levels were CFC-12, HCB, and TCE. The only analytes detected at

concentrations greater than or equal (≥) to1,000 µg/m^3 in soil gas were CFC-12, HCB, and PCE. Sample results for these analytes are provided in the following data tables.

Summary of Results for Dichlorodifluoromethane (CFC-12)

		Measured Concentration (µg/m^3)			
		Nov. 2016	Aug. 2017	Feb. 2018	Apr 2018
Sample Type	Sample ID	E1	E2	E3	E4
Outdoor Air	1335-OA-01	<3.8	2.8	2.4	2.2
Indoor Air	1335-IA-01	12	27	13	4.6
	1335-IA-02	11	22	9.7	4.8
Sub-Slab Soil Gas	1335-SS-01	300,000	680,000	540,000	330,000
	1335-SS-02	18,000	22,000	9,800	14,000

Screening level for indoor air is 1,020 µg/m^3 (RIASL$_{12}$)
Screening level for soil gas is 34,000 µg/m^3 (RIASL$_{12}$)

Summary of Results for Hexachlorobutadiene (HCB)

		Measured Concentration (µg/m^3)			
		Nov. 2016	Aug. 2017	Feb. 2018	Apr 2018
Sample Type	Sample ID	E1	E2	E3	E4
Outdoor Air	1335-OA-01	<33	<8.7	<8.5	<9.0
Indoor Air	1335-IA-01	<35	<8.6	<8.4	<11
	1335-IA-02	<68	<8.4	<9.0	<9.3
Sub-Slab Soil Gas	1335-SS-01	<8,600	<36,000	<13,000	<9,400
	1335-SS-02	3,600	3,800	1,700	1,400

Screening level for indoor air is 5.4 µg/m^3 (RIASL$_{12}$)
Screening level for soil gas is 180 µg/m^3 (RIASL$_{12}$)

Summary of Results for Tetrachloroethene (PCE)

		Measured Concentration (µg/m^3)			
		Nov. 2016	Aug. 2017	Feb. 2018	Apr 2018
Sample Type	Sample ID	E1	E2	E3	E4
Outdoor Air	1335-OA-01	<5.2	0.54	<0.22	<0.23
Indoor Air	1335-IA-01	<5.6	0.72	<0.21	<0.29
	1335-IA-02	<11	0.68	<0.23	<0.24
Sub-Slab Soil Gas	1335-SS-01	<1,400	<5,800	<2,100	<1,500
	1335-SS-02	1,200	890	1,000	700

Screening level for indoor air is 82 µg/m^3 (RIASL$_{12}$ and TRIASL$_{12}$)
Screening level for soil gas is 2,700 µg/m^3 (RIASL$_{12}$ and TRIASL$_{12}$)

Summary of Results for Trichloroethene (TCE)

		Measured Concentration (µg/m^3)			
		Nov. 2016	Aug. 2017	Feb. 2018	Apr 2018
Sample Type	Sample ID	E1	E2	E3	E4
Outdoor Air	1335-OA-01	<4.1	<0.18	<0.17	<0.18
Indoor Air	1335-IA-01	<4.5	<0.17	<0.17	<0.23
	1335-IA-02	<8.5	<0.17	<0.18	<0.19
Sub-Slab Soil Gas	1335-SS-01	<1,100	<4,600	<1,700	<1,200
	1335-SS-02	170	<200	270	170

Screening levels for indoor air are 4 µg/m^3 (RIASL$_{12}$) and 12 µg/m^3 (TRIASL$_{12}$)
Screening levels for soil gas are 130 µg/m^3 (RIASL$_{12}$) and 400 µg/m^3 (TRIASL$_{12}$)

	RIASL12 Exceedance
	TSRIASL12 Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 1335 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

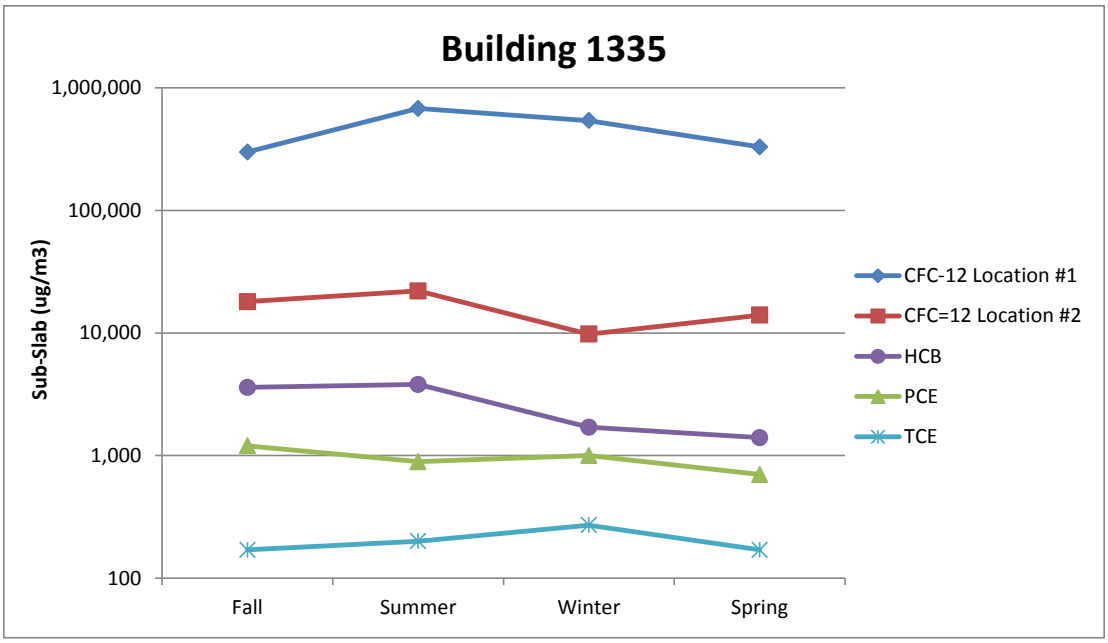
The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – CFC-12 is the only sub-slab soil gas analyte detected in both sample locations during each sampling event. As shown in Attachment 1, the soil gas concentrations of CFC-12 vary from 9,800 to 680,000 $\mu g/m^3$ over the four seasonal confirmation sampling events. The soil gas concentrations of CFC-12 across all four sampling events exhibit slightly less than two orders of magnitude of spatial variability (log of max./min. = 1.8). The maximum variability for any one sampling event was 9,800 to 540,000 $\mu g/m^3$ (log of max./min. = 1.7). Based on CFC-12 data, there is a relatively large amount of spatial variability in sub-slab soil gas given the size of the building and the number of sampling locations. The spatial variability for PCE, TCE, and HCB appears to be about one order of magnitude or less for each analyte, but the evaluation of the data set is limited by the presence of multiple ND values, which may obscure underlying data trends.

Temporal Variability of Soil Gas – The soil gas concentrations from one event to another vary by up to a factor of three. For example, sub-slab soil gas concentrations of CFC-12 vary from 300,000 to 680,000 $\mu g/m^3$ at location 1335-SS-01 (log max/min = 0.36) and from 9,800 to 22,000 $\mu g/m^3$ at location 1335-SS-02 (log max/min = 0.35). As shown in Attachment 1, sub-slab soil gas concentrations of HCB vary from 1,400 to 3,800 $\mu g/m^3$ at location 1335-SS-02 (log max/min = 0.43). Based on this evaluation, there is a relatively modest amount of temporal variability in sub-slab soil gas which is in-line with expectations. Overall, the amount of temporal variability is less than the amount of spatial variability but as previously discussed, the evaluation of the data set is limited by the presence of multiple ND values, which may obscure underlying data trends.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the data does not exhibit any definite upward or downward trend over the course of the four seasonal sampling events; however, for Building 1335 the event with the highest sample results occurred in the summer. This is illustrated in the graph below. Plots for HCB, PCE, and TCE are all for location 1335-SS-02. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For PCE, the highest sub-slab concentration was collected during the initial sampling event (fall) and the lowest concentration occurred during the E4. For CFC-12 and HCB, the highest sub-slab concentrations were collected during E2 (i.e., during summer). The lowest concentrations for CFC-12 and HCB varied by analyte and location. Overall, the minimum and maximum values appear to be randomly distributed among the various sampling events.

For CFC-12 at location 1335-SS-02, the lowest value (300,000 μg/m^3) was measured during E1 and the highest concentration (680,000 μg/m^3) was measured during E2. If only E1 had been performed, a negative bias of 127% would have been introduced (i.e., the E2 result was 127% higher than the E1 result). Therefore, implementing four seasonal confirmation sampling events provided a larger data set and increased the confidence in the findings including demonstrating the consistency of the maximum reported results.

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits very little spatial variability for any sampling event. Since HCB and TCE were ND in indoor air for all four sampling events and PCE was only detected in indoor air during E2, an evaluation of spatial variability could only be performed for CFC-12. The highest spatial variability occurred during E3 where indoor air concentrations of CFC-12 vary from 9.7 to 13 μg/m^3 yielding a RPD of 29%. The RPDs for CFC-12 during the other sampling events are even smaller (4%, 9%, and 20%). The data suggest the air within the building is well-mixed.

Temporal Variability of Indoor Air – The indoor air exhibits less than one order of magnitude of temporal variability. For example, indoor air concentrations of CFC-12 at location 1335-IA-01 varied from 4.6 to 27 μg/m^3 (log of max./min. = 0.77). CFC-12 at location 1335-IA-02 varied from 4.8 to 22 μg/m^3 (log of max./min. = 0.66). Therefore, temporal variability across the four seasons sampled is considered to be relatively small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. Also as expected, the indoor air data exhibit

greater temporal variability than the sub-slab soil gas data set. The temporal variability in indoor air concentrations for CFC-12 is believed to represent day-to-day fluctuations in the insignificant rate of VI. For other analytes, however, the comparisons are limited by the large percentage of ND values in both the sub-slab and the indoor air data sets.

Seasonal Effects – The sub-slab soil gas data exhibit relatively little variability from event to event. Maximum soil-gas values were detected during E2 (i.e., summer). The indoor air data set is predominantly ND values, but the highest CFC-12 values and the only PCE detections occurred during E2 (i.e., also during summer). The data do not support the hypothesis that wintertime should have the highest indoor air impacts.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated for CFC-12 based on maximum values since it had a 100% detection frequency for each of the seasonal confirmation sampling events. The calculated event-specific attenuation factors are shown in Table 1.

Table 1. Comparison of Building-Specific Attenuation Factors by Event

	E1 (Fall)	E2 (Summer)	E3 (Winter)	E4 (Spring)
Maximum Values				
CFC-12 in Sub-Slab Soil Gas ($\mu g/m^3$)	300,000	680,000	540,000	330,000
CFC-12 in Indoor Air ($\mu g/m^3$)	12	27	13	4.8
Attenuation Factor	4E-05	4E-05	2.4E-05	1.5E-05

The best estimate of a building-specific attenuation factor for Building 1335 is 4E-05 based on CFC-12 during E1 and E2. This is the most conservative value.

Temporal Variability in Attenuation Factor – As shown in Table 1, there was minimal temporal variability in the calculated attenuation factors observed in the data set. All calculated attenuation factors fall within a factor of three of one another and this amount of variability is not considered to be significant.

To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. All maximum indoor air and sub-slab soil gas values in Table 2 are from Sample Location 1335-xx-01, with the exception of the indoor air value from E4. In that case, the maximum result and the result from Sample Location 1335-xx-01 were very similar (4.8 $\mu g/m^3$ versus 4.6 $\mu g/m^3$). In general, maximum concentrations were location-specific, but the low spatial variability in indoor air results means that similar attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

There have been no detections of HCB, CFC-12 or TCE in indoor air, but the ND RLs for HCB exceed the draft project-specific $RIASL_{12}$ of HCB (5.4 $\mu g/m^3$). As shown in Table 2, using the selected building-specific attenuation factor, indoor air values for HCB due to VI were estimated based on the maximum detected sub-slab soil gas concentration for each event and the maximum ND RL for each event, since some of the ND RLs exceed the maximum detected results.

Table 2. Evaluation of Estimated Indoor Air Concentrations for HCB

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
Maximum Detection of HCB in Sub-Slab Soil Gas (μg/m^3)	3,600	3,800	1,700	1,400
Predicted Indoor Air Impacts (μg/m^3)[a]	0.14	0.15	0.07	0.06
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No	No
Evaluation Based on Maximum ND Reporting Limit				
Maximum Potential HCB Concentration in Sub-Slab Soil Gas (μg/m^3)[b]	8,600	36,000	13,000	9,400
Predicted Indoor Air Impacts(μg/m^3)[a]	0.34	1.4	0.52	0.38
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No	No

[a] – Based on the selected building-specific attenuation factor of 4E-05.
[b] – Based on maximum ND RL for HCB in soil gas samples.

As shown in Table 2, the ND evaluation demonstrates that all of the estimated indoor air concentrations for HCB attributable to VI are below the draft project-specific RIASL$_{12}$.

A summary of all VI data trends and findings is presented in Table 3.

Table 3. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	Less than two orders of magnitude	CFC-12 at 9,800 to 680,000 μg/m^3, log max./min. = 1.8
Temporal Variability of Soil Gas	Less than a factor of three	HCB at 1,400 to 3,800 μg/m^3, log max./min. = 0.43
Seasonal Trend Analysis	Seasonal sampling is appropriate	No definite upward or downward trend in concentration
Spatial Variability of Indoor Air	Very little variability during any event	CFC-12, RPD = 17%
Temporal Variability of Indoor Air	Less than one order of magnitude	CFC-12, log max./min. = 0.77
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends	Spatial variability: sub-slab > indoor air Temporal variability: indoor air > sub-slab
Best Estimate of Attenuation Factor	4.0E-05 (0.00004)	Most conservative value based on maximum detected results during E1 and E2
Temporal Variability in Attenuation Factor	No significant variability	Attenuation factors for each event were very similar
Overall Summary	Sub-slab soil gas data show no time dependence. No increase in impacts during wintertime.	Summer sampling event showed maximum sub-slab soil gas and maximum indoor air values for CFC-12

WEIGHT-OF-EVIDENCE SUMMARY

Building 1335 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the draft project-specific RIASL$_{12}$. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 1335:

- No exceedances of draft project-specific screening levels in indoor air.
- No exceedances of TSRIASL$_{12}$ in sub-slab soil gas.
- The sub-slab soil gas data do not show any strong time dependence nor do the data show any strong seasonal effects.

- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the summer (e.g., CFC-12 at locations 1335-xx-01 and 1335-xx-02). Similarly, the highest indoor air concentration for CFC-12 also was measured in the summer.

- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This is not surprising, given the small footprint of the building and the building ventilation. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.

- As shown in the table below, the building-specific attenuation factor yields estimated indoor air concentrations well below screening levels.

Parameters	TCE	CFC-12	HCB
Building-specific AF	4.00E-05	4.00E-05	4.00E-05
Maximum detected concentration in SSSG	270	680000	3800
Maximum ND RL in SSSG	1700	--	36000
Estimated Indoor Air Concentration - Detected	**0.011**	**27.2**	**0.15**
Estimated Indoor Air Concentration - ND	**0.068**	**--**	**1.4**
Indoor Air $RIASL_{12}$	4	1,020	5.4
Indoor Air $TSRIASL_{12}$	12	34,000	180

Based on the CSM for Building 1335, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 1335 and the sub-slab soil gas results have demonstrated relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow will implement an interim monitoring plan at Building 1335 until a revised program or more permanent corrective action plan is developed for the site.

Differential pressure measurements will be made at Building 1335 to provide another line of evidence in support that VI is insignificant at this building. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). Measurements will be collected at Sample Location 1335-xx-01. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., MBS) or Dow Midland Facility meteorological station, if available.

Indoor air will be monitored at location 1335-IA-01. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for CFC-12, HCB, and TCE. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, MDEQ will be provided a brief email notification. A

collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.1.4 VI Seasonal Confirmation Sampling Results Evaluation for Building 462

INTRODUCTION

Building 462 is a Category 2 building located north of the WWTP within the southern portion of the facility designated as Zone 1. It is known as the MRO/Investment Recovery Building and is a large warehouse that also contains office space and a shop.

The initial evaluation in the 2017 CAIP concluded that based on current use and the indoor air results, the VI pathway at Building 462 is an insignificant exposure pathway. However, based on the sub-slab soil gas results, Building 462 was determined to have the potential for future VI, and it was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) and the seasonal confirmation sampling event (E2) were evaluated in the 2017 CAIP. The remaining two seasonal events (E3 & E4) were completed and the results of all four of these sampling events were included in the 2018 Rescreen.

Building 462	
Initial Sampling Event	**Completed**
E1	Oct 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	Aug 2017 (Summer)
E3	Feb 2018 (Winter)
E4	May 2018 (Spring)

The findings of the 2018 Rescreen supported the conclusions of the 2017 CAIP, and Building 462 remained a Group 2 building. Based on the rescreen, no indoor air analytes were detected above screening levels during any of the sampling events at Building 462. The sub-slab soil gas AOIs are PCE and TCE due to exceedances of the draft project-specific $RIASL_{12}$ and the $TSRIASL_{12}$.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 462. The CSM is illustrated in Figure 5.1.4-1.

Building 462 is a large, single-story metal building. It is a large warehouse that also contains office space and a shop. The building is slab-on-grade construction with a footprint of approximately 23,890 ft^2

(2,220 m^2). The building has two heating, ventilation, and air conditioning (HVAC) units. One is dedicated to the shop and a larger office area, while the other unit cools the smaller office area. There is an air intake in the front of the building and another air intake located in the back.

There are two bay doors that are left open in good weather. The only underground utilities are the sewer lines. Penetrations of the slab include about a half-dozen floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The building is currently occupied by approximately 30 people, working 8-hour shifts. The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure). Building 462 is connected to Building 1294, the Investment Recovery Warehouse, which has no occupancy and is a Category 3 building.

A building survey was performed on September 29, 2016. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the primary chemicals identified were cleaners.

Based on DEQ guidance and the square footage of the building, indoor air and sub-slab soil gas samples were collected at 10 locations within the building (see Figure 5.1.4-2) and concurrent outdoor air samples were collected at one location.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 462. The sampling events encompass more than one year of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.4-A and indoor and outdoor air or Table 5.1.4-B. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil-gas at concentrations that exceeded draft project-specific screening levels;

b) Analytes detected in sub-slab soil-gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites. For this building, the only analytes detected in the sub-slab soil gas at concentrations above the draft project-specific screening levels were PCE and TCE. No other analytes were detected at concentrations greather than (≥)1,000 µg/m^3 in soil gas except for acetone, which was detected at a concentration of 1,200 µg/m^3 during E2; however, it is not included in this evaluation due to its low detection frequency. Sample results for these analytes are provided in the following data tables.

Summary of Results for Tetrachloroethene (PCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	462-OA-01	<5.7	0.34	0.26	1.1
Indoor Air	462-IA-01	<5.5	0.34	0.42	0.91
	462-IA-02	<5.7	0.36	0.41	0.92
	462-IA-03	<5.7	0.34	0.42	0.97
	462-IA-04	<5.1	0.34	0.55	1.2
	462-IA-05	<5.4	0.44	0.97	1.0
	462-IA-06	<5.2	0.36	0.35	0.95
	462-IA-07	<4.9	0.49	0.50	0.79
	462-IA-08	<5.5	0.49	0.45	1.0
	462-IA-09	<5.6	0.35	0.37	0.98
	462-IA-10	<5.8	0.35	0.34	0.91
Sub-Slab Soil Gas	462-SS-01	370	500	370	330
	462-SS-02	460	420	220	190
	462-SS-03	3,800	4,000	3,500	200
	462-SS-04	780	1,000	650	400
	462-SS-05	25,000	43,000	19,000	18,000
	462-SS-06	87	93	62	40
	462-SS-07	1,400	1,400	1,200	340
	462-SS-08	150	130	36	56
	462-SS-09	2,200	2,000	1,500	1,300
	462-SS-10	730	680	770	650

Screening level for indoor air is 82 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 2,700 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for Trichloroethene (TCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	462-OA-01	<4.5	<0.18	<0.17	<0.18
Indoor Air	462-IA-01	<4.4	<0.16	<0.18	<0.18
	462-IA-02	<4.5	<0.18	<0.17	<0.18
	462-IA-03	<4.5	<0.17	<0.19	<0.18
	462-IA-04	<4.0	<0.18	<0.18	0.21
	462-IA-05	<4.3	<0.19	0.21	<0.18
	462-IA-06	<4.1	<0.16	<0.20	<0.18
	462-IA-07	<3.9	<0.19	<0.18	<0.17
	462-IA-08	<4.3	<0.18	<0.18	<0.19
	462-IA-09	<4.4	<0.19	<0.18	<0.21
	462-IA-10	<4.6	<0.17	<0.18	<0.17
Sub-Slab Soil Gas	462-SS-01	<8.4	<4.2	<4.2	<4.2
	462-SS-02	<4.2	5.0	<4.2	<5.0
	462-SS-03	23	19	13	<4.0
	462-SS-04	4.2	<4.0	<4.2	<4.2
	462-SS-05	1,100	2,500	1,000	1,000
	462-SS-06	<4.0	<4.0	<4.2	<4.5
	462-SS-07	20	25	25	6.4
	462-SS-08	12	4.3	<4.2	<4.1
	462-SS-09	12	5.6	5.2	<4.4
	462-SS-10	6.6	6.8	4.4	9.5

Screening levels for indoor air are 4 µg/m³ ($RIASL_{12}$) and 12 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 130 µg/m³ ($RIASL_{12}$) and 400 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Acetone

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Aug. 2017	Feb. 2018	May 2018
		E1	E2	E3	E4
Outdoor Air	462-OA-01	<20	42	4.8	23
Indoor Air	462-IA-01	120	22	21	29
	462-IA-02	320	35	23	34
	462-IA-03	380	29	29	42
	462-IA-04	360	19	23	40
	462-IA-05	170	24	400 E	510 E
	462-IA-06	75	14	22	23
	462-IA-07	74	52	110	180 E
	462-IA-08	86	64	120	90
	462-IA-09	140	28	27	50
	462-IA-10	110	21	24	28
Sub-Slab Soil Gas	462-SS-01	<37	180	27	35
	462-SS-02	89	88	34	38
	462-SS-03	510	1,200	750	300
	462-SS-04	60	41	35	45
	462-SS-05	<360	250	<180	<180
	462-SS-06	33	47	36	43
	462-SS-07	100	120	82	90
	462-SS-08	98	110	26	61
	462-SS-09	110	43	55	18 J
	462-SS-10	34	55	34	29

Screening level for indoor air is 31,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 1,000,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

	$RIASL_{12}$ Exceedance
	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 462 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

The variability across all locations over all sampling events is the total variability. This encompasses various types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability. The comparison of two data values is typically expressed as a RPD. The comparison of three of more data values is typically expressed as the %CV, which is the standard deviation divided by the mean.

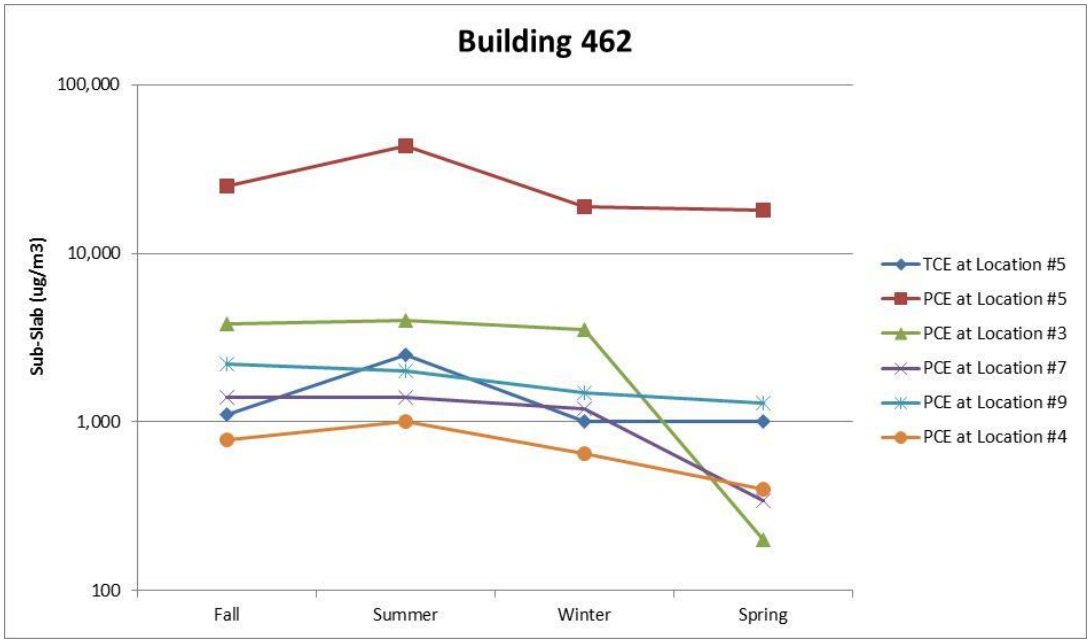
Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits almost three orders of magnitude of spatial variability. For example, sub-slab soil gas detections of PCE vary from 93 to 43,000 µg/m³ (log of max./min. = 2.7) across the 10 locations for E2. During that same sampling event, the range for TCE was <4 to 2,500 µg/m³ (log of max./min. = 2.8). E2 exhibited the maximum detected concentrations for PCE and TCE; however, the results for these analytes were fairly consistent throughout the four events.

Temporal Variability of Soil Gas – The soil gas exhibits approximately a factor of two variability for any given location over the four sampling events. For example, sub-slab soil gas concentrations of PCE vary

from 18,000 to 43,000 µg/m^3 at location 462-SS-05 (CV = 38%). At that same location, the range for TCE was 1,000 to 2,500 µg/m^3 (CV = 46%). Other locations exhibited similar variability, e.g., PCE at locations 462-SS-03, 462-SS-04, 462-SS-07, and 462-SS-09 have CVs of 54%, 31%, 40%, and 21%, respectively. Overall, the amount of temporal variability is less than the amount of spatial variability which is in-line with expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the soil gas data exhibits relatively consistent results with some evidence of a drop in concentration for the most recent sampling events. This is illustrated in the graph below, which shows various analytes at locations where they were detected at relatively high concentrations. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For PCE and TCE, the maximum sub-slab concentration was obtained during E2. For TCE at location 462-SS-05, the value increased from 1,100 µg/m^3 during E1 to 2,500 µg/m^3 during E2. If only the first sampling event had been performed, a negative bias of 127% would have been introduced (i.e., the TCE value for E2 was 127% higher than the TCE value for E1).

Indoor Air Data Trends

Spatial Variability of Indoor Air – PCE during the latter three sampling events was the only AOI that was consistently detected in the indoor air. Based on those results, the indoor air exhibits relatively little spatial variability for any given sampling event. For example, PCE was detected in all 10 indoor air samples and varied from 0.34 to 0.97 µg/m^3 during E3 (CV = 37%). PCE had even less spatial variability during E2 and E4 (CV = 15% and 10%, respectively). The above calculations did not take into account outdoor air concentrations of PCE, which were roughly equivalent to the indoor air concentrations of PCE during each sampling event, indicating that the indoor air may be influenced by outdoor air.

Temporal Variability of Indoor Air – The detected values for PCE exhibit variability of about a factor of three over time. For example, PCE was detected during three of the four sampling events and the values ranged from 0.34 to 1.2 µg/m^3 at location 462-SS-04 and from 0.45 to 1.0 µg/m^3 at location 462-SS-08.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The temporal variability of the indoor air data set was comparable to that for the soil gas data set. The indoor air data had less temporal variability than expected. This suggests that the AOIs are not currently in regular use in this building.

Seasonal Effects –The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations for PCE and TCE were measured in August (summer) and the highest indoor air concentration for PCE were measured in May (spring). The wintertime concentrations for PCE and TCE exhibited no increases for either soil gas or indoor air compared with other sampling events.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum values of sub-slab soil gas and indoor air. Values in Table 1 have not been corrected for any contribution from outdoor air.

Table 1. Calculated Attenuation Factors

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
PCE in Sub-Slab Soil Gas ($\mu g/m^3$)	25,000	43,000	19,000	18,000
PCE in Indoor Air ($\mu g/m^3$)	<5.8	0.49	0.97	1.2
PCE Attenuation Factor	NC	1.1E-05	5.1E-05	6.7E-05
TCE in Sub-Slab Soil Gas ($\mu g/m^3$)	1,100	2,500	1,000	1,000
TCE in Indoor Air ($\mu g/m^3$)	<4.6	<0.19	0.21	0.21
TCE Attenuation Factor	NC	<7.6E-05	2.1E-04	2.1E-04

NC - Not calculated due to elevated detection limits for indoor air.

The best estimate of attenuation factor for this building is 5.1E-05, based on PCE during E3 (0.97/ 19,000 = 5.1E-05). The attenuation factor will be biased high if there is contribution from either outdoor air or indoor sources. For E2 and E4, the measured outdoor air value is roughly equivalent to the measured indoor air values, whereas E3 appears to have the least contribution from outdoor air. In any event, the calculated attenuation factors were similar for PCE during the various sampling events, as shown in Table 1.

Temporal Variability in Attenuation Factor – As shown in Table 1, there was minimal temporal variability in the calculated attenuation factors observed in the data set. All calculated attenuation factors fall within about a factor of five of one another and this amount of variability is not considered to be significant.

To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. All maximum sub-slab soil gas values in Table 1 are from Sample Location 462-SS-05. In general, maximum indoor air concentrations were location-specific, but the low spatial variability in indoor air results means that similar attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

There have been no detections of EDB and various other compounds in indoor air, but the ND RLs often exceed the applicable screening levels. As shown in Table 2, using the selected building-specific attenuation factor, indoor air values due to VI were estimated based on the maximum detected sub-slab soil gas concentration for each event. Six additional analytes had one or more ND values in soil gas that exceeded screening levels and also had multiple ND values in indoor air that exceeded screening levels.

These six additional analytes were 1,1,2,2-tetrachloroethane, 1,1,2-TCA, 1,2,4-TCB, dibromomethane, HCB, and naphthalene. As shown in Table 2, the predicted indoor air concentrations attributable to VI are below the applicable screening levels.

Table 2. Evaluation of Estimated Indoor Air Concentrations for EDB

	E1	E2	E3	E4
Evaluation Based on Maximum Detection Limit for EDB				
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	<120	<57	<59	<59
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.006	<0.003	<0.003	<0.003
Exceedance of Screening Level of 0.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,1,2,2-TCA				
Maximum Detection of 1,1,2,2-TCE in Sub-Slab Soil Gas (μg/m^3)	<100	<51	<52	<53
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.005	<0.003	<0.003	<0.003
Exceedance of Screening Level of 2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,1,2-TCA				
Maximum Detection of 1,1,2-TCA in Sub-Slab Soil Gas (μg/m^3)	<84	<41	<42	<42
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.004	<0.002	<0.002	<0.002
Exceedance of Screening Level of 0.62 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,2,4-TCB				
Maximum Detection of 1,2,4-TCB in Sub-Slab Soil Gas (μg/m^3)	<460	<220	<230	<230
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.01	<0.01	<0.01
Exceedance of Screening Level of 6.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for Dibromomethane				
Maximum Detection of DBM in Sub-Slab Soil Gas (μg/m^3)	<440	<210	<220	<220
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.01	<0.01	<0.01
Exceedance of Screening Level of 12.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for Hexachlorobutadiene				
Maximum Detection of HCB in Sub-Slab Soil Gas (μg/m^3)	<660	<320	<330	<330
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.03	<0.02	<0.02	<0.02
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for Naphthalene				
Maximum Detection of Naph. in Sub-Slab Soil Gas (μg/m^3)	<160	<160	<80	<81
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.01	<0.01	<0.004	<0.004
Exceedance of Screening Level of 3.6 μg/m^3?	No	No	No	No

a – Based on the selected building-specific attenuation factor of 5.1E-05.

A summary of all VI data trends and findings is presented in Table 3.

Table 3. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	Almost three orders of magnitude	PCE during E2 ranged from 93 to 43,000 μg/m^3, log max./min. = 2.7 TCE during E2 ranged from <4 to 2,500 μg/m^3, log max./min. = 2.8
Temporal Variability of Soil Gas	Approximately a factor of two variability	PCE at location 462-SS-05 ranged from 18,000 to 43,000 μg/m^3, CV = 38% TCE at location 462-SS-05 ranged from 1,000 to 2,500 μg/m^3, CV = 46%
Seasonal Trend Analysis	Seasonal sampling is appropriate	No observed seasonal dependence
Spatial Variability of Indoor Air	Generally very little variability during any event	PCE during E2, E3, and E4 had CV = 15%, CV =37% and CV = 10%.
Temporal Variability of Indoor Air	About a factor of three variability over time in detected values	PCE at location 462-IA-04 ranged from 0.34 to 1.2 μg/m^3.

Table 3. Summary of Findings of Seasonal Confirmation Sampling (Continued)

Topic	Finding	Details
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. Less temporal variability in indoor air than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas ≅ indoor air, which indicates that the AOIs are not currently in regular use in this building
Best Estimate of Attenuation Factor	5.1E-05 (0.000051)	Most defensible value based on maximum detected sub-slab soil gas results during E3
Temporal Variability in Attenuation Factor	No significant variability	All calculated attenuation factors fall within a relatively narrow range.
Overall Summary	No increase in impacts during wintertime sampling	Summertime sampling event had highest sub-slab soil gas concentrations of PCE and TCE. Springtime sampling event had highest indoor air concentration of PCE.

WEIGHT-OF-EVIDENCE SUMMARY

Building 462 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the draft project-specific $RIASL_{12}$. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 462:

- No exceedances of draft project-specific screening levels in indoor air; and
- The soil gas beneath the building is not consistently high, with no more than eight of the 10 sample locations below the $RIASL_{12}$ for each AOI.
- The sub-slab soil gas data does not show any strong time dependence nor do the data show any strong seasonal effects.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the summer (e.g., PCE at locations 462-SS-05), and the highest indoor air concentration for PCE was measured in the spring.
- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.
- As shown in the table below, the building-specific attenuation factor yields estimated indoor air concentrations attributable to VI well below screening levels.

Parameters	TCE	PCE
Building-specific AF	5.1E-05	5.1E-05
Maximum detected concentration in SSSG	2,500	43,000
Maximum ND RL in SSSG	<8.4	--
Estimated Indoor Air Concentration - Detected	**0.13**	**2.2**
Estimated Indoor Air Concentration - ND	<4.3E-04	**--**
Indoor Air $RIASL_{12}$	4	2,700
Indoor Air $TSRIASL_{12}$	12	2,700

Based on the CSM for Building 462, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 462 and the sub-slab soil gas results have exhibited relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow will implement an interim monitoring plan at Building 462 until a revised program or more permanent corrective action plan is developed for the site.

Differential pressure measurements will be made at Building 462 to provide another line of evidence in support that VI is insignificant at this building. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). Measurements will be collected at Sample Locations 462-xx-03 and 462-xx-05. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., MBS) or Dow Midland Facility meteorological station, if available.

Indoor air will be monitored at locations 462-IA-03 and 462-IA-05. These locations were selected for continued monitoring since they demonstrated the highest sub-slab soil gas results. Monitoring will be performed for PCE and TCE. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, MDEQ will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.1.5 VI Seasonal Confirmation Sampling Results Evaluation for Building 680

INTRODUCTION

Building 680 is a Category 2 building located within the southwest portion of the facility designated as Zone 1. It is known as the Sulfonamides Building.

The initial evaluation in the 2017 CAIP concluded that based on current use and the indoor air results, the VI pathway at Building 680 was an insignificant exposure pathway. However, based on the sub-slab soil gas results, Building 680 was determined to have the potential for future VI, and it was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling events.

The results of the initial sampling event (E1) and the second seasonal confirmation sampling event (E2) were evaluated in the 2017 CAIP. The remaining two seasonal events (E3 and E4) were completed and the results of all four of these sampling events were included in the 2018 Rescreen.

Building 680	
Initial Sampling Event	**Completed**
E1	Oct 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	Sept 2017 (Summer)
E3	Feb 2018 (Winter)
E4	Apr 2018 (Spring)

The findings of the 2018 Rescreen acknowledged that while VI appears to be insignificant, some level of VI appears to be occurring for TCE and Building 680 was moved to VI Path Forward Building Group 4. Based on the rescreen, TCE was detected in indoor air above the draft project-specific $RIASL_{12}$ in each of the sampling events at Building 680; however, all the detected results were less than the $TSRIASL_{12}$. Therefore, no Expedited Building Summary was necessary.

The sub-slab soil gas AOIs are PCE,TCE, cis-1,2-dichloroethene (cis-1,2-DCE), 1,1,2-TCA, 1,2-dichloroethane (EDC), 1,2-EDB, carbon tetrachloride, chloroform, and hexachlorobutadience (HCB), due to exceedances of the draft project-specific $RIASL_{12}$ and/or the $TSRIASL_{12}$.

Based on DEQ guidance, indoor air and sub-slab soil-gas samples were collected during each event at four locations within the building (see Figure 5.1.5-1) and concurrent outdoor air samples were collected at one location. Figure 5.1.5-2 presents the sub-slab soil gas and indoor air results for TCE at each sample location.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that involves the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 680. The CSM is illustrated in Figure 5.1.5-3.

Building 680 is four stories tall but only has two internal floors. It was constructed in 1960 and contains process areas, office space, a control room, storage areas, a small laboratory, a locker room, and a garage. The building is slab-on-grade construction with a footprint of approximately 8,500 ft^2 (790 m^2). The building has central AC with the air intake at roof level and a steam radiation heating system. There is one bay door left open during the workday in good weather.

The only underground utilities are the sewer lines. There are multiple floor drains and various plumbing fixtures. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was performed on October 14, 2016. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals were found (e.g., bleach, various cleaners, wasp spray containing 80-90% petroleum distillates). Chemical storage cabinets within the building contain acetone, dichloromethane, hexane, isopropyl alcohol, methanol, methyl-ethyl ketone (MEK), methylene chloride, and toluene.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 680. The sampling events encompass more than one year of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.5-A and indoor and outdoor air or Table 5.1.5-B. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil gas at concentrations that exceeded draft project-specific screening levels;
b) Analytes detected in sub-slab soil gas at concentrations of 1,000 µg/m^3 or greater in one or more samples. Data for analytes detected above 1,000 µg/m^3 should provide the clearest signal and be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and
c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the analytes detected in the sub-slab soil gas at concentrations above the draft project-specific screening levels were the following nine compounds: PCE, TCE, cis-1,2-DCE, 1,1,2-TCA, EDC, EDB, carbon tetrachloride, chloroform, and HCB. Five other analytes of potential interest were detected at concentrations ≥1,000 µg/m^3 in soil gas: trans-1,2-DCE, 1,1-DCE), dichlorodifluoromethane (CFC-12), 1,1,1-TCA, and methylene chloride. In addition, acetone, ethanol, and 1,2,4-trimethylbenene were detected in one sub-slab sample in E4 at concentrations ≥1,000 µg/m^3; however, these analytes are not included in this evaluation due to their low detection frequency. Sample results for these analytes are provided in following data tables.

Summary of Results for Tetrachloroethene (PCE)

Sample Type	Sample ID	Measured Concentration (µg/m^3)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<5.4	0.39	4.5	3.0
Indoor Air	680-IA-01	<5.7	3.4	25	8.1
	680-IA-02	26	29	67	54
	680-IA-03	30	33	75	49
	680-IA-04	<5.3	54	4.2	5.8
Sub-Slab Soil Gas	680-SS-01	2,600	1,800	6,200	1,800
	680-SS-02	1,800	550	470	140
	680-SS-03	11,000	17,000	7,700	6,600
	680-SS-04	460,000	760,000	140,000	50,000

Screening level for indoor air is 82 µg/m^3 (RIASL$_{12}$ and TSRIASL$_{12}$)
Screening level for soil-gas is 2,700 µg/m^3 (RIASL$_{12}$ and TSRIASL$_{12}$)

Summary of Results for Trichloroethene (TCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<4.3	<0.17	0.30	0.26
Indoor Air	680-IA-01	<4.5	0.57	3.5	1.1
	680-IA-02	5.0	4.8	8.9	7.6
	680-IA-03	5.7	5.3	11	6.9
	680-IA-04	<4.2	3.8	0.24	0.31
Sub-Slab Soil Gas	680-SS-01	290	270	140	220
	680-SS-02	220	120	63	38
	680-SS-03	3,500	6,500	2,600	2,400
	680-SS-04	18,000	32,000	5,300	2,300

Screening levels for indoor air are 4 µg/m³ ($RIASL_{12}$) and 12 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 130 µg/m³ ($RIASL_{12}$) and 400 µg/m³ ($TSRIASL_{12}$)

Summary of Results for cis-1,2-Dichloroethene (cis-1,2-DCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.2	<0.13	0.36	0.30
Indoor Air	680-IA-01	<3.3	0.65	3.0	0.91
	680-IA-02	11	6.1	7.8	6.0
	680-IA-03	14	6.9	9.1	5.6
	680-IA-04	<3.1	6.1	0.36	0.43
Sub-Slab Soil Gas	680-SS-01	30	18	14	16
	680-SS-02	610	380	160	130
	680-SS-03	13,000	20,000	7,500	7,200
	680-SS-04	17,000	19,000	3,400	1,900

Screening levels for indoor air are 24 µg/m³ ($RIASL_{12}$) and 72 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 820 µg/m³ ($RIASL_{12}$) and 2,500 µg/m³ ($TRIASL_{12}$)

Summary of Results for 1,1,2-Trichloroethane (1,1,2-TCA)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<4.3	<0.17	<0.16	<0.18
Indoor Air	680-IA-01	<4.6	<0.17	<0.19	<0.18
	680-IA-02	<4.3	<0.17	<0.18	<0.18
	680-IA-03	<4.3	<0.18	<0.18	<0.18
	680-IA-04	<4.2	<0.18	<0.18	<0.18
Sub-Slab Soil Gas	680-SS-01	720	1,000	340	550
	680-SS-02	<4.7	<4.4	<4.4	<4.4
	680-SS-03	<89	<42	<44	<42
	680-SS-04	<240	<550	<280	<150

Screening level for indoor air is 0.62 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 20 µg/m³ ($RIASL_{12}$)

Summary of Results for 1,2-Dichloroethane (EDC)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.2	<0.13	<0.12	<0.13
Indoor Air	680-IA-01	<3.4	<0.13	<0.14	<0.13
	680-IA-02	<3.2	<0.13	<0.13	<0.13
	680-IA-03	<3.2	0.16	<0.13	<0.14
	680-IA-04	<3.2	0.20	<0.13	<0.14
Sub-Slab Soil Gas	680-SS-01	320	210	190	260
	680-SS-02	7.9	<3.2	<3.2	<3.2
	680-SS-03	<66	<31	<32	<31
	680-SS-04	850	<410	<210	<110

Screening level for indoor air is 4.6 µg/m³ ($RIASL_{12}$)
Screening levels for soil-gas is 150 µg/m³ ($RIASL_{12}$)

Summary of Results for 1,2-Dibromoethane (EDB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<6.1	<0.24	<0.22	<0.25
Indoor Air	680-IA-01	<6.4	<0.24	<0.27	<0.25
	680-IA-02	<6.1	<0.24	<0.25	<0.25
	680-IA-03	<6.1	<0.25	<0.25	<0.26
	680-IA-04	<6.0	<0.26	<0.25	<0.26
Sub-Slab Soil Gas	680-SS-01	240	68	68	65
	680-SS-02	<6.6	<6.2	<6.2	<6.1
	680-SS-03	<130	<60	<62	<59
	680-SS-04	<340	<770	<400	<210

Screening level for indoor air is 0.2 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 6.6 µg/m³ ($RIASL_{12}$)

Summary of Results for Carbon Tetrachloride

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<5.0	<0.20	0.48	0.42
Indoor Air	680-IA-01	<5.2	<0.20	0.46	0.41
	680-IA-02	<5.0	<0.20	0.51	0.47
	680-IA-03	<5.0	<0.20	0.46	0.46
	680-IA-04	<4.9	0.68	0.47	0.44
Sub-Slab Soil Gas	680-SS-01	1,100	670	2,200	350
	680-SS-02	30	8.3	<5.1	<5
	680-SS-03	<100	<49	<51	<48
	680-SS-04	680	1,000	<320	<170

Screening level for indoor air is 22 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 710 µg/m³ ($RIASL_{12}$)

Summary of Results for Chloroform

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.9	<0.16	<0.14	<0.16
Indoor Air	680-IA-01	<4.1	0.17	0.29	0.21
	680-IA-02	<3.8	0.27	0.46	0.36
	680-IA-03	<3.8	0.38	0.45	0.40
	680-IA-04	<3.8	0.64	<0.16	<0.16
Sub-Slab Soil Gas	680-SS-01	1,500	1,500	700	940
	680-SS-02	380	53	120	15
	680-SS-03	170	240	120	100
	680-SS-04	2,000	2,000	<250	140

Screening levels for indoor air are 5.2 µg/m³ ($RIASL_{12}$) and 52 µg/m³ ($TRIASL_{12}$)
Screening levels for soil-gas are 170 µg/m³ ($RIASL_{12}$) and 1,700 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Hexachlorobutadiene (HCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<34	<8.5	<7.7	<8.7
Indoor Air	680-IA-01	<36	<8.4	<9.4	<8.6
	680-IA-02	<34	<8.3	<8.6	<8.8
	680-IA-03	<34	<8.6	<8.7	<8.9
	680-IA-04	<33	<9.1	<8.6	<9.0
Sub-Slab Soil Gas	680-SS-01	3,400	2,000	2,100	4,400
	680-SS-02	170	84	52	47
	680-SS-03	4,600	9,600	3,200	4,100
	680-SS-04	<1,900	<4,300	<2,200	<1,200

Screening level for indoor air is 5.4 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 180 µg/m³ ($RIASL_{12}$)

Summary of Results for trans-1,2-Dichloroethene (trans-1,2-DCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Oct. 2016
		E1	E2	E3	E1
Outdoor Air	680-OA-01	<3.2	<0.63	<0.57	<0.65
Indoor Air	680-IA-01	<3.3	<0.63	<0.70	<0.64
	680-IA-02	<3.1	<0.62	<0.64	<0.65
	680-IA-03	<3.1	<0.64	<0.65	<0.66
	680-IA-04	<3.1	<0.67	<0.64	<0.67
Sub-Slab Soil Gas	680-SS-01	32	32	12	22
	680-SS-02	21	14	5.2	4.4
	680-SS-03	400	740	270	360
	680-SS-04	1,300	1,800	400	240

Screening level for indoor air is 790 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 26,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for 1,1-Dichloroethene (1,1-DCE)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.2	<0.063	<0.057	<0.065
Indoor Air	680-IA-01	<3.3	<0.063	0.088	<0.064
	680-IA-02	<3.1	0.15	0.17	0.21
	680-IA-03	<3.1	0.16	0.21	0.19
	680-IA-04	<3.1	0.087	<0.064	<0.067
Sub-Slab Soil Gas	680-SS-01	5,100	3,300	460	910
	680-SS-02	26	9.9	9.1	<3.2
	680-SS-03	180	290	120	120
	680-SS-04	260	<400	<200	<110

Screening levels for indoor air are 620 µg/m³ ($RIASL_{12}$) and 1,900 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 20,000 µg/m³ ($RIASL_{12}$) and 61,000 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Dichlorodifluoromethane (CFC-12)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.9	2.8	2.3	2.2
Indoor Air	680-IA-01	<4.1	2.7	2.4	2.2
	680-IA-02	<3.9	2.8	2.3	2.0
	680-IA-03	<3.9	2.8	2.3	2.0
	680-IA-04	<3.8	3.1	2.3	2.0
Sub-Slab Soil Gas	680-SS-01	5,600	310	290	99
	680-SS-02	47	<4	8.6	3.9
	680-SS-03	<81	<38	<40	<38
	680-SS-04	230	<500	460	<130

Screening level for indoor air is 1,020 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 34,000 µg/m³ ($RIASL_{12}$)

Summary of Results for trans-1,1,1-Trichloroethane (1,1,1-TCA)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<4.3	<0.17	<0.16	<0.18
Indoor Air	680-IA-01	<4.6	<0.17	0.19	<0.18
	680-IA-02	<4.3	<0.17	0.50	<0.18
	680-IA-03	<4.3	<0.18	<0.18	<0.18
	680-IA-04	<4.2	1.1	<0.18	<0.18
Sub-Slab Soil Gas	680-SS-01	<30	<18	<15	11
	680-SS-02	540	27	180	10
	680-SS-03	<89	<42	<44	<42
	680-SS-04	2,700	2,500	<280	190

Screening level for indoor air is 7,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 230,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for Methylene Chloride

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<28	12	150	6.2
Indoor Air	680-IA-01	<14.5	3.3	88	22
	680-IA-02	<13.5	5.2	36	3.9
	680-IA-03	<13.5	2.5	14	2.8
	680-IA-04	<13.5	3.1	130	50
Sub-Slab Soil Gas	680-SS-01	<190	<110	<93	56
	680-SS-02	<30	<28	<28	<28
	680-SS-03	<570	<110	<280	<270
	680-SS-04	1,000	<1,400	<1,800	<940

Screening levels for indoor air are 1,800 µg/m³ ($RIASL_{12}$) and 2,900 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas are 61,000 µg/m³ ($RIASL_{12}$) and 97,000 µg/m³ ($TSRIASL_{12}$)

Summary of Results for Ethanol

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<6.0	1.9	4.2	<1.5
Indoor Air	680-IA-01	<6.3	11	42	220
	680-IA-02	<6.0	9.1	22	190
	680-IA-03	<6.0	14	25	22
	680-IA-04	<5.9	9.7	5.9	14
Sub-Slab Soil Gas	680-SS-01	72	<24	32	17
	680-SS-02	13	23	18	7.8
	680-SS-03	<120	<58	<61	<58
	680-SS-04	<340	<760	<390	1,400

Screening level for indoor air is 19,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 630,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for Acetone

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<19	15	12	5.3
Indoor Air	680-IA-01	<20	11	12	14
	680-IA-02	<19	8	36	10
	680-IA-03	<19	22	300	8.7
	680-IA-04	<18	28	6.4	16
Sub-Slab Soil Gas	680-SS-01	170	240	240	320
	680-SS-02	55	44	27	33
	680-SS-03	<390	190	470	220
	680-SS-04	<420	<950	<1,200	1,000

Screening level for indoor air is 31,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)
Screening level for soil-gas is 1,000,000 µg/m³ ($RIASL_{12}$ and $TSRIASL_{12}$)

Summary of Results for 1,2,4-Trimethylbenzene (1,2,4-TMB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Sept. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	680-OA-01	<3.9	<0.79	<0.71	<0.81
Indoor Air	680-IA-01	<4.1	5.7	<0.86	<0.80
	680-IA-02	<3.9	2.4	<0.79	<0.81
	680-IA-03	<3.9	1.7	<0.80	<0.82
	680-IA-04	<3.8	1.2	<0.79	<0.82
Sub-Slab Soil Gas	680-SS-01	<27	<16	21	22
	680-SS-02	<4.2	8.0	<4.0	<3.9
	680-SS-03	<81	<38	<40	<38
	680-SS-04	<220	<490	<250	2,000

Screening levels for indoor air are 180 µg/m³ ($RIASL_{12}$) and 560 µg/m³ ($TSRIASL_{12}$)
Screening levels for soil-gas is 6,100 µg/m³ ($RIASL_{12}$) and 18,000 µg/m³ ($TSRIASL_{12}$)

	$RIASL_{12}$ Exceedance
	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 680 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

The variability across all locations over all sampling events is the total variability. This encompasses different types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability. The comparison of two data values is typically expressed as a RPD. The comparison of three of more data values is typically expressed as the %CV, which is the standard deviation divided by the mean.

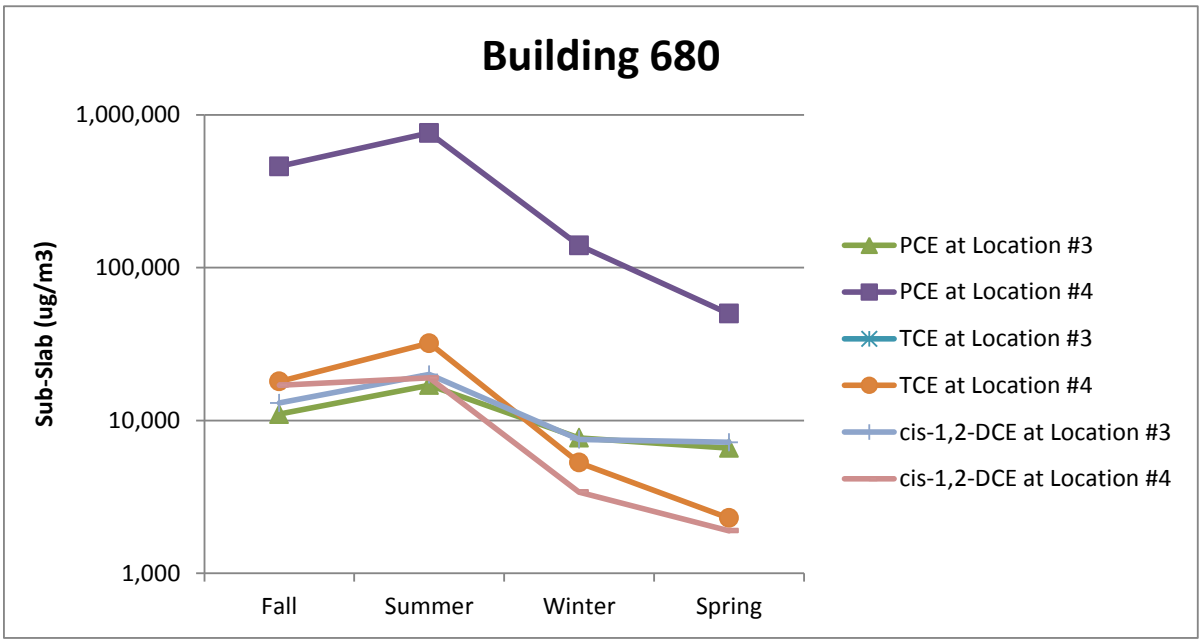
Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits up to three orders of magnitude of spatial variability. For example, sub-slab detections of PCE vary from 550 to 760,000 µg/m³ (log of max./min. = 3.1) across the four locations for the 2nd sampling event. During that same sampling event, the range for TCE was 120 to 32,000 µg/m³ (log of max./min. = 2.4) and the range for cis-1,2-DCE was 18 to 20,000 µg/m³ (log of max./min. = 3.0). For other sampling events, the log (max./min.) generally was about 2.5 for PCE and 1.9 for TCE.

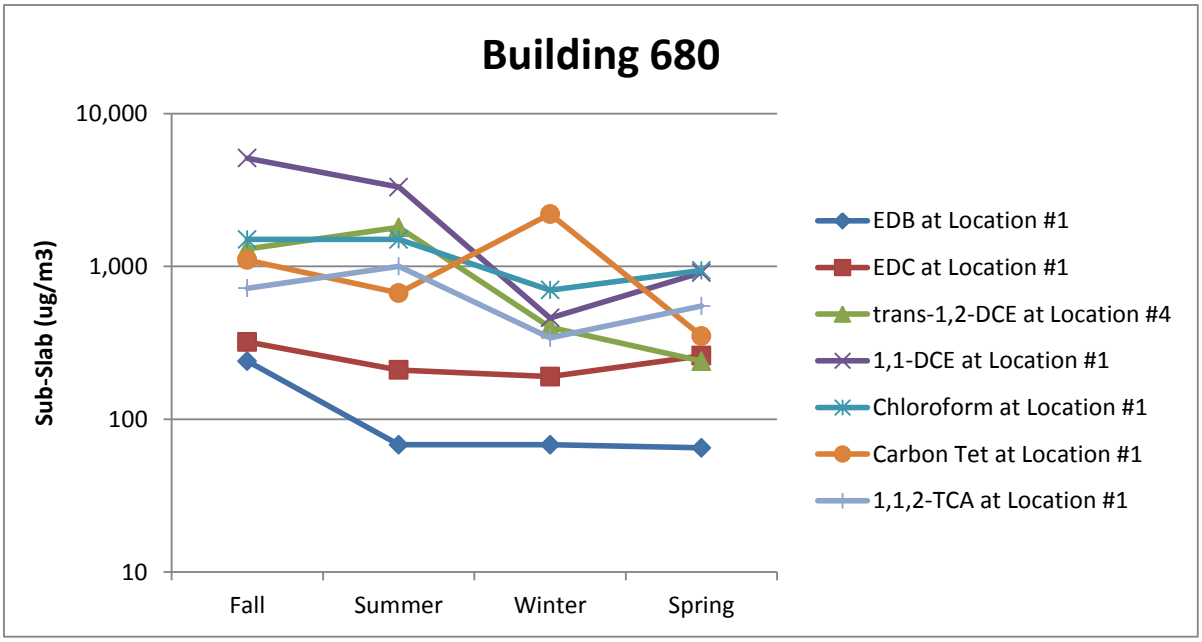
Temporal Variability of Soil Gas – The soil gas exhibits up to one order of magnitude of temporal variability. For example, sub-slab concentrations of PCE vary from 50,000 to 760,000 µg/m³ at location 680-SS-04 (log max/min = 1.2) across all four sampling events. At that same location, the range for TCE was 2,300 to 32,000 µg/m³ (log max/min = 1.1). The variability for PCE and TCE at other locations was less (e.g., about a factor of three). Similarly, the variability for other compounds was relatively small.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed but the sub-slab soil gas data at locations with the highest concentrations exhibit some downward trend over the course of the four sampling events. This is illustrated in the graph below, which shows results for two

locations with the highest concentrations for the three analytes detected at the highest concentrations (i.e., 680-SS-03 and 680-SS-04). Note that the y-axis is a log scale.



For analytes with lower sub-slab soil gas concentrations, the values tended to be more stable over time. This is illustrated in the figure below. Data for various analytes at location 680-SS-01 are shown (i.e., the location where the highest concentrations of that analyte generally were detected over the four sampling events) along with data for trans-1,2-DCE at location 680-SS-04 (i.e., where it was detected at the highest concentrations). Note that the y-axis is still a log scale, but for a lower range of values.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For the chemicals present at the highest concentrations in the sub-slab

(i.e., PCE, TCE, and cis-1,2-DCE), the maximum sub-slab concentration was obtained during E2 (summer). For PCE at location 680-SS-04, the value increased from 460,000 during E1 to 760,000 during E2. If only the first sampling event had been performed, a negative bias of 65% would have been introduced (i.e., the PCE value for E2 was 65% higher than the PCE value for E1).

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits about one order of magnitude of spatial variability. For example, PCE was detected in all four indoor air samples and varied from 4.2 to 75 µg/m^3 during the 3rd sampling event (log max./min. = 1.3). PCE had about the same amount of spatial variability during E2 and E4. During E3, TCE was detected in all four indoor air samples and varied from 0.24 to 0.11 µg/m^3 (log max./min. = 1.7). TCE had less spatial variability during the other sampling events.

Temporal Variability of Indoor Air – The detected values for PCE and TCE exhibit temporal variability of about one order of magnitude over time. For example, PCE was detected during three of the four sampling events at locations 680-IA-01 and 680-IA-04 and the values ranged from 4.2 to 54 µg/m^3 at location 680-IA-04 and from 3.4 to 25 µg/m^3 at location 680-IA-01. For TCE, the variability over time was similar to that for PCE. For example, TCE was detected during three of the four sampling events at location 680-IA-04, with values ranging from 0.24 to 3.8 µg/m^3.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab data and the indoor air data had similar temporal variability, which is contrary to expectations. This suggests that the AOIs are not currently in regular use in these buildings.

Seasonal Effects –The data lend some credence to the hypothesis that wintertime will have higher indoor air impacts. The highest sub-slab concentrations were measured in August, but the highest indoor air concentration for PCE and TCE were measured in February. The higher wintertime values, however, may be related to a rain event prior to sampling.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum values and are shown in Table 1. The values in Table 1 have not been corrected for any contribution from outdoor air.

Table 1. Calculated Attenuation Factors

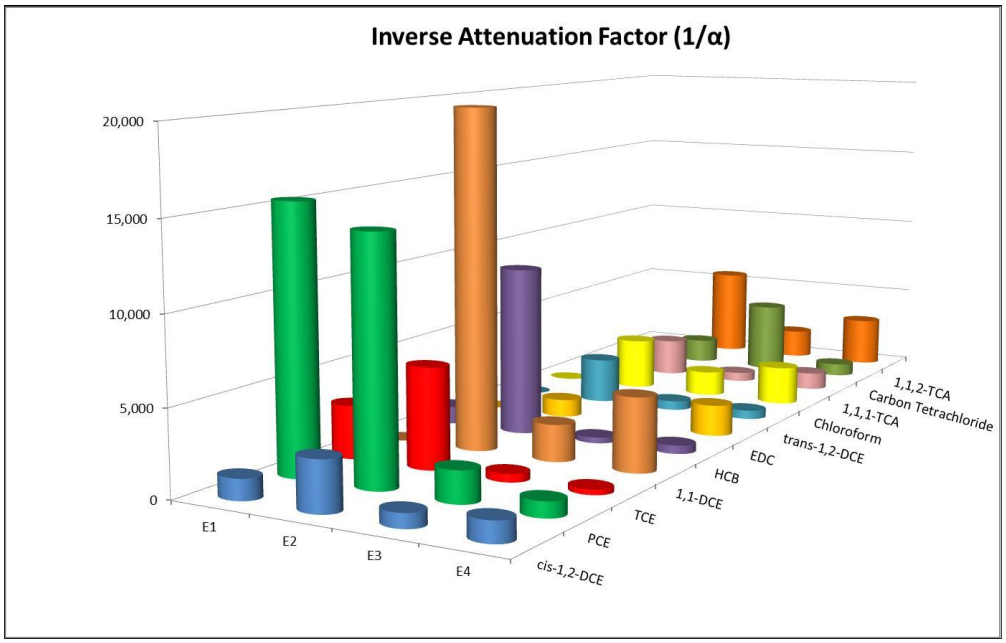
	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
1,1-DCE	NC	4.8E-05	4.6E-04	2.3E-04
PCE	6.5E-05	7.1E-05	5.4E-04	1.1E-03
TCE	3.2E-04	1.7E-04	2.1E-03	3.2E-03
cis-1,2-DCE	8.2E-04	3.4E-04	1.2E-03	8.3E-04
HCB	<7.8E-03	<9.5E-04	<2.9E-03	<2.0E-03
EDC	NC	9.5E-04	7.4E-04	<5.4E-04
trans-1,2-DCE	NC	<3.7E-04	<1.8E-03	<1.9E-03
Chloroform	NC	3.2E-04	6.6E-04	4.3E-04
1,1,1-TCA	NC	4.4E-04	2.8E-03	<9.5E-04
Carbon Tetrachloride	NC	6.8E-04	2.3E-04	1.3E-03
1,1,2-TCA	NC	<1.8E-04	<5.6E-04	<3.3E-04

NC - Not calculated due to elevated detection limits for indoor air.

The best estimates of a building-specific attenuation factor for Building 680 are the values for 1,1-DCE for each sampling event. This analyte generally has the smallest attenuation factor for each sampling event

(i.e., the least bias due to contributions from any indoor or outdoor sources). 1,1,-DCE is the only analyte detected at relatively high concentrations in the subsurface with all of what was detected indoors likely attributable to VI (i.e., the bias introduced by indoor emission sources and/or outdoor air is believed to be negligible). During E1, 1,1-DCE and several other analytes were ND but with relatively high RLs. For E1, the best estimate of a building-specific attenuation factor is PCE.

Temporal Variability in Attenuation Factor – As shown in Table 1, there was slightly less than one order of magnitude in temporal variability in the calculated attenuation factors observed in the data set, with E3 having the least attenuation. The variability is illustrated in the figure below that plots the inverse attenuation factor for various compounds for each sampling event. Assuming VI was the only source of these analytes in indoor air, all of the columns would be expected to have about the same height. Shorter columns represent greater contribution from indoor or outdoor sources for a given analyte.



NON-DETECT EVALUATION

There were 11 ND analytes in indoor air with RLs that exceeded the indoor air screening level during E1. Of those, only three analytes continued to have ND exceedances in E2 – E4: 1,2,4-TCB, EDB and HCB. In E4, 1,2,4-TCB ND RLs were all below the indoor air screening levels. EDB and HCB were already identified as AOIs due to detections in sub-slab soil gas that exceed the screening levels; however, estimated indoor air concentrations are provided below. Furthermore, due to laboratory limitations to achieve low enough RLs that consistently meet screening levels for EDB and HCB, further investigation for these analytes will be conducted once the facility-wide priority buildings have been sampled and evaluated.

There have been no detections of HCB or EDB in indoor air, but the ND RLs often exceed the draft project-specific $RIASL_{12}$ for HCB (5.4 µg/m^3) and for EDB (0.2 µg/m^3). As shown in Tables 2 and 3, using the selected building-specific attenuation factor, indoor air values due to VI were estimated based on the maximum detected sub-slab soil gas concentration for each event.

Table 2. Evaluation of Estimated Indoor Air Concentrations for HCB

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
Maximum Detection of HCB in Sub-Slab Soil Gas (μg/m^3)	4,600	9,600	3,200	4,400
Building-specific attenuation factor	6.5E-05	4.8E-05	4.6E-04	2.3E-04
Predicted Indoor Air Impacts (μg/m^3)[a]	0.30	0.46	1.5	1.0
Exceedance of Screening Level of 5.4 μg/m^3?	No	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

Table 3. Evaluation of Estimated Indoor Air Concentrations for EDB

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	240	68	68	65
Building-specific attenuation factor	6.5E-05	4.8E-05	4.6E-04	2.3E-04
Predicted Indoor Air Impacts ((μg/m^3)[a]	0.02	0.003	0.03	0.01
Exceedance of Screening Level of 0.2 (μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit				
Maximum Detection Limit of EDB in Sub-Slab Soil Gas ((μg/m^3)	<340	<770	<400	<210
Building-specific attenuation factor	8.2E-04	3.4E-04	1.2E-03	8.3E-04
Predicted Indoor Air Impacts ((μg/m^3)[a]	<0.02	<0.04	<0.18	<0.05
Exceedance of Screening Level of 0.2 (μg/m^3?	No	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

As shown in Tables 2 and 3, the ND evaluation demonstrates that the estimated indoor air concentrations for HCB and EDB attributable to VI are below their respective draft project-specific $RIASL_{12}$ for all four sampling events based on the maximum detected values and, for EDB, based on the detection limits for certain sub-slab soil gas samples. A summary of all VI data trends and findings is presented in Table 4.

Table 4. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	Three orders of magnitude or less	PCE during E2 ranged from 550 to 760,000 µg/m3, log max./min. = 3.1 TCE during E2 ranged from 120 to 32,000 µg/m3, log max./min. = 2.4 For other sampling events, log max./min. ranges generally from 1.9 – 2.5
Temporal Variability of Soil Gas	One order of magnitude	PCE at location 680-SS-04 ranged from 50,000 to 760,000 µg/m3, log max./min. = 1.2 Similarly, variability for other analytes was relatively small
Seasonal Trend Analysis	Seasonal sampling is appropriate	No observed seasonal dependence, but some downward trend in concentration for the highest PCE, TCE, and cis-1,2-DCE impacts
Spatial Variability of Indoor Air	One order of magnitude or less	PCE during E3 ranged from 4.2 to 75 µg/m3, log max./min. = 1.3
Temporal Variability of Indoor Air	One order of magnitude	PCE at location 680-SS-04 ranged from 4.2 to 54 µg/m3, log max./min. = 1.1
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. Less temporal variability in indoor air than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas = indoor air

Table 4. Summary of Findings of Seasonal Confirmation Sampling (Continued)

Topic	Finding	Details
Best Estimate of Attenuation Factor	Varies from event to event	Most defensible values are based on 1,1-DCE and PCE data. Values vary from a minimum of 4.8E-05 and a maximum of 4.6E-04
Temporal Variability in Attenuation Factor	Wintertime event had the lowest attenuation	All calculated attenuation factors fall within one order of magnitude
Overall Summary	Possible increase in impacts during wintertime sampling	Summertime sampling event had highest sub-slab soil gas concentrations of TCE, PCE, and cis-1,2-DCE Wintertime sampling event had highest indoor air concentrations of PCE, TCE, and cis-1,2-DCE

WEIGHT-OF-EVIDENCE SUMMARY

Building 680 is confirmed as a VI Path Forward Group 4B building due to correlated sub-slab soil gas and indoor air sample exceedances for TCE. After further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant for analytes other than TCE at Building 680:

- No exceedances of draft project-specific screening levels in indoor air with the exception of TCE; and
- The sub-slab soil gas results indicate that concentrations are stable or decreasing.

The results to date are inconclusive and do not provide a clear picture of the VI potential in Building 680. Three of the four sub-slab soil gas samples have exhibited the expected variability in concentration over time (i.e., a three-fold range from the lowest to the highest value). The highest sub-slab soil gas concentrations were measured at Location 680-SS-04, which is a small annex attached to the shop in the main part of the building (see Figure 5.1.5-2). The sub-slab soil gas concentrations are about an order of magnitude higher here than the other sample locations. The data at location 680-SS-04 have shown a marked decrease in concentration over the last two rounds of sampling (e.g., PCE values at that location for the four rounds of sampling are: 460,000; 760,000; 140,000; and 50,000 µg/m3). Further observations indicating inconsistent results include:

- The maximum indoor air concentrations that were measured do not occur at the same locations where the maximum soil gas concentrations were measured. In fact, the lowest PCE and TCE indoor air concentrations have been measured above the location where the highest sub-slab soil gas concentrations were detected.
- PCE had the highest soil gas concentrations of any chemical, but often had the lowest attenuation factor. This suggests that the maximum PCE sub-slab soil gas result represents a relatively small area.

The indoor air results have exhibited about one order of magnitude variability from one location to another. Over time, the results at any given location have varied by a factor of two or three (i.e., spatial variability is greater than temporal variability). The highest indoor air results have occurred at Locations 680-IA-02 (inside an office next to a laboratory) and 680-IA-03 (inside the women's locker room).

Based on the seasonal confirmation sampling results and trend analysis, further investigation is warranted at Building 680 to determine the following:

- Whether subsurface concentrations at locations 680-SS-01, 680-SS-02, and 680-SS-03 are representative of the soil gas beneath the building?

- Are there indoor air emission sources that are contributing to the concentrations of PCE, TCE, and other AOIs in indoor air that were not identified in the initial building survey and chemical inventory?

- Are indoor air results at locations 680-SS-01 and 680-SS-02 affected by the adjacent laboratory, either directly through the wall or indirectly via the HVAC and air handling system?

- Are there floor drains or other preferential pathways affecting indoor air results within the women's locker room?

- If the February 2018 indoor air results were a function of a rain event and sewer lines, how frequently do such events occur and what mitigation steps can be implemented?

PATH FORWARD

Insufficient information exists to make a final human exposure under control EI determination for Building 680. More investigations are planned to better understand vapor transport and VI potential at the building. Further investigation is warranted and the building-specific Interim Action Plan is discussed below.

Building-specific Interim Action Plan

Dow will implement an interim action plan at Building 680 to determine if VI is a significant pathway. The following actions are described below.

Four additional sampling locations will be added within the building and seasonal confirmation sampling will continue for both sub-slab soil gas and indoor air until trend analysis indicates if VI is significant. An outdoor air sample will also be collected at the time of each sampling event. Sample locations will be added in the following areas:

- In the hallway outside the two laboratories;

- Men's locker room;

- Storage Room/Utilities; and

- Shop.

A more in depth building survey and chemical inventory will be conducted to identify indoor emission sources. No sources of PCE or TCE were previously found but further investigation could provide insights into the inconclusive indoor air results.

Indoor air screening will be conducted using a portable instrument to collect real-time analyte-specific data. If real-time measurements for PCE and/or TCE can be made, the observed concentration gradients within the building will help determine an indoor source and/or identify if there is a complete VI pathway.

Potential preferential pathways in the women's locker room will be evaluated. An additional sample will be collected in the men's locker room to provide additional information. Floor drains and other openings will be screened with a PID. The PID will also be utilized before and after water is added to the floor drains to observe any fluctuations in output.

Differential pressure measurements will be made at Building 680 to provide another line of evidence. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). At a minimum, measurements will be collected at Sample

Location 680-xx-03 and another location(s) may be added based on the results from the new sample locations. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., MBS) or Dow Midland Facility meteorological station, if available.

Reporting and Notification

High level email summary updates will be provided to MDEQ as data becomes available and evaluation is performed. In the event an indoor air result(s) exceeds the $TSRIASL_{12}$, MDEQ will be provided a brief email notification. If there is a correlated sample location exceedance and the indoor air result is above $TSRIASL_{12,}$ interim response actions will be implemented while further investigation continues to determine the source of VI. If a known indoor air exceedance cannot be demonstrated to originate from an indoor source or is determined to be due to VI, mitigation will be designed and implemented.

Results from each sampling event will be reported in the annual CAIP. When data and/or findings are available, updates will be provided to MDEQ in the monthly Corrective Action meetings.

Dow may propose changes to the frequency or other aspects of this interim action plan based on an evaluation of the data, changes in building use or implementation of other interim response actions to address the potential VI pathway.

5.1.6 VI Seasonal Confirmation Sampling Results Evaluation for Building 838

INTRODUCTION

Building 838 is a Category 2 building located within the southwest portion of the facility designated as Zone 1. It is known as the Sulfonamides Shop and contains office space, a shop, storage room, locker room, and a lunch room.

The initial evaluation in the 2017 CAIP concluded that based on current use and the indoor air results, the VI pathway at Building 838 is an insignificant exposure pathway. However, based on the sub-slab soil gas results, Building 838 was determined to have the potential for future VI, and it was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs, but where initial indoor air results were all less than screening levels. Any building placed in Group 2 is scheduled for seasonal confirmation sampling.

The results of the initial sampling event (E1) and the seasonal confirmation sampling event (E2) were evaluated in the 2017 CAIP. The remaining two seasonal events (E3 & E4) were completed and the results of all four of these sampling events were included in the 2018 Rescreen.

Building 838	
Initial Sampling Event	**Completed**
E1	Oct 2016 (Fall)
Seasonal Confirmation Sampling Event	**Completed**
E2	Aug 2017 (Summer)
E3	Feb 2018 (Winter)
E4	Apr 2018 (Spring)

The findings of the 2018 Rescreen supported the conclusions of the 2017 CAIP, and Building 838 remained a Group 2 building. Based on the rescreen, no indoor air analytes were detected above screening levels during any of the sampling events at Building 838. The sub-slab soil gas AOIs are PCE, TCE, and HCB due to exceedances of the draft project-specific $RIASL_{12.}$ PCE and TCE also exceeded the $TSRIASL_{12}$.

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant. Sufficient information exists to make a human exposure under control EI determination.

VAPOR INTRUSION CONCEPTUAL SITE MODEL

VI is an exposure pathway that results from the migration of volatilized chemicals from the subsurface to indoor air in overlying, occupied buildings. A source, migration route and a human receptor must be present for the VI pathway to be complete. The focus of this building specific investigation is to evaluate the potential VI exposure pathway for Dow employees and contractors at Building 838. The CSM is illustrated on Figure 5.1.6-1.

Building 838 is a two-story, metal building constructed in 1967. It contains office space, a shop, storage room, locker room, and a lunch room. The building is slab-on-grade construction with a footprint of approximately 2,885 ft^2 (268 m^2). The building has central AC with the air intake located on the roof of the 1st floor, next to the AC unit.

There is one large door that is infrequently left open. The only underground utilities are the sewer lines. The land surrounding the building is covered in asphalt and concrete. The depth to groundwater in this area of the facility is approximately 5 ft bgs and the soils are largely fill material. Groundwater flow is towards the south or southwest.

The building is currently occupied by no more than 10 people, who work 8-hour shifts. The typical parameters for non-residential exposures are assumed to apply to workers at this building (i.e., 40 hours/week, 50 weeks/year exposure).

A building survey was performed on September 15, 2016. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the primary chemicals identified were degreasers, cleaners, motor oil, and insecticides.

Based on DEQ guidance and the square footage of the building, indoor air and sub-slab soil-gas samples were collected at three locations within the building (see Figure 5.1.6-2) and concurrent outdoor air samples were collected at one location.

EVALUATION OF SEASONAL CONFIRMATION SAMPLING EVENTS

Four seasonal sampling events have been completed at Building 838. The sampling events encompass more than one year of time and include sampling during each season of the year. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.6-A and indoor and outdoor air or Table 5.1.6-B. The results from the four seasonal confirmation sampling events were evaluated with respect to spatial variability, temporal variability, and seasonal trend analysis.

Building specific attenuation factors were calculated and compared between events to evaluate temporal variability and determine the best estimate of a building-specific attenuation factor. This evaluation serves to confirm that the existing study design is appropriate, and also provides insight for the determination of the path forward for this building.

This evaluation focused on any analytes detected in the sub-slab soil gas samples that met the criterion for inclusion in one or more of the following categories:

a) Analytes detected in sub-slab soil-gas at concentrations that exceeded draft project-specific screening levels;

b) Analytes detected in sub-slab soil-gas at concentrations of 1,000 $\mu g/m^3$ or greater in one or more samples. Data for analytes detected above 1,000 µg/m3 should provide the clearest signal and

be the simplest to interpret when assessing data trends. The same data trends observed for these analytes are expected to apply to other similar analytes present at lower concentrations; and

c) PCE and TCE. These two analytes are of particular interest for many VI evaluations at industrial sites.

For this building, the only analytes detected in the sub-slab soil gas at concentrations above the draft project-specific screening levels were PCE, TCE, and HCB. No other analytes were detected at concentrations ≥1,000 µg/m^3 in soil gas. Sample results for these three analytes are provided in the following data tables.

Summary of Results for Tetrachloroethene (PCE)

Sample Type	Sample ID	Measured Concentration (µg/m^3)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	838-OA-01	<5.4	2.1	4.5	<0.33
Indoor Air	838-IA-01	<8.6	3.5	1.4	2.9
	838-IA-02	<5.6	6.2	2.4	3.9
	838-IA-03	<21	4.0	2.4	2.9
Sub-Slab Soil Gas	838-SS-01	120	82	420	670
	838-SS-02	28,000	31,000	6,400	16,000
	838-SS-03	1,900	2,200	2,200	2,300

Screening level for indoor air is 82 µg/m^3 (RIASL$_{12}$ and TSRIASL$_{12}$)
Screening level for soil-gas is 2,700 µg/m^3 (RIASL$_{12}$ and TSRIASL$_{12}$)

Summary of Results for Trichloroethene (TCE)

Sample Type	Sample ID	Measured Concentration (µg/m^3)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	838-OA-01	<4.3	1.3	2.0	<0.26
Indoor Air	838-IA-01	<6.8	0.24	0.16	0.27
	838-IA-02	<4.4	0.35	0.18	0.30
	838-IA-03	<16	0.25	0.24	0.27
Sub-Slab Soil Gas	838-SS-01	7.2	5.8	21	37
	838-SS-02	700	1,000	200	480
	838-SS-03	190	240	260	290

Screening levels for indoor air are 4 µg/m^3 (RIASL$_{12}$) and 12 µg/m^3 (TSRIASL$_{12}$)
Screening levels for soil-gas are 130 µg/m^3 (RIASL$_{12}$) and 400 µg/m^3 (TSRIASL$_{12}$)

Summary of Results for Hexachlorobutadiene (HCB)

Sample Type	Sample ID	Measured Concentration (µg/m³)			
		Oct. 2016	Aug. 2017	Feb. 2018	Apr. 2018
		E1	E2	E3	E4
Outdoor Air	838-OA-01	<34	<9.0	<7.8	<13
Indoor Air	838-IA-01	<54	<8.9	<8.2	<8.7
	838-IA-02	<35	<8.2	<9.0	<9.5
	838-IA-03	<130	<7.9	<9.0	<8.4
Sub-Slab Soil Gas	838-SS-01	38	35	97	310
	838-SS-02	3,000	3,200	440	1,300
	838-SS-03	<52	60	<45	<60

Screening level for indoor air is 5.4 µg/m³ ($RIASL_{12}$)
Screening level for soil-gas is 180 µg/m³ ($RIASL_{12}$)

	$RIASL_{12}$ Exceedance
	$TSRIASL_{12}$ Exceedance

EVALUATION OF VI DATA TRENDS

Data trends for Building 838 are discussed below for both sub-slab soil gas and indoor air. When data exhibit a narrow range of variability, it is typical practice to express the range as a percentage. When data exhibit a large range of variability, however, it is more useful to express the range in orders of magnitude (i.e., factors of 10). This can be expressed mathematically as the log of the ratio of maximum/minimum values. If the values differ by a factor of 10, the log of the ratio is 1, if the values differ by a factor of 100, the log of the ratio is 2, and so on.

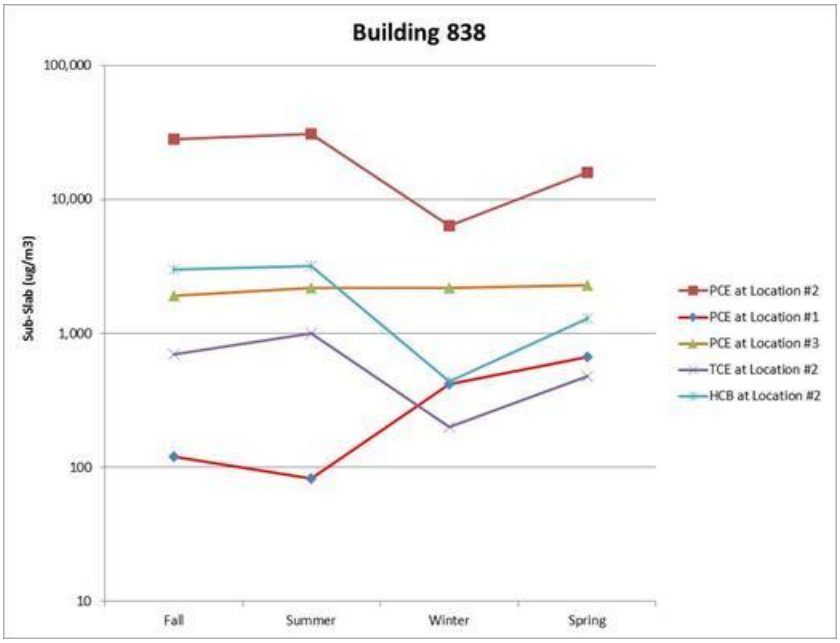
The variability across all locations over all sampling events is the total variability. This encompasses various types of variability, including spatial variability (i.e., how do the results vary from location to location), temporal variability (i.e., how do the results at a given location vary over time), and measurement variability. Measurement variability can be determined by evaluating results of duplicate or collocated samples and includes both sampling variability and analytical variability.

Sub-Slab Soil Gas Data Trends

Spatial Variability of Sub-Slab Soil Gas – The soil gas exhibits more than two orders of magnitude of spatial variability. E2 exhibited the maximum detected concentrations for the three AOIs. For example, sub-slab detections of PCE vary from 82 to 31,000 µg/m³ (log of max./min. = 2.6) across the three locations for E2. During that same sampling event, the range for TCE was 5.8 to 1,000 µg/m³ (log of max./min. = 2.2) and the range for HCB was 35 to 3,200 µg/m³ (log of max./min. = 2.0). Overall, the results for these three analytes were fairly consistent throughout the four events.

Temporal Variability of Soil Gas – The soil gas exhibits less than one order of magnitude of temporal variability. For example, sub-slab soil gas concentrations of HCB vary from 35 to 310 µg/m³ at location 838-SS-01 (log max/min = 0.95). At that same location, the range for PCE was 82 to 670 µg/m³ (log max/min = 0.91) and the range for TCE was 5.8 to 37 µg/m³ (log max/min = 0.80). Overall, the amount of temporal variability is less than the amount of spatial variability which is in-line with expectations.

Seasonal Confirmation Sampling Trend Analysis – No formal statistical tests were performed, but the soil-gas data exhibits relatively consistent results over the course of the four sampling events and no observed seasonal dependence. This is illustrated in the graph below, which shows various analytes at locations where they were detected at relatively high concentrations. Note that the y-axis is a log scale.



The data set was examined to see what the potential consequences would have been had only a single sampling event been performed. For PCE, TCE, and HCB, the maximum sub-slab soil gas concentration was obtained during E2. For TCE at location 838-SS-02, the value increased from 700 μg/m^3 during E1 to 1,000 μg/m^3 during E2. If only the first sampling event had been performed, a negative bias of 43% would have been introduced (i.e., the HCB value for E2 was 43% higher than the HCB value for E1).

Indoor Air Data Trends

Spatial Variability of Indoor Air – The indoor air exhibits relatively little spatial variability for any given sampling event. For example, PCE was detected in all three indoor air samples and varied from 3.5 to 6.2 μg/m^3 during E2 (CV = 26%). During that same event, TCE was detected in all three indoor air samples and varied from 0.24 to 0.35 μg/m^3 (CV = 18%). PCE and TCE had even less spatial variability during E3 and E4. The data suggest the air within the building is well-mixed.

Temporal Variability of Indoor Air – The detected values for PCE and TCE exhibit variability of about a factor of two over time. For example, PCE was detected during three of the four sampling events and the results ranged from 1.4 to 3.5 μg/m^3 at location 838-IA-01, from 2.4 to 6.2 μg/m^3 at location 838-IA-02, and from 2.4 to 4.0 μg/m^3 at location 838-IA-03. For TCE, the variability over time was even less than for PCE. For example, TCE was detected during three of the four sampling events at location 838-IA-03, with results ranging from 0.24 to 0.27 μg/m^3. Overall, the temporal variability of the indoor air data was considered to be small.

Additional Analyses

Comparison of Sub-Slab Soil Gas and Indoor Air Data Sets – As expected, the sub-slab soil gas data exhibit greater spatial variability than the indoor air data set. The sub-slab soil gas data also exhibit greater temporal variability than the indoor air data set, which is contrary to expectations. This suggests that the AOIs are not currently in regular use in these buildings.

Seasonal Effects –The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations for PCE, TCE, and HCB were measured in August (summer). Similarly, the highest indoor air concentration for PCE was measured in August. The wintertime concentrations for PCE and TCE exhibited a slight decrease for both sub-slab soil gas and indoor air compared with other sampling events.

Comparison of Attenuation Factors by Event – Attenuation factors were calculated based on maximum sub-slab soil gas and indoor air values. The best estimate of attenuation factor for this building is 2E-04, based on PCE during E2, which is the most conservative value. The results were similar for PCE and TCE during other sampling events as shown in Table 1. Values in Table 1 have not been corrected for any contribution from outdoor air.

Table 1. Calculated Attenuation Factors

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
PCE in Sub-Slab Soil Gas (µg/m3)	28,000	31,000	6,400	16,000
PCE in Indoor Air (µg/m3)	<21	6.2	2.4	3.9
PCE Attenuation Factor	<7.5E-04	2.0E-04	3.8E-04	2.4E-04
TCE in Sub-Slab Soil Gas (µg/m3)	700	1,000	260	480
TCE in Indoor Air (µg/m3)	<16	0.35	0.24	0.30
TCE Attenuation Factor	NC	3.5E-04	9.2E-04	6.2E-04

NC - Not calculated due to elevated detection limits for indoor air.

Temporal Variability in Attenuation Factor – As shown in Table 1, there was minimal temporal variability in the calculated attenuation factors observed in the data set. All calculated attenuation factors fall within about a factor of four of one another and this amount of variability is not considered to be significant.

To be as conservative as possible, the maximum values were used in calculating the attenuation factor for each event. Most of the maximum sub-slab soil gas values in Table 2 are from Sample Location 838-xx-02, with the exception of the TCE value from E3. In that case, the maximum result and the result from Sample Location 838-xx-02 were similar (260 µg/m^3 versus 200 µg/m^3). In general, maximum indoor air concentrations were location-specific, but the low spatial variability in indoor air results means that similar attenuation factors would be obtained whichever indoor air value was used in the calculations.

NON-DETECT EVALUATION

There have been no detections of HCB in indoor air, but the ND RLs often exceed the draft project-specific RIASL$_{12}$ (5.4 µg/m^3). As shown in Table 2, using the selected building-specific attenuation factor, indoor air concentrations attributable to VI were estimated based on the maximum detected sub-slab soil gas concentration for each event.

As shown in Table 2, the ND evaluation demonstrates that the estimated indoor air concentrations for HCB attributable to VI are below the draft project-specific RIASL$_{12}$ for all four sampling events.

Table 2. Evaluation of Estimated Indoor Air Concentrations for HCB

	E1	E2	E3	E4
Evaluation Based on Maximum Detected Value				
Maximum Detection of HCB in Sub-Slab Soil Gas (µg/m^3)	3,000	3,200	440	1,300
Predicted Indoor Air Impacts (µg/m^3)[a]	0.60	0.64	0.09	0.26
Exceedance of Screening Level of 5.4 µg/m^3?	No	No	No	No

a – Based on the selected building-specific attenuation factor of 2E-04.

A similar evaluation based on maximum RLs (i.e., highest ND values) was performed for seven analytes that were rarely or never detected in sub-slab soil gas but the RLs sometimes exceeded the draft project-specific screening levels. These analytes are 1,1,2,2-tetrachloroethane, 1,1,2-TCA, 1,2,4-TCB, 1,2-EDB, alpha-chlorotoluene, dibromomethane, and naphthalene the results are given below in Table 3. In each case, the predicted indoor air impacts due to VI are below the applicable screening level.

Table 3. Evaluation of Estimated Indoor Air Concentrations

	E1	E2	E3	E4
Evaluation Based on Maximum Detection Limit for 1,2,4-TCB				
Maximum Detection of 1,2,4-TCB in Sub-Slab Soil Gas (μg/m^3)	<540	<220	<80	<310
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.11	<0.04	<0.02	<0.06
Exceedance of Screening Level of 6.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for EDB				
Maximum Detection of EDB in Sub-Slab Soil Gas (μg/m^3)	<140	<58	<20	<81
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.03	<0.01	<0.004	<0.02
Exceedance of Screening Level of 0.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,1,2,2-TCA				
Maximum Detection of 1,1,2,2-TCA in Sub-Slab Soil Gas (μg/m^3)	<120	<52	<18	<72
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.01	<0.004	<0.01
Exceedance of Screening Level of 2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for 1,1,2-TCA				
Maximum Detection of 1,1,2-TCA in Sub-Slab Soil Gas (μg/m^3)	<100	<41	<18	<58
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.01	<0.004	<0.01
Exceedance of Screening Level of 0.62 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for Dibromomethane				
Maximum Detection of DBM in Sub-Slab Soil Gas (μg/m^3)	<520	<220	<76	<300
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.1	<0.04	<0.02	<0.06
Exceedance of Screening Level of 12.2 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for alpha-Chlorotoluene				
Maximum Detection of alpha-Chloro. in Sub-Slab Soil Gas (μg/m^3)	<94	<39	<14	<55
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.02	<0.01	<0.003	<0.01
Exceedance of Screening Level of 2.4 μg/m^3?	No	No	No	No
Evaluation Based on Maximum Detection Limit for Naphthalene				
Maximum Detection of Naph. in Sub-Slab Soil Gas (μg/m^3)	<190	<160	<28	<110
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.04	<0.03	<0.01	<0.02
Exceedance of Screening Level of 3.6 μg/m^3?	No	No	No	No

a – Based on the selected building-specific attenuation factor of 2.0E-04.

A summary of all VI data trends and findings is presented in Table 4.

Table 4. Summary of Findings of Seasonal Confirmation Sampling

Topic	Finding	Details
Spatial Variability of Soil Gas	More than two orders of magnitude	PCE during E2 ranged from 82 to 31,000 μg/m^3, log max./min. = 2.6 TCE during E2 ranged from 5.8 to 1,000 μg/m^3, log max./min. = 2.2
Temporal Variability of Soil Gas	Less than one order of magnitude	HCB at location 838-SS-01 ranged from 35 to 310 μg/m^3, log max./min. = 0.95
Seasonal Trend Analysis	Seasonal sampling is appropriate	No observed seasonal dependence
Spatial Variability of Indoor Air	Generally very little variability during any event	PCE during E2 had CV = 26%. TCE during E2 had CV = 18%
Temporal Variability of Indoor Air	About a factor of two variability over time in detected concentrations	PCE at location 838-IA-02 ranged from 2.4 to 6.2 μg/m^3.
Comparison of Sub-Slab Soil Gas vs. Indoor Air	Data show the expected trends for spatial variability. Less temporal variability in indoor air than expected.	Spatial variability: sub-slab soil gas > indoor air Temporal variability: sub-slab soil gas > indoor air, which indicates AOIs are not currently in regular use in the building.

Table 4. Summary of Findings of Seasonal Confirmation Sampling (Continued)

Topic	Finding	Details
Best Estimate of Attenuation Factor	2.0E-04 (0.0002)	Most conservative value based on maximum detected PCE in sub-slab soil gas results during E2
Temporal Variability in Attenuation Factor	No significant variability	All calculated attenuation factors fall within a relatively narrow range.
Overall Summary	No increase in impacts during wintertime sampling	Summertime sampling event had highest sub-slab soil gas concentrations of TCE, PCE, and HCB. Summertime sampling event had highest indoor air concentration of PCE.

WEIGHT-OF-EVIDENCE SUMMARY

Building 838 was confirmed as a VI Path Forward Group 2 building due to its potential for VI based on sub-slab soil gas exceedances of the draft project-specific $RIASL_{12}$. However, after further investigation and evaluation, the following evidence supports the conclusion that VI is insignificant at Building 838:

- No exceedances of draft project-specific screening levels in indoor air; and
- The sub-slab soil gas data does not show any strong time dependence nor do the data show any strong seasonal effects.
- The data do not support the hypothesis that wintertime should have the highest indoor air impacts. The highest sub-slab soil gas concentrations generally were measured in the summer (e.g., PCE at locations 838-SS-02). Similarly, the highest indoor air concentration for PCE also was measured in the summer.
- The indoor air data show relatively little spatial variability, despite the greater spatial variability in the sub-slab soil gas values. This evaluation confirms that the sub-slab soil gas and indoor air concentrations were relatively constant from season to season.
- As shown in the table below, the building-specific attenuation factor yields estimated indoor air concentrations attributable to VI well below screening levels.

Parameters	TCE	PCE	HCB
Building-specific AF	2.0E-04	2.0E-04	2.0E-04
Maximum detected concentration in SSSG	1,000	31,000	3,200
Maximum ND RL in SSSG	--	--	60
Estimated Indoor Air Concentration - Detected	**0.2**	**6.2**	**0.64**
Estimated Indoor Air Concentration - ND	--	**--**	**0.012**
Indoor Air $RIASL_{12}$	4	2,700	5.4
Indoor Air $TSRIASL_{12}$	12	2,700	180

Based on the CSM for Building 838, VI is an insignificant exposure pathway for current building utilization.

PATH FORWARD

Based on the evaluation of the four seasonal confirmation sampling events, the VI pathway continues to be insignificant for Building 838 and the sub-slab soil gas results have exhibited relatively stable concentrations and no evidence of increasing over time. Sufficient information exists to make a human exposure under control EI determination. However, while currently there is no evidence of potential VI, for future use, LTM is warranted and the building-specific Interim Monitoring Plan is discussed below.

Building-specific Interim Monitoring Plan

Dow will implement an interim monitoring plan at Building 838 until a revised program or more permanent corrective action plan is developed for the site.

Differential pressure measurements will be made at Building 838 to provide another line of evidence in support that VI is insignificant at this building. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). Measurements will be collected at Sample Location 838-xx-02. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., MBS) or Dow Midland Facility meteorological station, if available.

Indoor air will be monitored at location 838-IA-02. This location was selected for continued monitoring since it demonstrated the highest sub-slab soil gas results. Monitoring will be performed for PCE, TCE, and HCB. An outdoor air sample will also be collected at the time of each monitoring event. Interim monitoring will be performed semi-annually for a minimum of two years and monitoring results will undergo trend analysis. If results continue to be consistent and below screening levels, monitoring will be conducted on an annual basis. If indoor air results are observed to be increasing, further evaluation will be performed, which may include collection of a sub-slab soil gas sample(s) and an increase in monitoring frequency. Results from each monitoring event will be reported in the annual CAIP. In the event an indoor air result(s) exceeds screening levels, MDEQ will be provided a brief email notification. A collocated indoor air and sub-slab soil gas sample will be collected from that location within 45 days. If both sub-slab soil gas and indoor air results indicate that VI continues to be insignificant, monitoring will continue at an appropriate frequency. If both sub-slab soil gas and indoor air results indicate that VI is significant and confirm Group 4 conditions, the building will be moved to Group 4 for follow-up actions.

Dow may propose changes to the frequency or other aspects of this interim monitoring plan in the future based on an evaluation of the data, changes in building use or implementation of other corrective actions to address the potential VI pathway.

5.1.7 Vapor Intrusion Evaluation for Building 1098

Building 1098 is a Category 2 building in Zone 1 and was evaluated in Section 5.2.10 in the 2017 CAIP. It is a small building that includes both a shop and office space. It is known as the EVO Maintenance Shop and is located within the southeast portion of the facility designated as Zone 1. The building is single story with an open-air storage loft and contains a maintenance shop and two offices. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1098 is an insignificant exposure pathway based on current use. Building 1098 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The results from the initial sampling event were rescreened in the August 2018 Rescreen. All indoor air analytes were less than screening levels at Building 1098. However, based on exceedances in sub-slab soil gas, Building 1098 was moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be implemented.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. The sampling locations are shown on Figure 5.1.7-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.7-A and indoor and outdoor air on Table 5.1.7-B.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals was found to be stored within the building and each is listed in the survey (e.g., various cleaners, stains, degreasers, primers, galvanizers).

SUB-SLAB SOIL GAS RESULTS EVALUATION

Building 1098 is approximately 6,250 ft^2 in size. Four sub-slab soil gas samples and four indoor air samples were collected (along with one outdoor air sample) in October 2016. Detected results of 1,4-DCB and CFC-12 exceed the MDEQ draft project-specific $RIASL_{12}$. Table 1098-1 presents the sub-slab soil gas results for the analytes that exceed the applicable screening level.

Table 1098-1. Summary of Sub-Slab Soil Gas Detects for Building 1098

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,4-Dichlorobenzene	25%	1,800	25%	1,000
CFC-12	100%	6,600 - 320,000	50%	34,000

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 1098-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1098-2. Vapor Intrusion Evaluation for Building 1098

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,4-Dichlorobenzene	0%	ND	30	ND
CFC-12	100%	4.4 - 11	1,020	ND

*The screening level provided is the draft project-specific $RIASL_{12}$.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1098 is an insignificant exposure pathway based on current use. However, based on the exceedances in sub-slab soil gas, Building 1098 has been moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be performed. The first round of seasonal sampling is scheduled for February 2019. A full evaluation will be presented in the 2019 CAIP.

5.1.8 Vapor Intrusion Evaluation for Building 1159

EXPEDITED BUILDING SUMMARY

An Expedited Building Summary was submitted for Building 1159 on August 24, 2018. MDEQ requested expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Therefore, each indoor air result was compared to the $TSRIASL_{12}$ from the August 2017 Media-Specific Volatilization to Indoor Air Interim

Action Screening Levels. PCE was the only analyte in indoor air detected at Building 1159 greater than the $TSRIASL_{12}$.

The VI findings concluded that the PCE detected in the indoor air at Building 1159 is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop involving degreasers or other products. Interim response actions are not necessary to address the detections of PCE in indoor air at Building 1159.

BACKGROUND

Building 1159 is a Zone 1 add-on building that was identified in 2017 and is attached to Building 3303. Building 1159 is located in the southwestern quadrant of the facility near Gate 23 and is known as the EVO Maintenance Shop (see Figure 5.1.8-1). This building is connected to Building 3303 via doorways to a locker room and hallway leading to the main shop area. Building 3303 is a Zone 1 building evaluated in the 2017 CAIP and all results from the two sample locations collected in late 2016 were below screening levels. Both Buildings 3303 and 1159 appear to have been built between 1965 and 1982. Building 1159 is a 8,976 ft^2 slab-on-grade single story structure with no basement or elevator. Building 1159 consists of a locker room, an expendable stocking area, and two large shop areas. The ground cover around the outside of the building is predominantly asphalt.

The building is heated via ceiling mounted electrical heaters. The locker room is cooled via central AC. The smaller of the two shop areas has a small individual AC unit, but it appears mechanical fans used in tandem with open bay doors are used to cool the shop area in warmer months. Building 1159 has three bay doors that are typically open most of the time during the summer and opened rarely during the winter. A shared intake for 3303 and the locker room for 1159 is located near the southeastern side of the structure.

The occupants of this building work 10-hour shifts Monday through Thursday. Approximately 10-15 people use the shop area and locker room in this building. The workers in this building use either a contracted laundry service or the washer/dryers found in the locker room.

DATA SUMMARY

Building 1159 was sampled in November 2017. The analytical results were compared to the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1159	
Initial Sampling Event	**Completed**
E1	November 2017 (Fall)

Indoor air and sub-slab soil gas samples were collected at five locations within Building 1159. In addition, one outdoor air sample was collected in conjunction with the indoor air sampling to provide evidence regarding the potential contribution from outdoor air to the concentrations measured in indoor air. The sampling locations are shown on Figure 5.1.8-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.1.8-A and indoor and outdoor air on Table 5.1.8-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

A survey using a portable analyzer with a PID found low readings of detectable VOCs in the ambient air at various locations including the sump in the shop and a drain in the hallway. The highest PID reading noted was 0.9 parts per billion by volume (ppbv), which was detected in the ambient air of the southwest portion of the shop. However, during the survey, welding work continued and vehicles actively moved in and out of the shop. The chemical inventory performed during the building survey identified many potential indoor emission sources. The extensive inventory indicated that PCE is stored and/or used

within the building (e.g. degreasers, etc.). The building survey and chemical inventory for Building 1159 are provided in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-seven of the 65 analytes were ND in each of the samples. Eighteen analytes were detected in sub-slab soil gas and all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and/or $TSRIASL_{12}$, if available.

EVALUATION OF VAPOR INTRUSION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. All detections in sub-slab soil gas were less than screening levels. In indoor air, PCE was detected at concentrations that exceeded the $TSRIASL_{12}$ (82 $\mu g/m^3$) in four of five samples with sample locations in the maintenance shop and expendable stocking area. The detected indoor air concentrations that exceeded the $TSRIASL_{12}$ ranged from 110 – 670 $\mu g/m^3$. PCE was ND in the outdoor air sample. TCE was detected in indoor air at concentrations that slightly exceeded the $RIASL_{12}$ (4 $\mu g/m^3$) in three of five samples with sample locations in the maintenance shop and expendable stocking area. The detected indoor air concentrations that only slightly exceeded screening levels ranged from 4.9 – 6.8 $\mu g/m^3$. TCE was not detected in sub-slab soil gas and all RLs were below the $RIASL_{12}$ (130 $\mu g/m^3$). TCE was also ND in the outdoor air sample.

The maximum detection of PCE in sub-slab soil gas at Building 1159 is 160 $\mu g/m^3$ and all the results in sub-slab soil gas are significantly below the screening level ($RIASL_{12}$ and $TRIASL_{12}$ = 2,700 $\mu g/m^3$). The indoor air values for PCE are four to five times higher than the sub-slab soil gas values, which clearly demonstrates that what is being detected indoors is not due to VI. The PCE and TCE detected in the indoor air is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop involving degreasers or other products. The building survey identified Lectra Clean Heavy Duty Electrical Parts Degreaser in several locations within the building. This product contains 90 - 100% PCE. The maximum result of PCE detected in indoor air in Building 1159 is 670 $\mu g/m^3$, which is less than 1% of the Dow IH OEL.

Table 1159-1 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. The analytes listed below have ND RLs in indoor air that exceed screening levels; however, since all detected results in sub-slab gas were below screening levels, it is highly unlikely that these analytes would be present in indoor air > screening level due to VI.

Table 1159-1. Non Detect Evaluation for Building 1159

Soil Gas Analytes with ND RL > SL	ND Result Summary
1,1,2-Trichloroethane	0% Detection Frequency, 4 of 5 samples in SSSG had RLs < $RIASL_{12}$, 3 of 5 IA samples had RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$, 4 of 5 samples in SSSG had RLs < $RIASL_{12}$, All SSSG RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	0% Detection Frequency, 3 of 5 samples in SSSG had RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	0% Detection Frequency, 4 of 5 samples in SSSG had RLs < $RIASL_{12}$

CONCLUSIONS AND RECOMMENDATIONS

The VI pathway at Building 1159 is an insignificant exposure pathway based on current use. However, based on the indoor air results for PCE, Building 1159 has been placed in VI Path Forward Building Group 3 and further investigation into the indoor air results will be conducted.

5.2 Zone 2 Phase 1 Rescreen Evaluations

The Zone 2 Phase 1 buildings were evaluated in the 2017 CAIP (December 2017) and again in the 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 (August 2018). The Zone 2 Phase 1 VI results are presented in the following subsections as follows:

VI Path Forward Group 1 Buildings:

- Section 5.2.1 Buildings 972, 1, 477, 489, and 934

VI Path Forward Group 2, 3, and 4A/4B Buildings:

- Section 5.2.2 Building 833
- Section 5.2.3 Building 941
- Section 5.2.4 Building 948
- Section 5.2.5 Building 1025
- Section 5.2.6 Building 1028
- Section 5.2.7 Building 1233
- Section 5.2.8 Building 768
- Section 5.2.9 Building 827
- Section 5.2.10 Building 849
- Section 5.2.11 Building 858
- Section 5.2.12 Building 969
- Section 5.2.13 Building 1222
- Section 5.2.14 Building 1377

5.2.1 Zone 2 Phase 1 Group 1 Buildings

The Zone 2 Phase 1 buildings were evaluated in the 2017 CAIP (December 2017) and again in the 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report (August 2018). The following Zone 2 Phase 1 buildings were identified as VI Path Forward Building Group 1 in the 2017 CAIP:

- Building 972;
- Building 1;
- Building 477;
- Building 489; and
- Building 934.

The 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report dated August 2018 presented the results of the comparison of the analytical results presented in the 2017 CAIP to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. The findings of the rescreen supported the conclusions of the 2017 CAIP for the Group 1 buildings since all detected results of analytes in sub-slab soil gas and indoor air are less than the draft project-specific $RIASL_{12}$.

The table below presents the Zone 2 Phase 1 buildings that remain in VI Path Forward Building Group 1.

Zone 2 Phase 1 Group 1 Building Summary

Building#	Building Name	Occupancy Category#	2017 CAIP		2018 Rescreen		Path Forward
			Section#	Conclusion	Section#	Conclusion	
972	Granular Formulation Plant	1	5.4.6	Group 1	3.4	Group 1	No further VI evaluation is warranted at this time.
1	Agrosciences Office, Production Plant, and Warehouse	1	5.4.10	Group 1	3.8	Group 1	No further VI evaluation is warranted at this time.
477	Garlon Process Area	2	5.4.11	Group 1	3.9	Group 1	No further VI evaluation is warranted at this time.
489	Herbicide Liquid Formulation Building	2	5.4.12	Group 1	3.10	Group 1	No further VI evaluation is warranted at this time.
934	Liquid Formulation/ 858 Building After Hours	2	5.4.17	Group 1	3.15	Group 1	No further VI evaluation is warranted at this time.

5.2.1.1 Vapor Intrusion Evaluation for Building 972

Building 972 is a Category 1 building in Zone 2 and was evaluated in Section 5.4.6 in the 2017 CAIP. It is a large building that includes office space, shop, laboratory, and a truck garage. It is known as the Granular Formulation Plant and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 972 is an insignificant exposure pathway based on current use. Building 972 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.1.1-A and indoor and outdoor air on Table 5.2.1.1-B.

The findings of the rescreen support the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air are below the $RIASL_{12}$. Therefore, Building 972 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.2.1.2 Vapor Intrusion Evaluation for Building 1

Building 1 is a Category 1 building in Zone 2 and was evaluated in Section 5.4.10 in the 2017 CAIP. It is a large building that includes office space, process area, warehouse, shop, and one control room. It is known as the Agrosciences Office, Production Plant, and Warehouse and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1 is an insignificant exposure pathway based on current use. Building 1 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.1.2-A and indoor and outdoor air on Table 5.2.1.2-B.

The findings of the rescreen support the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air were less than the draft project-specific $RIASL_{12}$. Therefore, Building 1 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.2.1.3 Vapor Intrusion Evaluation for Building 477

Building 477 is a Category 2 building in Zone 2 and was evaluated in Section 5.4.11 in the 2017 CAIP. This building is primarily process area but includes office space and a shop. It is known as Garlon Process Area and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 477 is an insignificant exposure pathway based on current use. Building 477 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.1.3-A and indoor and outdoor air on Table 5.2.1.3-B.

The findings of the rescreen support the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air were below the draft project-specific $RIASL_{12}$. Therefore, Building 477 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.2.1.4 Vapor Intrusion Evaluation for Building 489

Building 489 is a Category 2 building in Zone 2 and was evaluated in Section 5.4.12 in the 2017 CAIP. This building has a process area, a warehouse, a laboratory, and an office space. It is known as the Herbicide Liquid Formulation Building and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 489 is an insignificant exposure pathway based on current use. Tetrahyrofuran was identified as an AOI in indoor air; however, there was no evidence of VI. Building 489 was placed into VI Path Forward Building Group 3 and further investigation into the indoor air result was to be conducted.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.1.4-A and indoor and outdoor air on Table 5.2.1.4-B.

All detected results of analytes in sub-slab soil gas and indoor air are less than the draft project-specific $RIASL_{12}$, including the single detect of tetrahydrofuran. Therefore, Building 489 will be moved into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.2.1.5 Vapor Intrusion Evaluation for Building 934

Building 934 is a Category 2 building in Zone 2 and was evaluated in Section 5.4.17 in the 2017 CAIP. This building is single story and includes a large warehouse with a small office and process area. It is known as the Liquid Formulation/858 Building After Hours and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 934 is an insignificant exposure pathway based on current use. Building 934 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.1.5-A and indoor and outdoor air on Table 5.2.1.5-B.

The findings of the rescreen support the conclusions of the 2017 CAIP. All detected results of analytes in sub-slab soil gas and indoor air are less than the $RIASL_{12}$. Therefore, Building 934 remains in VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.2.2 Vapor Intrusion Evaluation for Building 833

Building 833 is a Category 2 building in Zone 2. The results of the initial sampling event were evaluated in Section 5.4.3 of the 2017 CAIP. Building 833 has office space, sampling supply storage and a sample preparation area and is known as the Craft Services Fab Shop. It is approximately 5,220 ft^2 and is located within the central portion of the facility designated as Zone 2.

The 2018 Vapor Intrusion Rescreen of Zone 1 and Zone 2 Phase 1 Report dated August 2018 presented the results of the comparison of the analytical results presented in the 2017 CAIP to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.2-A and indoor and outdoor air on Table 5.2.2-B.

The findings of the rescreen support the conclusions of the 2017 CAIP. The VI Pathway at Building 833 is an insignificant exposure pathway based on current use. However, due to the slight exceedance of chloroform in indoor air Building 833 will be moved into VI Path Forward Building Group 3 and further investigation into the indoor air exceedance will be conducted.

5.2.3 Vapor Intrusion Evaluation for Building 941

EXPEDITED BUILDING SUMMARY

An Expedited Building Summary was submitted for Building 941 on August 24, 2018. MDEQ requested expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Therefore, each indoor air result from the initial three sampling events was compared to the $TSRIASL_{12}$ from the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels. PCE and TCE were the only analytes in indoor air detected at Building 941 greater than the $TSRIASL_{12}$.

The VI findings concluded that the contribution of VI to the measured indoor air concentrations appears to be significant at sample location 941-IA-04 and interim response actions were appropriate to address detected concentrations at that location. TCE was much more evenly distributed throughout the building

than other various chlorinated VOCs. This finding suggests that factors other than VI were involved, such as indoor air emission sources for TCE at locations other than sample location 941-IA-04. Further investigation and sampling, as well as on-going seasonal confirmation sampling was recommended.

DATA SUMMARY

Building 941 is a Category 1 building located in the central portion of the facility designated as Zone 2. It is known as the Specialty Intermediates/Herbicides Inter Control Room and is a large, single story building that includes process area, laboratory, and office space.

The results of the initial sampling event were evaluated in Section 5.4.4 of the 2017 CAIP. The results were re-evaluated in the 2018 Rescreen. To date, Building 941 has undergone four complete seasonal confirmation sampling events, with a fifth event (E5) that occurred this fall; however, the data for E5 will not be available until early 2019 and is not evaluated in this report. A sixth event (E6) is scheduled for Winter 2019.

Building 941	
Initial Sampling Event	**Completed**
E1	May 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Sept 2017 (Fall)
E3	Feb 2018 (Winter)
E4	Aug 2018 (Summer)
E5 (not evaluated in this report)	November 2018 (Fall)
E6	*Scheduled - Feb 2019 (Winter)*

TCE was detected in indoor air above the $TSRIASL_{12}$ at two sample locations during E1. E2 had no exceedances of TCE in indoor air. However, during E3, TCE and PCE were detected above the $TSRIASL_{12}$ (TCE in five sample locations and PCE in one location). During E4, no exceedances of the indoor air $TSRIASL_{12}$ occurred for TCE or PCE.

The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.3-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.3-A and indoor and outdoor air on Table 5.2.3-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and a few slight detections were noted in the 0.1-parts per million (ppm) range in the ambient air of the control room and office east of the north door. During the initial building survey (2017), the ambient air in the ladies room was 0.5 ppm and the drain in the ladies room yielded a 16.8 ppm reading. There were no other detections indicated throughout the screening of the building and while the ladies room reading was the largest reading during the PID screening, the other results were minimal. Open conduits were discovered under the refrigerator located on the western side of the control room just south of the most northern entrance to the switch room. The conduits were identified at the very end of the initial sampling event when the refrigerator was moved slightly in order for the sampling crew to safely access the proposed sub-slab soil gas sample location. Upon discussing the presence of the conduits with pertinent 941 personnel, the conduits were promptly capped. A chemical inventory was completed during the building survey that identified degreasers, cleaners, motor oil, and

insecticides. The full chemical inventory list is presented with the building survey in Appendix E. One of the items identified on the survey is an aerosol product that contains 60 to 100% TCE.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), eight analytes were detected above the draft project-specific $RIASL_{12}$ including four analytes that were also detected above the $TSRIASL_{12}$;

2. During the second event (fall 2017), nine analytes were detected above the draft project-specific $RIASL_{12}$ including four analytes that were also detected above the $TSRIASL_{12}$;

3. During the third event (winter 2018), nine analytes were detected above the draft project-specific $RIASL_{12}$ including four analytes that were also detected above the $TSRIASL_{12}$; and

4. During the fourth event (summer 2018), eight analytes were detected above the draft project-specific $RIASL_{12}$ including four analytes that were also detected above the $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 941-1.

Table 941-1. Summary of Sub-Slab Soil Gas Exceedances for Building 941

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	78%	8.1 - 12,000	56%	20
1,1,2-Trichloroethane (2)	67%	20 - 5,300	56%	20
1,1,2-Trichloroethane (3)	89%	11 - 8,100	67%	20
1,1,2-Trichloroethane (4)	56%	54 - 4,600	56%	20
1,1-Dichloroethene (1)	100%	11 - 9,800	0%	20,000
1,1-Dichloroethene (2)	100%	28 - 37,000	11%	20,000
1,1-Dichloroethene (3)	100%	50 - 7,200	0%	20,000
1,1-Dichloroethene (4)	100%	9.5 - 53,000	11%	20,000
1,2-Dichloroethane (1)	56%	4 - 14,000	33%	150
1,2-Dichloroethane (2)	44%	6.3 - 2,800	33%	150
1,2-Dichloroethane (3)	44%	6.8 - 16,000	33%	150
1,2-Dichloroethane (4)	44%	16 - 2,900	33%	150
Bromodichloromethane (1)	22%	190 – 290	11%	200
Bromodichloromethane (2)	22%	220 – 240	22%	200
Bromodichloromethane (3)	22%	250 – 280	22%	200
Bromodichloromethane (4)	11%	150	0%	200
Carbon Tetrachloride (1)	44%	13 - 4,800	33%	710
Carbon Tetrachloride (2)	67%	13 - 6,300	33%	710
Carbon Tetrachloride (3)	78%	6.8 - 4,800	33%	710
Carbon Tertrachloride (4)	67%	17 - 3,800	33%	710
Chloroform (1)	100%	5.1 - 11,000	44%	170
Chloroform (2)	100%	6.2 - 12,000	56%	170
Chloroform (3)	100%	6.1 - 15,000	56%	170
Chloroform (4)	100%	12 - 9,600	67%	170
cis-1,2-Dichloroethene (1)	56%	20 - 9,300	11%	820
cis-1,2-Dichloroethene (2)	78%	12 - 9,100	11%	820
cis-1,2-Dichloroethene (3)	78%	5.2 - 10,000	11%	820
cis-1,2-Dichloroethene (4)	67%	17 - 12,000	11%	820
Naphthalene (1)	33%	14 – 29	0%	120
Naphthalene (2)	11%	24	0%	120
Naphthalene (3)	33%	11 – 130	11%	120
Naphthalene (4)	11%	39	0%	120

Table 941-1. Summary of Sub-Slab Soil Gas Exceedances for Building 941 (Continued)

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
PCE (1)	100%	270 - 160,000	22%	2,700
PCE (2)	100%	450 - 170,000	44%	2,700
PCE (3)	100%	470 - 250,000	33%	2,700
PCE (4)	100%	88 - 210,000	22%	2,700
TCE (1)	100%	25 - 65,000	67%	130
TCE (2)	100%	27 - 84,000	67%	130
TCE (3)	100%	44 - 83,000	78%	130
TCE (4)	100%	6.2 - 63,000	89%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 941-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air. Relatively high analyte concentrations were detected in indoor air at one location during the third seasonal confirmation sampling event; however, results during the fourth seasonal confirmation sampling event were observed to be within the range of results detected during the first and second confirmation sampling events.

Table 941-2. Vapor Intrusion Evaluation for Building 941

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	100%	0.19 - 1.8	0.62	ND
1,1,2-Trichloroethane (2)	89%	0.24 - 0.58	0.62	ND
1,1,2-Trichloroethane (3)	89%	0.52 - 12	0.62	ND
1,1,2-Trichloroethane (4)	100%	0.3 - 0.44	0.62	ND
1,1-Dichloroethene (1)	100%	0.41 - 2	620	0.29
1,1-Dicholroethene (2)	100%	0.56 - 4.4	620	0.14
1,1-Dichloroethene (3)	100%	0.08 - 14	620	0.11
1,1-Dichloroethene (4)	100%	0.27 - 3.5	620	0.24
1,2-Dichloroethane (1)	100%	0.76 - 2.4	4.6	0.54
1,2-Dichloroethane (2)	100%	0.16 - 0.56	4.6	ND
1,2-Dichloroethane (3)	100%	0.3 - 14	4.6	0.24
1,2-Dichloroethane (4)	100%	0.41 - 0.88	4.6	0.20
Bromodichloromethane (1)	0%	ND	6.2	ND
Bromodichloromethane (2)	0%	ND	6.2	ND
Bromodichloromethane (3)	0%	ND	6.2	ND
Bromodichloromethane (4)	0%	ND	6.2	ND
Carbon Tetrachloride (1)	100%	0.76 - 2.3	22	0.69
Carbon Tetrachloride (2)	100%	0.29 - 0.7	22	0.35
Carbon Tetrachloride (3)	100%	0.47 - 4.9	22	0.60
Carbon Tetrachloride (4)	100%	0.46 - 0.77	22	0.51
Chloroform (1)	100%	0.3 - 3.4	5.2	0.18
Chloroform (2)	100%	0.76 - 6.3	5.2	0.33
Chloroform (3)	100%	0.16 - 15	5.2	0.43
Chloroform (4)	100%	0.84 - 1.6	5.2	0.20
cis-1,2-Dichloroethene (1)	11%	0.13	24	ND
cis-1,2-Dichloroethene (2)	33%	0.15 - 0.42	24	ND
cis-1,2-Dichloroethene (3)	67%	0.14 - 22	24	ND
cis-1,2-Dichloroethene (4)	0%	ND	24	ND

Table 941-2. Vapor Intrusion Evaluation for Building 941 (Continued)

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Naphthalene (1)	0%	ND	3.6	ND
Naphthalene (2)	22%	0.47 - 0.52	3.6	ND
Naphthalene (3)	0%	ND	3.6	ND
Naphthalene (4)	22%	0.57 - 0.68	3.6	ND
PCE (1)	100%	1.1 - 2.8	82	2
PCE (2)	100%	0.94 – 8	82	2.3
PCE (3)	100%	0.44 – 210	82	13
PCE (4)	100%	3.6 - 5.8	82	2.5
TCE (1)	100%	1 – 15	4	ND
TCE (2)	100%	2.4 - 7.2	4	0.35
TCE (3)	100%	0.22 – 76	4	0.43
TCE (4)	100%	0.92 - 4.2	4	0.30

*Screening level provided is the draft project-specific $RIASL_{12}$.

1,1,2-Trichloroethane (1,1,2-TCA), 1,2-dichloroethane, chloroform, PCE, and TCE were detected in indoor air above the $RIASL_{12}$. Sub-slab soil gas and indoor air results for each of those analytes by sample location and sampling event are provided on Figures 5.2.3-2 through 5.2.3-6, respectively. PCE and TCE were also detected in indoor air above the $TSRIASL_{12}$.

As shown on Figures 5.2.3-2 through 5.2.3-6, 1,1,2-TCA was detected above the screening level in indoor air at multiple sample locations during E1 and E3. 1,2-Dichloroethane was detected above the indoor air screening level at six sample locations during E3. Chloroform was detected above the indoor air screening level at a single sample location during E2 and at six sample locations during E3. PCE exceeded the indoor screening level once at sample location 941-IA-04 during E3. TCE exceeded the indoor air screening level in all four events. For sub-slab soil gas, chloroform, cis-1,2-DCE, PCE, and TCE exceed the $TSRIASL_{12}$ for each sampling event.

As shown on Figure 5.2.3-6, TCE was detected in indoor air above the $TSRIASL_{12}$ at two sample locations during E1. During E2, there were no $TSRIASL_{12}$ exceedances of TCE or any other analyte in indoor air. During E3, TCE and PCE were detected above the $TSRIASL_{12}$ (TCE in five sample locations and PCE in a single location). However, during E4 there were no exceedances of screening levels, with the exception of TCE at sample location 941-IA-02, which only slightly exceeded the $RIASL_{12}$ (4.2 $\mu g/m^3$ versus $RIASL_{12}$ of 4.0 $\mu g/m^3$).

The distribution of VOCs in the subsurface varies depending on the chemical, but sample location 941-SS-04 has some of the highest detected concentrations for a number of chlorinated VOCs, including PCE. A preferential pathway (i.e., floor drain with elevated PID readings) likely exists at that location (restroom) and it appears that VI was significant at that location during E3 due to the correlation of sub-slab soil gas and indoor air results. At sample location 941-IA-04, these indoor air impacts appear to be related to the subsurface concentration of these chemicals. An inch of rain fell the day before E3, and this may have contributed to the higher rates of VI that were observed.

Building-specific attenuation factors were calculated for specific sample locations and analytes for E3 and are shown in Table 941-3. At sample location 941-xx-04, the attenuation factors calculated for various chlorinated VOCs were approximately 0.001. Data for sample location 941-xx-05 are shown in Table 941-3 for comparison since this sample location also had relatively high sub-slab soil gas concentrations but the indoor air impacts were lower. Attenuation factors at sample location 941-xx-05 (approximately 0.0004) were three to ten times lower than the attenuation factors at sample location 941-xx-04. The comparison of attenuation factors further demonstrates that there is likely a preferential pathway for VI at sample location 941-xx-04.

Table 941-3. Attenuation Factors for Selected Analytes during E3

	Measurement Result (µg/m3)					
	Location 941-xx-04			Location 941-xx-05		
Sample ID	Indoor Air	Sub-Slab	α	Indoor Air	Sub-Slab	α
PCE	210	250,000	8.4E-04	1.5	4,900	3.1E-04
TCE	76	83,000	9.2E-04	6.8	77,000	8.8E-05
cis-1,2-DCE	22	10,000	2.2E-03	<0.12	270	<4.4E-04
1,1-DCE	14	7,200	1.9E-03	4.5	7,200	6.3E-04
EDC	9.5	3,700	2.6E-03	0.48	770	6.2E-04
1,1,1-TCA	8.9	6,100	1.5E-03	0.97	3,800	2.6E-04
Carbon tetrachloride	4.9	2,800	1.8E-03	0.94	1,900	4.9E-04
Chloroform	15	9,000	1.7E-03	1.8	7,400	2.4E-04

Notes:
< - Non-detect at the reporting limit (RL).
ND values were used to calculate the attenuation factor (the full RL value was used).
The indoor air values were not adjusted for the outdoor air results.
Attenuation factor based on indoor air concentration/sub-slab soil gas concentration.

TCE was more evenly distributed in indoor air than PCE during E3. PCE was detected at far lower concentrations elsewhere in the building relative to sample location 941-IA-04. This also was true for cis-1,2-DCE, a breakdown product of PCE and TCE. This isomer of DCE is unlikely to be present in any indoor emission sources, as there are no known consumer products that contain this isomer (but the trans-isomer was found in products at this building). Therefore, its distribution is likely due to VI and represents what would be expected for other analytes if there were no indoor or outdoor sources. Both PCE and cis-1,2-DCE were at least 20-times to 30-times lower at other locations compared with sample location 941-IA-04. This was not true for TCE, which was much more evenly distributed throughout the building. This finding suggests factors other than VI were involved, such as indoor air emission sources for TCE at locations other than sample location 941-IA-04.

Table 941-4 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the seven analytes listed below, only EDB and HCB require further evaluation and will be evaluated after the seasonal confirmation sampling is complete (at least one more event is scheduled for February 2019).

Table 941-4. Non Detect Evaluation for Building 941

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$, except for during E3, where 11% of ND results are above $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$.
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$, except for during E3, where 11% of ND RLs were above $RIASL_{12}$.

Table 941-4. Non Detect Evaluation for Building 941 (Continued)

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$, except for during E3, where 11% of ND RLs were above $RIASL_{12}$.
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$, except for during E3, where 11% of ND RLs were above $RIASL_{12}$.
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND INTERIM ACTIONS

To date, the four seasonal confirmation sampling events at Building 941 have generated inconsistent indoor air results. The results for sub-slab soil gas are generally consistent in comparison. Based on the sub-slab soil gas and indoor air results, there is evidence of potential VI at Building 941. Building 941 remains in VI Path Forward Building Group 4, and can be further classified as Group 4B. Group 4B consists of buildings that have seasonal confirmation sample results that demonstrate correlated sub-slab soil gas and indoor air screening level exceedances indicate that VI is likely significant. Currently, more investigations are planned to better understand vapor transport and VI potential at Building 941. Further investigation is warranted and the building-specific interim actions are discussed below.

In September 2018, an air purifier with carbon-impregnated filters was installed in Building 941 in the women's restroom near sample location 941-IA-04 to reduce VOC concentrations. This is a temporary measure being used until the vapor pathway is controlled or mitigated at this location. The air purifier and filters are monitored weekly at this location. Weekly PID measurements are collected near the drains and in the ambient air in the women's restroom (941-IA-04). Also, water was added to the floor drains to block or negate any preferential pathway associated with dry plumbing traps.

During the initial PID measurements on September 18, 2018, the ambient air PID reading was 0.2 ppm and the reading from the shower drains was 0.0 ppm. Field personnel poured one gallon of water down the drain to fill/rewet the trap. On September 25, 2018, the ambient air PID reading was 0.0 ppm and the shower drains was 1.9 ppm. When field personnel returned to bathroom/locker room after obtaining water to fill/rewet the trap, the door to the bathroom/locker room was locked. The occupant sprayed air deodorizer prior to exiting the room. The next ambient air PID reading observed was 1.1 ppm and approximately 3-5 minutes later, the ambient air PID readings returned to 0.0 ppm. Field personnel poured approximately a gallon of water down the shower drains and collected another reading from the shower drains of approximately 6.6 ppm. On September 26, 2018, the ambient air PID reading was 0.0 ppm. The PID reading from the shower drains was also 0.0 ppm. All weekly ambient air and shower drain PID readings have been 0.0 ppm since the September 26, 2018 measurements.

Further investigations and building–specific interim actions include:

- Seasonal confirmation sampling will continue.
- A more in depth building survey and chemical inventory will be conducted to identify indoor emission sources. Screening levels for PCE and TCE were noted during sampling and the spatial distribution of TCE in the indoor air suggests an indoor source.
- Indoor air screening will be conducted using a portable instrument to collect real-time analyte-specific data. If real-time measurements for PCE and/or TCE can be made, the observed concentration gradients within the building will help determine if there is an indoor source.
- Potential preferential pathways will continue to be evaluated. An additional sample will be collected in the men's locker room to provide additional information. Floor drains and other

openings will continue to be screened with a PID. The PID will also be utilized before and after water is added to the floor drains to observe any fluctuations in output.

- Differential pressure measurements will be made at Building 941 to provide another line of evidence. One week of continuous differential pressure measurements will be made using an Omniguard 5 Cellular Differential Pressure Recorder or an equivalent device. Measurements will be made during the winter heating season (i.e., October 1 – March 31). At a minimum, measurements will be collected at Sample Location 941-xx-04. The data will be compared with regional barometric pressure data obtained from the nearest National Weather Station (e.g., MBS) or Dow Midland Facility meteorological station, if available.

- Collect information to better understand the local sewer system and how rainfall events or water infiltration can affect vapor transport.

Reporting and Notification

High level email summary updates will be provided to MDEQ as data becomes available and evaluation is performed. In the event an indoor air result(s) exceeds the $TSRIASL_{12}$, MDEQ will be provided a brief email notification. If there is a correlated sample location exceedance and the indoor air result is above $TSRIASL_{12,}$ interim response actions will be implemented while further investigation continues to determine the source of VI. If a known indoor air exceedance is determined to be due to VI, mitigation will be designed and implemented.

Results from each sampling event will be reported in the annual CAIP. When data and/or findings are available, updates will be provided to MDEQ in the monthly Corrective Action meetings. A full evaluation with path forward recommendations will be provided in the 2019 CAIP.

Dow may propose changes to the frequency or other aspects of these interim actions based on an evaluation of the data, changes in building use or implementation of other interim response actions to address the potential VI pathway.

5.2.4 Vapor Intrusion Evaluation for Building 948

Building 948 is a Category 2 building located in the central portion of the facility designated as Zone 2. It is known as the Phenoxy Herbicides Building and is a two-story building that includes process area, a control room, a laboratory, locker rooms, and office space.

The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 948 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 948 was placed in VI Path Forward Building Group 4 and placed into a seasonal confirmation sampling regime to assess potential seasonal variation.

The results of the initial sampling event (E1) were evaluated in Section 5.4.5 of the 2017 CAIP. Since that time, two additional seasonal events (E2 & E3) have been completed, with a fourth event (E4) that occurred this fall; however, the data will not be available until early 2019 and is not included in this report. The results of all completed events are included in this evaluation.

Building 948	
Initial Sampling Event	**Completed**
E1	May 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Feb 2018 (Winter)
E3	Aug 2018 (Summer)
E4 (not evaluated in this report)	*November 2018 (Fall)*

Based on the 2018 rescreen, PCE was detected in indoor air above the $TSRIASL_{12}$ at six sample locations during the initial sampling event. PCE is one of the chemicals used in the process at Building 948 and therefore is expected to be detected. The maximum detected results of PCE in indoor air, however, are less than 1% of the Dow OEL. Furthermore, during E2 and E3, PCE was detected in indoor air below the screening level at all nine sample locations, which includes the locations of the previous exceedances. Therefore, no Expedited Building Summary was necessary.

DATA SUMMARY

The analytical results from each sampling event were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.4-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.4-A and indoor and outdoor air on Table 5.2.4-B. The analytical data is presented in Appendix C. Field sampling logs are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, included cleaners, disinfectants, and spray paint. The chemical inventory is included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), seven analytes were detected above the draft project-specific $RIASL_{12}$ including four analytes that also exceed the $TSRIASL_{12}$;

2. During the second event (winter 2018), the same seven analytes were detected above the draft project-specific $RIASL_{12}$ including three analytes that also exceed the $TSRIASL_{12}$; and

3. During the third event (summer 2018), four analytes were detected above the draft project-specific $RIASL_{12}$ including three analytes that also exceed the $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 948-1.

Table 948-1. Summary of Sub-Slab Soil Gas Exceedances for Building 948

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
Benzene (1)	44%	28 - 4,700	11%	510
Benzene (2)	33%	11 - 1,500	11%	510
Benzene (3)	22%	4.8 -8.3	0%	510
Chloroform (1)	44%	12 - 630	33%	170
Chloroform (2)	56%	18 -620	44%	170
Chloroform (3)	56%	92 -950	33%	170

Table 948-1. Summary of Sub-Slab Soil Gas Exceedances for Building 948 (Continued)

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	Screening Level* (µg/m³)
cis-1,2-Dichloroethene (1)	89%	24 - 5,800	44%	820
cis-1,2-Dichloroethene (2)	89%	13 - 6,500	33%	820
cis-1,2-Dichloroethene (3)	89%	44 -37,000	44%	820
Cumene (1)	44%	26 - 3,100	22%	380
Cumene (2)	33%	92 - 1,600	11%	380
Cumene (3)	11%	140	0%	380
Ethylbenzene (1)	56%	25 - 11,000	11%	1,600
Ethylbenzene (2)	44%	26 - 6,400	11%	1,600
Ethylbenzene (3)	67%	11 - 750	0%	1,600
PCE (1)	100%	380 - 230,000	89%	2,700
PCE (2)	100%	4,600 - 260,000	100%	2,700
PCE (3)	100%	1,300 -230,000	78%	2,700
TCE (1)	100%	22 - 16,000	78%	130
TCE (2)	100%	200 - 16,000	100%	130
TCE (3)	100%	33 -13,000	78%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 948-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 948-2. Vapor Intrusion Evaluation for Building 948

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	Indoor Air Screening Level* (µg/m³)	Outdoor Air Result (µg/m³)
Benzene (1)	56%	0.43 - 2.4	15.4	0.6
Benzene (2)	100%	0.49 - 0.75	15.4	0.49
Benzene (3)	100%	0.28 - 0.57	15.4	0.34
Chloroform (1)	100%	0.27 - 0.8	5.2	ND
Chloroform (2)	100%	0.28 - 0.51	5.2	0.18
Chloroform (3)	100%	0.30 - 1.3	5.2	0.20
cis-1,2-Dichloroethene (1)	67%	0.57 - 0.88	24	ND
cis-1,2-Dichloroethene (2)	89%	0.20 - 1.4	24	ND
cis-1,2-Dichloroethene (3)	100%	0.13 - 0.25	24	ND
Cumene (1)	0%	ND	11.4	ND
Cumene (2)	0%	ND	11.4	ND
Cumene (3)	0%	ND	11.4	ND
Ethylbenzene (1)	100%	0.44 - 1.6	48	ND
Ethylbenzene (2)	100%	0.38 - 4.1	48	ND
Ethylbenzene (3)	100%	0.20 - 1.1	48	0.18
PCE (1)	100%	21 - 330	82	5.1
PCE (2)	100%	4.1 - 13	82	5.4
PCE (3)	100%	6 - 12	82	4.9
TCE (1)	89%	0.19 - 1.1	4	ND
TCE (2)	100%	0.28 - 0.39	4	0.2
TCE (3)	67%	0.17 - 0.40	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

PCE was the only analyte detected above a screening level in indoor air during any of the three sampling events. Sub-slab soil gas and indoor air results for PCE by sampling location and sampling event are provided on Figure 5.2.4-2. PCE exceeded the $RIASL_{12}$ for indoor air during E1 at sampling locations 948-IA-04 through 948-IA-09, with concentrations ranging from 250 µg/m^3 to 330 µg/m^3. During E2 and E3, there were no PCE exceedances in indoor air above the screening level. PCE is used in the process at Building 948 and it is likely that process operations influenced the indoor air results during E1.

Table 948-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 15 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 948-3. Non Detect Evaluation for Building 948

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ during E3
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$, All ND RLs < $RIASL_{12}$ during E3
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	All detects and ND RLs < $RIASL_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dioxane	11% Detection Frequency for E1, 0% Detection Frequency for E2 and E3; All detects and ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ in E1 and E1
Chloroform	100% Detection Frequency, All detects < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ E2 and E3
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results for all other analytes, the VI pathway at Building 948 is an insignificant exposure pathway based on current use. PCE is used in the process at Building 948 and the maximum detected results of PCE in indoor air are less than 1% of the Dow OEL. However, based on the sub-slab soil gas results and given the potential for future VI, Building 948 remains in VI Path Forward Building Group 4A due to the lack of correlated sample exceedances indicating VI is insignificant and IA exceedances likely due to workplace chemical use. A full evaluation will be represented in the 2019 CAIP.

5.2.5 Vapor Intrusion Evaluation for Building 1025

Building 1025 is a Category 2 building in Zone 2. The results of the initial sampling event (Spring 2017) were evaluated in Section 5.4.7 of the 2017 CAIP. Building 1025 is a medium-sized single story office

building and is known as the Building 1025 Office Building. It is approximately 8,350 ft^2 and is located within the central portion of the facility designated as Zone 2. The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 1025 was an insignificant exposure pathway based on current use. Building 1025 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at that time.

The results from the initial sampling event were rescreened. No indoor air analytes were detected above screening levels at Building 1025. Therefore, no Expedited Building Summary was necessary. Due to three sub-slab soil gas analytes with results that exceed the screening level, Building 1025 was moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be performed.

During follow-up discussions with building representatives, it was determined that an area of the building assumed to be infrequently used was an area of high use. The number of samples collected in the initial sampling event was based oon the total square footage of the building, as per MDEQ guidance but they were placed in the areas of the building anticipated to be in the highest use. In Fall 2017, an additional three samples were collected in the large southern room and the data sets were combined for this evaluation.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

In April 2017, sub-slab soil gas samples were collected from six locations from within the building. In November 2017, three additional add-on sub-slab soil gas locations were sampled for a total of nine locations. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.5-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.5-A and indoor and outdoor air on Table 5.2.5-B. The complete analytical reports for the initial six sub-slab soil gas and indoor and outdoor air samples were presented in the 2017 CAIP.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included bleach and various cleaners.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. When compared to the draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available, four analytes had detected results greater than the $RIASL_{12}$, including one result for PCE that was detected above the $TSRIASL_{12}$. The sub-slab soil gas results for the analytes that exceed the appropriate screening level is summarized in Table 1025-1.

Table 1025-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1025

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,1- Dichloroethane	67%	7.4 - 3,300	11%	2,500
Ethylbenzene	89%	9.6 - 11,000	25%	1,600
PCE	88%	340 - 6600	13%	2,700
Total Xylenes	100%	41 - 47,000	11%	22,000

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 1025-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1025-2. Vapor Intrusion Evaluation for Building 1025

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,1 - Dichloroethane	0%	ND	74	ND
Ethylbenzene	100%	0.44 - 1.5	48	0.47
PCE	100%	3.4 - 6.9	82	2.1
Total Xylenes	100%	2.33 - 9.9	680	0.89

* Screening level provided is the draft project-specific $RIASL_{12}$.

Detected indoor air concentrations for these three analytes are at least an order of magnitude less than the draft project-specific $RIASL_{12}$.

Table 1025-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the eight analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 1025-3. Non Detect Evaluation for Building 1025

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1025 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1025 will be moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be performed. A full evaluation will be presented in the 2019 CAIP.

5.2.6 Vapor Intrusion Evaluation for Building 1028

Building 1028 is a Category 1 building in Zone 2 and was evaluated in Section 5.4.8 in the 2017 CAIP. It is a medium-sized single story office building with a laboratory. It is known as the Sulfonamide Control Room and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling results, the VI pathway at Building 1028 is an insignificant exposure pathway based on current use. Building 1028 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted. The results from the initial sampling event (Spring 2017) were rescreened in the 2018 Rescreen Report (August 2018) and the evaluation is presented below.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. The sampling locations are shown on Figure 5.2.6-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.6-A and indoor and outdoor air on Table 5.2.6-B. The analytical reports for sub-slab soil gas and indoor and outdoor air samples are presented in Appendix C. Field sampling logs are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals was found to be stored within the building and each is listed in the survey (e.g., various cleaners, stains, degreasers, primers, and galvanizers). The chemical inventory is included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Building 1028 is approximately 5,250 ft^2 in size. Four sub-slab soil gas samples and four indoor air samples were collected (along with one outdoor air sample) in April 2017. A single detected result of chloroform in sub-slab soil gas exceeded the MDEQ draft project-specific $RIASL_{12}$. Table 1028-1 presents the sub-slab soil gas result for chloroform.

Table 1028-1. Summary of Sub-Slab Soil Gas Detects for Building 1028

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
Chloroform	100%	7.2 - 260	25%	170

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 1028-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1028-2. Vapor Intrusion Evaluation for Building 1028

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform	100%	0.24 - 0.48	5.2	ND

*The screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results for chloroform are below the screening level. EDB is the only ND analyte in sub-slab soil gas with a single RL that exceeds screening levels and will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1028 is an insignificant exposure pathway based on current use. However, based on the one exceedance in sub-slab soil gas, Building 1028 will be moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be performed. A full evaluation will be presented in the 2019 CAIP.

5.2.7 Vapor Intrusion Evaluation for Building 1233

Building 1233 is a Category 1 building located in the central portion of the facility designated as Zone 2. It is known as the Garlon Plant Granular Building and is a single story building that includes process area, a laboratory, a shop, and office space.

The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 1233 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1233 was placed in VI Path Forward Building Group 2 and was resampled. Group 2 is a designation for buildings that have sub-slab soil gas AOIs; however, indoor air results were less than screening levels. These buildings are placed into seasonal confirmation sampling to assess potential seasonal variation.

The results of the initial sampling event (E1) were evaluated in Section 5.4.9 of the 2017 CAIP. Since that time, two additional seasonal events (E2 & E3) have been completed, with a fourth event (E4) that occurred this fall; however, the data from E4 will not be available until 2019 and is not included in this report. The results of all completed events are included in this evaluation.

Building 1233	
Initial Sampling Event	**Completed**
E1	May 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Feb 2018 (Winter)
E3	Aug 2018 (Summer)
E4 (not evaluated in this report)	*November 2018 (Fall)*

No indoor air analytes were detected above screening levels at Building 1233. Therefore, no Expedited Building Summary was necessary. The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP.

DATA SUMMARY

The analytical results presented in the 2017 CAIP, as well as the additional seasonal sampling events conducted in the winter and summer of 2018, were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from four locations from within the building. Indoor air samples were collected at four locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.7-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.7-A and indoor and outdoor air on Table 5.2.7-B. The analytical data are presented in Appendix C. Field sampling logs are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, included cleaners, gas duster, insecticides, and spray paint. The chemical inventory is included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), seven analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE which were also detected above the $TSRIASL_{12}$;

2. During the second event (winter 2018), the same seven analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE which were also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), the same seven analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE which were also detected above the $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 1233-1.

Table 1233-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1233

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	50%	300 - 470	50%	20
1,1,2-Trichloroethane (2)	50%	250 - 420	50%	20
1,1,2-Trichloroethane (3)	50%	160 - 220	50%	20
1,2-Dichloroethane (1)	100%	6.6 - 1,000	50%	150
1,2-Dichloroethane (2)	75%	8.2 - 1,200	50%	150
1,2-Dichloroethane (3)	50%	250 - 340	50%	150
1,2-Dichloropropane (1)	75%	32 - 2,600	50%	410
1,2-Dichloropropane (2)	75%	30 - 2,700	50%	410
1,2-Dichloropropone (3)	75%	17 - 810	50%	410
Chloroform (1)	100%	78 - 480	50%	170
Chloroform (2)	100%	77 -- 420	50%	170
Chloroform (3)	100%	67 - 310	25%	170
HCB (1)	75%	250 - 5,200	75%	180
HCB (2)	100%	46 - 4,300	75%	180
HCB (3)	100%	68 - 2,200	75%	180
PCE (1)	100%	580 - 7,100	50%	2,700
PCE (2)	100%	490 - 6,200	50%	2,700
PCE (3)	100%	600 - 3,700	25%	2,700
TCE (1)	100%	8.2 - 16,000	50%	130
TCE (2)	75%	51 - 14,000	50%	130
TCE (3)	75%	39 - 5,800	50%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 1233-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well

as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1233-2. Vapor Intrusion Evaluation for Building 1233

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	0%	ND	0.62	ND
1,1,2-Trichloroethane (2)	25%	0.24	0.62	ND
1,1,2-Trichloroethane (3)	0%	ND	0.62	ND
1,2-Dichloroethane (1)	0%	ND	4.6	ND
1,2-Dichloroethane (2)	100%	0.19 - 0.25	4.6	0.12
1,2-Dichloroethane (3)	100%	0.47 - 0.69	4.6	0.14
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
Chloroform (1)	100%	0.67 - 0.77	5.2	0.34
Chloroform (2)	100%	1.2 - 1.7	5.2	0.37
Chloroform (3)	100%	1.0 - 1.5	5.2	0.97
HCB (1)	0%	ND	5.4	ND
HCB (2)	0%	ND	5.4	ND
HCB (3)	0%	ND	5.4	ND
PCE (1)	50%	0.22 - 0.24	82	ND
PCE (2)	100%	1.0 - 1.6	82	0.73
PCE (3)	100%	3.1 - 3.3	82	2.4
TCE (1)	25%	0.22	4	ND
TCE (2)	75%	0.27 - 1.5	4	ND
TCE (3)	100%	0.57 - 1.2	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results for Building 1233 are less than screening levels.

Table 1233-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the seven analytes listed below, only EDB requires further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 1233-3. Non Detect Evaluation for Building 1233

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, 75% ND RLs < $RIASL_{12}$ for E1 and E2, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1233 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1233 remains in VI Path Forward Building Group 2 seasonal confirmation sampling continues, and a full evaluation will be presented in the 2019 CAIP.

5.2.8 Vapor Intrusion Evaluation for Building 768

Building 768 is a Category 2 building in Zone 2. Building 768 is approximately 14,090 ft^2 and has a warehouse, laboratory and process area with office space. It is known as the Pilot Plant Office/Lab and is located within the central portion of the facility designated as Zone 2. The results of the initial sampling event were evaluated in Sections 5.4.13 of the 2017 CAIP. The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 768 is an insignificant exposure pathway based on current use and was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted at this time.

The results from the initial sampling event (May 2017) were rescreened in the 2018 Rescreen Report (August 20118) and the evaluation is presented below. No indoor air analytes were detected above screening levels at Building 768.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

In April 2017, sub-slab soil gas samples were collected from six locations from within the building. Indoor air samples were collected at six locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.8-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.8-A and indoor and outdoor air on Table 5.2.8-B. The analytical reports for the sub-slab soil gas and indoor and outdoor air samples are presented in Appendix C. Field sampling logs are presented in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included bleach and various cleaners. The chemical inventory is all presented in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The analytes detected above the draft project-specific $RIASL_{12}$ are summarized in Table 768-1. TCE also had a single result detected above the $TSRIASL_{12}$.

Table 768-1. Summary of Sub-Slab Soil Gas Exceedances for Building 768

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	Screening Level* (µg/m³)
Chloroform	83%	39 - 360	17%	170
TCE	83%	63 - 410	67%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 768-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analyte detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 768-2. Vapor Intrusion Evaluation for Building 768

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	Indoor Air Screening Level* (µg/m³)	Outdoor Air Result (µg/m³)
Chloroform	33%	0.33 - 0.49	5.2	0.15
TCE	17%	0.19	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results for Building 768 are below screening levels. 1,1,2-Trichloroethane, EDB, and HCB are the only ND analytes in sub-slab soil gas that have at least one ND RL that exceeds screening levels and will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 768 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results, Building 768 will be moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be performed. A full evaluation will be presented in the 2019 CAIP.

5.2.9 Vapor Intrusion Evaluation for Building 827

Building 827 is a Category 1 building located in the central portion of the facility designated as Zone 2. It is known as the Growth Insecticides Building and is a large two-story building that includes office space, a laboratory, shop, and warehouse space.

The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 827 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 827 was placed in VI Path Forward Building Group 2. Group 2 is a designation for buildings that have sub-slab soil gas AOIs; however, indoor air results were less than screening levels. These buildings are placed into an seasonal confirmation sampling to assess potential seasonal variation.

The results of the initial sampling event (E1) were evaluated in Section 5.4.14 of the 2017 CAIP. Since that time, additional seasonal events (E2 & E3) have been completed, with a fourth event (E4) that occurred this fall; however, the data for E4 will not be available until early 2019 and is not included in this report. The results of all completed events are included in this evaluation.

Building 827	
Initial Sampling Event	**Completed**
E1	May 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Feb 2018 (Winter)
E3	Aug 2018 (Summer)
E4 (not evaluated in this report)	*November 2018 (Fall)*

Based on the 2018 rescreen, TCE was detected in indoor air above the $TSRIASL_{12}$ at one sample location during the initial sampling event. During the second and third rounds of seasonal sampling, TCE was detected below the draft project-specific $RIASL_{12}$ at all 14 sample locations, including the location of the initial exceedance. Therefore, no Expedited Building Summary was necessary.

DATA SUMMARY

The analytical results presented in the 2017 CAIP, as well as the additional seasonal sampling events conducted in the winter and summer of 2018, were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from 14 locations from within the building. Indoor air samples were collected at 14 locations corresponding to the soil gas sample locations, along with two outdoor air samples from the main air intakes. The sampling locations are shown on Figure 5.2.9-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.9-A and indoor and outdoor air on Table 5.2.9-B. The analytical data is presented in Appendix C. The field sampling logs are presented in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, included degreasers, cleaners, rain and stain protector, penetration catalysts, rust breakers, heavy duty traffic paint, and lithium chloride. The chemical inventory is also provided in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), two analytes (PCE and TCE) were detected above the draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$;

2. During the second event (winter 2018), the same two analytes were detected above the draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$; and

3. During the third event (summer 2018), the same two analytes were detected above the draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 827-1.

Table 827-1. Summary of Sub-Slab Soil Gas Exceedances for Building 827

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	Screening Level* (µg/m³)
PCE (1)	100%	28 - 170,000	29%	2,700
PCE (2)	100%	18 - 240,000	29%	2,700
PCE (3)	100%	13 - 240,000	21%	2,700
TCE (1)	43%	4 - 1,100	14%	130
TCE (2)	29%	28 - 1,900	21%	130
TCE (3)	43%	6.8 - 1,700	14%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 827-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 827-2. Vapor Intrusion Evaluation for Building 827

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	Indoor Air Screening Level* (µg/m³)	Outdoor Air Result (µg/m³)
PCE (1)	93%	0.21 - 9.5	82	ND
PCE (2)	100%	0.47 - 6.5	82	0.24 - 4.2
PCE (3)	100%	1.6 - 2.9	82	1.7 - 1.9
TCE (1)	100%	0.19 - 32	4	ND
TCE (2)	100%	0.26 - 1.6	4	ND
TCE (3)	7%	4	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

TCE was detected in indoor air above the draft project-specific $RIASL_{12}$ in two sample locations (locations 827-IA-04 and 827-IA-14) during the initial sampling event. Sub-slab soil gas and indoor air results for each sample location and sampling event is provided on Figure 5.2.9-2. The TCE result at location 827-IA-04 also exceeded the $TSRIASL_{12}$; however, during the E2 and E3 TCE was detected at or below the screening level at all 14 sample locations. Furthermore, as shown on Figure 5.2.9-2, sub-slab soil gas results at both of those sample locations are ND or below the screening level, which indicates that the the indoor air results at those locations are not attributable to VI and are likely due to workplace chemical use.

1,1,2-TCA, chloroform, and ethylbenzene were also detected in indoor air above the draft project-specific $RIASL_{12}$ during the initial sampling event, but all results were below their respective $TSRIASL_{12}$. None of these constituents were detected above the draft project-specific $RIASL_{12}$ during the E2 or E3 seasonal sampling events, except for chloroform which was detected above the $RIASL_{12}$ in one indoor air sample location (location 827-IA-13) during E3. None of these analytes were detected above the $RIASL_{12}$ in sub-slab soil gas during any of the three sampling events; therefore, indoor air detections are likely due to workplace chemical use and not attributable to VI.

Table 827-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0%

detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 12 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 827-3. Non Detect Evaluation for Building 827

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	14% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$ in E2 and E3, 93% ND RLs < $TSRIASL_{12}$ for E1
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	21%-50% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$, for E2 and E3, 93% ND RLs < $RIASL_{12}$ in E1
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ for E2 and E3, 93% ND RLs < $RIASL_{12}$ in E1
Chloroform	93%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ for E2 and E3, 93% ND RLs < $RIASL_{12}$ in E1
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ for E2 and E3, 93% ND RLs < $RIASL_{12}$ in E1
Hexachlorobutadiene	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0%-14% Detection Frequency, All detects and ND RLs < $RIASL_{12}$ in E2 and E3, 93% ND RLs < $RIASL_{12}$ in E1

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 827 is an insignificant exposure pathway and indoor air detections appear to be the result of workplace chemical use and not attributable to VI. Indoor air detections were less than 0.2% of the Dow OELs for analytes that exceeded the $RIASL_{12}$. However, based on the sub-slab soil gas results and given the potential for future VI, Building 827 remains in VI Path Forward Building Group 4A, due to the lack of correlated sample exceedances indicating VI is insignificant and IA exceedances likely due to workplace chemical use. A full evaluation will be presented in the 2019 CAIP.

5.2.10 Vapor Intrusion Evaluation for Building 849

Building 849 is a Category 2 building in Zone 2 and was evaluated in Section 5.4.15 in the 2017 CAIP. This building is a warehouse with a small office. It is known as the 768 Building Warehouse and is located within the central portion of the facility designated as Zone 2. The 2017 CAIP concluded that based on the sampling 849, the VI pathway at Building 849 is an insignificant exposure pathway based on current use. Building 849 was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted. The results from the initial sampling event (Spring 2017) were rescreened in the 2018 Rescreen Report (August 2018) and the evaluation is presented below.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs. The

sampling locations are shown on Figure 5.2.10-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.10-A and indoor and outdoor air on Table 5.2.10-B. The analytical reports are presented in Appendix C. The field sampling logs are included in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and a wide variety of chemicals was found to be stored within the building and each is listed in the survey (e.g., various cleaners, stains, degreasers, primers, galvanizers). The chemical inventory is also included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Building 849 is approximately 8,360 ft^2 in size and sits on a 2.5 – 3 ft above grade slab. Six sub-slab soil gas samples and six indoor air samples were collected (along with one outdoor air sample) in April 2017. A single detected sub-slab soil gas result of ethylbenzene exceeded the MDEQ draft project-specific $RIASL_{12}$. Table 849-1 presents the sub-slab soil gas results for ethylbenzene.

Table 849-1. Summary of Sub-Slab Soil Gas Detects for Building 849

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
Ethylbenzene	100%	8.8- 2,100	17%	1,600

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 849-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 849-2. Vapor Intrusion Evaluation for Building 849

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Ethylbenzene	100%	0.36 - 1.4	48	ND

*The screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results for ethylbenzene are below the screening level. One out of six ND RLs exceeds the screening levels in sub-slab soil gas for 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,2,4-trichlorobenzene, and HCB. EDB ND RLs exceeded the screening level at five out of six locations. These five ND analytes will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 849 is an insignificant exposure pathway based on current use. However, based on the single exceedance of ethylbenzene in sub-slab soil gas, Building 849 will be moved into VI Path Forward Building Group 2 and seasonal confirmation sampling will be conducted. A full evaluation will be presented in the 2019 CAIP.

5.2.11 Vapor Intrusion Evaluation for Building 858

Building 858 is a Category 2 building located in the central portion of the facility designated as Zone 2. It is known as the Dursban Production Building and is multiple stories tall. The building is a manufacturing building that includes process, a laboratory, and shop areas, in addition to office space, a kitchen, library, and a locker room. Office space is on the first floor.

The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 858 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 858 was placed in VI Path Forward Building Group 2 and was resampled. Group 2 is a designation for buildings that have sub-slab soil gas AOIs; however, indoor air results were less than screening levels. These buildings are placed into seasonal confirmation sampling to assess potential seasonal variation.

The results of the initial sampling event (E1) were evaluated in Section 5.4.16 of the 2017 CAIP. Since that time, two additional seasonal events (E2 & E3) have been completed, with a fourth event (E4) that occurred this fall; however, the data from E4 will not be available until early 2019 and is not included in this report. The results of all completed events are included in this evaluation.

Building 858	
Initial Sampling Event	**Completed**
E1	April 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Feb 2018 (Winter)
E3	July 2018 (Summer)
E4 (not included in this report)	*November 2018 (Fall)*

Chloroform was detected in indoor air above the draft project-specific $RIASL_{12}$ during all three sampling events; however, all detected results were below the $TSRIASL_{12}$. Therefore, no Expedited Building Summary was necessary.

DATA SUMMARY

The analytical results presented in the 2017 CAIP, as well as the additional seasonal sampling events conducted in the winter and summer of 2018, were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from six locations from within the building. Indoor air samples were collected at six locations corresponding to the soil gas sample locations, along with two outdoor air samples from the main air intakes. The sampling locations are shown on Figure 5.2.11-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.11-A and indoor and outdoor air on Table 5.2.11-B. The analytical data is presented in Appendix C. The field sampling logs are included in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, included degreasers, cleaners, lubricants, rust breakers, and spray paint. The chemical inventory is also included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), five analytes were detected above the draft project-specific $RIASL_{12}$ including benzene and ethylbenzene which were also detected above the $TSRIASL_{12}$;

2. During the second event (winter 2018), five analytes were detected above the draft project-specific $RIASL_{12}$ including benzene, chloroform, and ethylbenzene which were also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), four analytes were detected above the draft project-specific $RIASL_{12}$ including benzene which was also detected above the $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 858-1.

Table 858-1. Summary of Sub-Slab Soil Gas Exceedances for Building 858

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,2-Dichloropropane (1)	17%	1300	17%	410
1,2-Dichloropropane (2)	0%	ND	0%	410
1,2-Dichloropropane (3)	0%	ND	0%	410
Benzene (1)	67%	4.4 - 15,000	33%	510
Benzene (2)	50%	4.6 - 33,000	33%	510
Benzene (3)	50%	2.6 - 6,600	17%	510
CFC-12 (1)	100%	48 - 660,000	50%	34,000
CFC-12 (2)	100%	32 - 2,700,000	50%	34,000
CFC-12 (3)	100%	31 - 2,300,000	50%	34,000
Chloroform (1)	33%	300 - 1,400	33%	170
Chloroform (2)	33%	290 - 2,700	33%	170
Chloroform (3)	50%	120 -1,000	17%	170
Ethylbenzene (1)	67%	4.7 - 21,000	17%	1,600
Ethylbenzene (2)	33%	470 - 44,000	17%	1,600
Ethylbenzene (3)	33%	3.4 - 170	0%	1,600
Total Xylenes (1)	67%	5.75 – 11,000	0%	22,000
Total Xylenes (2)	50%	8.4 - 34,000	17%	22,000
Total Xylenes (3)	33%	6.4 - 660	0%	22,000
Vinyl Chloride (1)	17%	750	0%	910
Vinyl Chloride (2)	17%	720	0%	910
Vinyl Chloride (3)	17%	1,000	17%	910

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 858-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 858-2. Vapor Intrusion Evaluation for Building 858

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
Benzene (1)	100%	0.68 - 1.5	15.4	0.54
Benzene (2)	100%	0.69 - 0.96	15.4	0.61 - 0.72
Benzene (3)	100%	0.44 - 0.49	15.4	0.32 - 0.37
CFC-12 (1)	100%	3.4 - 5.3	1020	2.0
CFC-12 (2)	100%	3.6 - 9.5	1020	2.4
CFC-13 (3)	100%	4.1 - 7.0	1020	2.2 - 2.3
Chloroform (1)	100%	1 - 5.3	5.2	ND
Chloroform (2)	100%	1.8 - 16	5.2	0.42 - 8.6
Chloroform (3)	100%	4.3 - 19	5.2	0.94 - 1.7
Ethylbenzene (1)	100%	0.2 - 1.3	48	ND
Ethylbenzene (2)	100%	0.31 - 1.8	48	0.29 - 0.95
Ethylbenzene (3)	100%	0.49 - 0.62	48	0.22 - 0.46
Total Xylenes (1)	100%	0.74 - 6.8	680	ND
Total Xylenes (2)	100%	1.79 - 3.09	680	0.97 - 1.34
Total Xylenes (3)	100%	1.96 - 2.76	680	1.16 - 1.53
Vinyl Chloride	0%	ND	28	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

Chloroform is the only analyte at Building 858 that exceeds the indoor air $RIASL_{12}$ (5.2 $\mu g/m^3$); however, there were no chloroform exceedances of the $TSRIASL_{12}$ (52 $\mu g/m^3$). Sub-slab soil gas and indoor air results for each sample location and sampling event is provided for chloroform on Figure 5.2.11-2. During the initial sampling event (E1), chloroform very slightly exceeded the indoor air screening level at one sample location (location 858-IA-04 result of 5.3 $\mu g/m^3$ versus $RAISL_{12}$ of 5.2 $\mu g/m^3$). During E2 chloroform exceeded the screening level at two locations (locations 858-IA-01 and 858-IA-02 at 15 $\mu g/m^3$ and 16 $\mu g/m^3$, respectively). It is important to note that chloroform was ND in both outdoor air samples in E1; however, during E2 and E3, chloroform was detected in both of the outdoor air samples, with one E2 result of 8.6 $\mu g/m^3$, which exceeds the indoor air draft project-specific-$RIASL_{12}$. Therefore, it is likely that outdoor air is contributing to the concentrations of chloroform that are being detecting indoors. During E3 chloroform exceeded the screening level at two locations (locations 858-IA-03 and 858-IA-04 at 6.2 $\mu g/m^3$ and 19 $\mu g/m^3$, respectively). The maximum detected chloroform result was 19 $\mu g/m^3$, which is <0.2% of the Dow OEL.

The sample locations of chloroform exceedances are inconsistent between sampling events, which indicates the indoor air results could be due to indoor or outdoor sources and not predominantly attributable to VI. As shown on Figure 5.2.11-1, sample location 858-IA-01 is near a main entry door to the building and also near a large laboratory. Sample location 858-IA-02 is adjacent to the men's locker room and in a hallway that shares the main entry door to the laboratory. Sample locations 858-IA-03 and 858-IA-04 are located near the kitchen. Each of these sample locations are near the laboratory or the building's kitchen area, where it is likely that the treated water could be contributing to the indoor air results. Chloroform is ubiquitous in indoor air and often found in soil gas samples. Chloroform is one of the trihalomethanes produced by chlorination of water supplies. It has long been known that chloroform and other VOCs in tap water can be emitted into indoor air (McKone, 1987). Washing machines and kitchen sinks also may be significant sources (Howard and Corsi, 1998 and Howard and Corsi, 1996).

Chloroform concentrations in indoor air due to VI were estimated from the building-specific attenuation factor and the maximum sub-slab soil gas concentration for each event. The contribution of chloroform in indoor air from VI at Building 858 appears to be far less than 1 $\mu g/m^3$ based on the sub-slab

concentrations and the building-specific attenuation factor based on measurement results for CFC-12, as shown in Table 858-3 below.

Table 858-3. Evaluation of Estimated Indoor Air Concentrations for Chloroform

	E1	E2	E3
Evaluation Based on Maximum Detected Value			
Maximum Detection of Chloroform in Sub-Slab Soil Gas (μg/m^3)	1,400	2,700	1,000
Building-specific attenuation factor	8.0E-06	3.5E-06	3.0E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	0.01	0.01	0.003
Exceedance of Screening Level of 5.2 μg/m^3?	No	No	No
Maximum Detection Limit of Chloroform in Sub-Slab Soil Gas (μg/m^3)	<4,000	<17,000	<14,000
Building-specific attenuation factor	8.0E-06	3.5E-06	3.0E-06
Predicted Indoor Air Impacts (μg/m^3)[a]	<0.03	<0.06	<0.04
Exceedance of Screening Level of 5.2 μg/m^3?	No	No	No

[a] Based on the selected building-specific attenuation factor for each sampling event.

The above evaluation demonstrates that the estimated indoor air concentrations of chloroform attributable to VI are below its project-specific RIASL$_{12}$ for all three sampling events based on the maximum detected values and also based on the maximum detection limits.

Table 858-4 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 30 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 858-4. Non Detect Evaluation for Building 858

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,1-Dichloroethane	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,2,4-Trichlorobenzene (1,2,4-TCB)	0% Detection Frequency, All ND RLs < TSRIASL$_{12}$
1,2,4-Trimethylbenzene	17%-33% Detection Frequency, All detects and ND RLs < RIASL$_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > RIASL$_{12}$**
1,2-Dichloroethane	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,3,5-Trimethylbenzene	0%-17% Detection Frequency, All detects and ND RLs < RIASL$_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,4-Dichlorobenzene	0% Detection Frequency, All ND RLs < RIASL$_{12}$
1,4-Dioxane	0% Detection Frequency, All ND RLs < RIASL$_{12}$
2-Hexanone	0% Detection Frequency, All ND RLs < RIASL$_{12}$
2-Propanol	100% Detection Frequency, All detects < RIASL$_{12}$

Table 858-4. Non Detect Evaluation for Building 858 (Continued)

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0%-17% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Bromoform	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$ for E1 and E2
Carbon Tetrachloride	100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Chlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Chloromethane	0%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
cis-1,2-Dichloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Cumene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0%-17% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Styrene	0%-33% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Tetrachloroethene (PCE)	0%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Trichloroethene (TCE)	0%-17% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
trans-1,2-DCE	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 858 is an insignificant exposure pathway based on current use. However, based on the indoor air results for chloroform, sub-slab soil gas results, and given the potential for future VI, Building 858 has been moved to VI Path Forward Building Group 4A due to the lack of correlated sample exceedances indicating VI is insignificant and the IA exceedances likely due to workplace chemical use. Seasonal confirmation sampling will be performed.

As screened results become available for chloroform, Dow will provide a high-level email summary update and will discuss the results during the next Corrective Action Status meeting. If any correlated sub-slab soil gas and indoor air results above $TSRIASL_{12}$ are identified, Dow will implement an IM. A full evaluation will be presented in the 2019 CAIP.

5.2.12 Vapor Intrusion Evaluation for Building 969

Building 969 is a Category 2 building located in the central portion of the facility designated as Zone 2. It is known as the Ag Chem Development Building and is multiple stories tall but the office space is on the first floor. The building is a manufacturing building that includes process, a warehouse, a laboratory, and office space. The warehouse area is built on a 3.5-ft raised slab.

The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 969 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 969 was placed in VI Path Forward Building Group 2 and was resampled. Group 2 is a designation for buildings that have sub-slab soil gas AOIs; however, indoor air results were less than screening levels. These buildings were placed into seasonal confirmation sampling to assess potential seasonal variation.

The results of the initial sampling event (E1) were evaluated in Section 5.4.18 of the 2017 CAIP. Since that time, two additional seasonal events (E2 & E3) have been completed, with a fourth event (E4) that

occurred this fall; however, the data from E4 will not be available until early 2019 and is not included in this report. The results of all completed events are included in this evaluation.

Building 969	
Initial Sampling Event	**Completed**
E1	Apr 2017 (Spring)
Seasonal Sampling Event	**Completed**
E2	Feb 2018 (Winter)
E3	Aug 2018 (Summer)
E4 (not included in this report)	*November 2018 (Fall)*

During the first two sampling events, no analytes were detected in indoor air above the screening levels. During the third seasonal sampling event, chloroform was the only analyte detected in indoor air above the draft project-specific $RIASL_{12}$; however, all detected results were below the $TSRIASL_{12}$. Additionally, chloroform was not detected in any of the sub-slab soil gas samples. Therefore, no Expedited Building Summary was necessary. The findings of the 2018 rescreen supported the conclusions of the 2017 CAIP.

DATA SUMMARY

The analytical results presented in the 2017 CAIP, as well as the additional seasonal sampling events conducted in the winter and summer of 2018, were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.12-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.12-A and indoor and outdoor air on Table 5.2.12-B. The analytical data are presented in Appendix C. The field sampling logs are included in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E Drains and other openings were screened with a PID and no soil gas entry points were identified; however, there were a few very minor detections (results <0.5) in the men's and women's bathrooms, kitchenette area, and one office. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, included cleaners, anti-static spray, ice eliminator, and lubricants. The chemical inventory is also included in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are listed below by sampling event:

1. During the initial event (spring 2017), four analytes were detected above the draft project-specific $RIASL_{12}$ including benzene which was also detected above the $TSRIASL_{12}$;

2. During the second event (winter 2018), two analytes (benzene and naphthalene) were detected above the draft project-specific $RIASL_{12}$ and results for benzene were less than the $TSRIASL_{12}$.

3. During the third event (summer 2018), six analytes were detected above the draft project-specific $RIASL_{12}$ including benzene which was also detected above the $TSRIASL_{12}$.

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 969-1.

Table 969-1. Summary of Sub-Slab Soil Gas Exceedances for Building 969

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,2,4-Trimethylbenzene (1)	67%	11 - 200	0%	6,100
1,2,4-Trimethylbenzene (2)	67%	3.8 - 450	0%	6,100
1,2,4-Trimethylbenzene (3)	78%	8.9 - 8,300	11%	6,100
Benzene (1)	100%	3.6 - 3,800	11%	510
Benzene (2)	67%	6.5 - 1,300	11%	510
Benzene (3)	89%	3.9 - 15,000	44%	510
Cumene (1)	44%	7.9 - 330	0%	380
Cumene (2)	44%	16 - 52	0%	380
Cumene (3)	56%	32 - 1,300	11%	380
Ethylbenzene (1)	100%	15 - 12,000	11%	1,600
Ethylbenzene (2)	100%	5.7 - 1,500	0%	1,600
Ethylbenzene (3)	100%	9.8 - 12,000	33%	1,600
Naphthalene (1)	56%	42 - 570	33%	120
Naphthalene (2)	33%	21 - 510	22%	120
Naphthalene (3)	44%	130 - 3,100	44%	120
Total Xylenes (1)	100%	49 - 42,800	11%	22,000
Total Xylenes (2)	100%	14.7 - 5,600	0%	22,000
Total Xylenes (3)	89%	37.9 - 34,000	11%	22,000

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 969-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 969-2. Vapor Intrusion Evaluation for Building 969

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,2,4-Trimethylbenzene (1)	11%	1.3	184	ND
1,2,4-Trimethylbenzene (2)	0%	ND	184	ND
1,2,4-Trimethylbenzene (3)	22%	1.5 - 3.5	184	ND
Benzene (1)	100%	0.55 - 1.3	15.4	0.6
Benzene (2)	67%	0.32 - 0.43	15.4	0.41
Benzene (3)	67%	0.33 - 0.40	15.4	0.31
Cumene (1)	0%	ND	11.4	ND
Cumene (2)	0%	ND	11.4	ND
Cumene (3)	0%	ND	11.4	ND
Ethylbenzene (1)	100%	0.77 - 3.3	48	0.64
Ethylbenzene (2)	89%	0.23 - 2.7	48	0.22
Ethylbenzene (3)	100%	0.46 - 6.0	48	0.27
Naphthalene (1)	0%	ND	3.6	ND
Naphthalene (2)	0%	ND	3.6	ND
Naphthalene (3)	22%	1.3 - 2.3	3.6	ND

Table 969-2. Vapor Intrusion Evaluation for Building 969 (Continued)

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Total Xylenes (1)	100%	2.78 - 11.7	680	2.02
Total Xylenes (2)	100%	0.525 - 9.7	680	0.45
Total Xylenes (3)	100%	1.9 - 24.4	680	1.1

*Screening level provided is the draft project-specific $RIASL_{12}$.

Chloroform was detected in indoor air during the third seasonal sampling event with results exceeding the draft project-specific $RIASL_{12}$; however, all detected results were below the $TSRIASL_{12}$. Chloroform was not detected in sub-slab soil gas samples; therefore, indoor air detections appear to be the result of workplace chemical use, chlorinated tap water, and not attributable to VI.

Table 969-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 12 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 969-3. Non Detect Evaluation for Building 969

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	0%-11% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0%-33% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Chloroform	68%-78% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Dibromochloromethane	0%-22% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Trichloroethene	11%-33% Detection Frequency, All detects and ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 969 is an insignificant exposure pathway based on current use. Indoor air detections appear to be the result of workplace chemical use and not attributable to VI. However, based on the sub-slab soil gas results and given the potential for future VI, Building 969 remains in VI Path Forward Building Group 2, seasonal confirmation sampling will continue, and a full evaluation will be presented in the 2019 CAIP.

5.2.13 Vapor Intrusion Evaluation for Building 1222

Building 1222 is a Category 2 building in Zone 2. Building 1222 has a maintenance shop with office space and is approximately 16,340 ft^2. It is known as the Dursban Maintenance and is located within the central portion of the facility designated as Zone 2. The results of the initial sampling event were evaluated in Sections 5.4.19 of the 2017 CAIP. The initial evaluation in the 2017 CAIP concluded that based on the indoor air results, the VI pathway at Building 1222 is an insignificant exposure pathway based on current use and was placed into VI Path Forward Building Group 1 and no further VI evaluation was warranted. The results from the initial sampling event (Spring 2017) were rescreened in the 2018 Rescreen Report (August 2018) and the evaluation is presented below.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

In April 2017, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.13-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.13-A and indoor and outdoor air on Table 5.2.13-B. The analytical reports for the sub-slab soil gas and indoor and outdoor air samples are presented in Appendix C. The field sampling logs are presented in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included bleach and various cleaners. The chemical inventory is also presented in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. When compared to the draft project-specific $RIASL_{12}$, four analytes had at least one result in sub-slab soil gas that exceeded the screening level. None of the analytes had detections in sub-slab soil gas above the $TSRIASL_{12}$. The sub-slab soil gas results for the analytes that exceeded the applicable screening level are summarized in Table 1222-1.

Table 1222-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1222

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,2-Dichloroethane	11%	400	11%	150
CFC-11	100%	10,000 - 180,000	44%	45,000
CFC-12	100%	400 - 240,000	22%	34,000
TCE	11%	180	11%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 1222-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well

as the corresponding indoor air sample result. The outdoor air sample result is also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1222-2. Vapor Intrusion Evaluation for Building 1222

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,2-Dichloroethane	0%	ND	4.6	ND
CFC-11	100%	1.1 - 1.3	1,340	1.1
CFC-12	100%	2 - 2.1	1,020	2
TCE	0%	ND	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results at Building 1222 are below the screening level. There are 25 ND analytes with RLs that exceed sub-slab soil gas screening levels and will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1222 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1222 has been moved to VI Path Forward Building Group 2 and seasonal confirmation sampling will be conducted. A full evaluation will be presented in the 2019 CAIP.

5.2.14 Vapor Intrusion Evaluation for Building 1377

Building 1377 is a Category 2 building in Zone 2 and is located within the central portion of the facility designated as Zone 2. Building 1377 is 90% warehouse with a small office space on the first floor on the eastern side of the building. It also has a lunchroom and is known as the Division #1 Warehouse. The results of the initial sampling event were evaluated in Section 5.4.20 of the 2017 CAIP and placed Building 1377 in VI Path Forward Group 3. The 2018 Vapor Intrusion Rescreen Report dated August 2018 presented the results of the comparison of the analytical results presented in the 2017 CAIP to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

1,2-EDB was detected in indoor air above the draft project-specific $RIASL_{12}$ at a single sample location; however, all sub-slab soil gas results at Building 1377 are less than screening levels which indicates that the EDB result is attributable to indoor sources and not due to VI. The findings of the rescreen support the conclusions of the 2017 CAIP and Building 1377 will remain in VI Path Forward Building Group 3 and the indoor air result will be further investigated.

DATA SUMMARY

The analytical results presented in the 2017 CAIP were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

In May 2017, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.2.14-1. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.2.14-A and indoor and outdoor air on Table 5.2.14-B. The complete analytical reports for the

sub-slab soil gas and indoor and outdoor air samples are presented in Appendix C. Field sampling logs are included in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included cleaners and insecticide. The chemical inventory is also included in Appendix E.

RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. When compared to the draft project-specific $RIASL_{12}$, all sub-slab soil gas results at Building 1377 were less than the screening level.

VI only potentially occurs if an analyte is present in both sub-slab soil gas and indoor air. EDB was ND in all nine sub-slab soil gas samples and was also ND in the other eight indoor air samples. The comparison of indoor air results to the draft project-specific $RIASL_{12}$ demonstrated that the single detected concentration of EDB in indoor air only slightly exceeded the draft project-specific $RIASL_{12}$. Table 1377-1 summarizes the indoor air and outdoor air results for EDB.

Table 1377-1. Indoor Air Results for Building 1377

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
EDB	11%	0.32	0.2	ND

*Draft project-specific $RIASL_{12}$.

1,1,2-Trichloroethane, 1,2,4-trichlorobenzene, EDB, and HCB have ND RLs that exceeded sub-slab soil gas screening levels in at least one sample. These analytes will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

The VI pathway at Building 1377 is an insignificant exposure pathway based on current use. EDB was only detected in one of nine indoor air samples and was ND in all sub-slab soil gas samples. However, based on the single exceedance of EDB in indoor air due to sources other than VI, Building 1377 will remain in VI Path Forward Building Group 3 and the indoor air result will be further investigated.

5.3 Zone 2 Phase 2

Zone 2 Phase 2 contains 71 buildings and structures that were visited and evaluated for the potential for exposure via VI. Of these 71 buildings and structures, 14 buildings in Zone 2 Phase 2 were categorized as priority buildings (Category 1 and 2 buildings).

The priority buildings in Zone 2 Phase 2 are as follows:

Category 1:

- Building 1130 – Styrene Mono Offices and Control Room includes offices, laboratory, control room, instrument shop, locker rooms, and a kitchen;
- Building 1215 – #52 Gate is the Saginaw Road Gatehouse;
- Building 1255 – DPF Offices is an EH&S building; and
- Building 1314 – TTCC (6-5457) includes one office and a truck center.

Category 2:

- Building 304 – Dow Automotive – Brake Fluids Building includes an office and warehouse;
- Building 388 – Fabrication Shop includes one office and a shop;
- Building 499 – Demineralized Water Plant includes offices, laboratory, process shop, and warehouse;
- Building 593 – Fabrication Shop includes and offices, shop, and warehouse;
- Building 779 – Miscellaneous Shipping includes offices, locker rooms, kitchen, and a warehouse;
- Building 826 – Maintenance Shop includes offices, conference rooms, locker rooms, kitchen, shop, and a warehouse;
- Building 921 – RD & Yard Maintenance includes offices, locker rooms, kitchen, conference room, and shop;
- Building 922 – Garage/General Trucking Building includes offices, kitchen, locker room, shop, and warehouse;
- Building 923 – Hydrochem (6-1641) includes offices, locker rooms, kitchen, conference room, and shop; and
- Building 935 – Riggers Building includes offices and warehouse.

The Zone 2 Phase 2 VI sampling results are presented in the following subsections as follows:

- Section 5.3.1 Building 304
- Section 5.3.2 Building 388
- Section 5.3.3 Building 593

- Section 5.3.4 Building 923
- Section 5.3.5 Building 935
- Section 5.3.6 Building 499
- Section 5.3.7 Building 779
- Section 5.3.8 Building 826/494
- Section 5.3.9 Building 921
- Section 5.3.10 Building 922
- Section 5.3.11 Building 1130
- Section 5.3.12 Building 1215
- Section 5.3.13 Building 1255
- Section 5.3.14 Building 1312
- Section 5.3.15 Building 1314

The VI analytical results were provided to the IH staff and results will be presented to the occupants of each building.

5.3.1 Vapor Intrusion Evaluation for Building 304

BACKGROUND

Building 304 is located in the southwestern quadrant of the Midland facility and is known as the Dow Automotive and Brake Fluids Building (see Figure 5.3.1-1). Per aerial photography, the western two thirds of the structure were constructed before 1938 and the eastern third was constructed in the 1950s. The 26,465 ft^2 building consists of office space, a control room, locker rooms, a kitchen, lab space, warehouse space, shop/storage space, a small mixing/blending process area for brake fluid, and a packaging area. The building is roughly two stories tall. The building is a slab-on-grade construction with no basement or elevators; however, the ground surface was built up to accommodate truck bays on the south side of the building. The ground surface around the building is concrete and asphalt on the southern and eastern sides, gravel and grassy medians/beds on the western side, and gravel and railroad tracks on the northern side.

Approximately 10-15 occupants work an 8-hour day shift during the week and very rarely work weekend hours. The occupants use a contracted laundry service to clean uniforms and work clothes; however, there are some washer/dryers located in the second floor locker room on the south side of the building. The occupants do use gas-powered equipment on occasion in the warehouse portion of the building and the gasoline/fuels are rarely stored in the building.

The building is heated via hot air circulation in the office areas, but steam heaters are used in the warehouse and shop area. The office areas and lab area are cooled via three central AC units. Two intakes are located on the south side of the building. Mechanical fans are also used in the vicinity of the truck bays. Four exhaust fans are located on the north side of the warehouse, and one exhaust fan is located on the east side of the shop area. The lab does contain a lab hood on its western wall. The eight

bay doors, which are mainly on the south side of the building in the warehouse area, are predominantly open all the time during the summer, but are shut as much as possible during the colder, winter months.

DATA SUMMARY

Building 304 has undergone three seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 304 since results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 304	
Initial Sampling Event	**Completed**
E1	November 2017 (Fall)
Seasonal Sampling Event	**Completed**
E2	March 2018 (Spring)
E3	Aug 2018 (Summer)
E4	*Scheduled – Winter 2019*

For each sampling event, sub-slab soil gas samples were collected from 11 locations from within the building. Indoor air samples were collected at 11 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.1-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.1-A and indoor and outdoor air on Table 5.3.1-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 304-1:

1. During the initial event (fall 2017), eight analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE, which were also detected above the $TSRIASL_{12}$;

2. During the second event (spring 2018), eight analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE, which were also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), eight analytes were detected above the draft project-specific $RIASL_{12}$ including chloroform, PCE and TCE, which were also detected above the $TSRIASL_{12}$.

Table 304-1. Summary of Sub-Slab Soil Gas Exceedances for Building 304

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	0%	ND	0%	20
1,1,2-Trichloroethane (2)	9%	42	9%	20
1,1,2-Trichloroethane (3)	0%	ND	0%	20

Table 304-1. Summary of Sub-Slab Soil Gas Exceedances for Building 304 (Continued)

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	Screening Level* (µg/m³)
1,2-Dichloroethane (1)	73%	12 – 4,800	45%	150
1,2-Dichloroethane (2)	55%	30 – 3,800	45%	150
1,2-Dichloroethane (3)	55%	64 – 5,000	45%	150
1,2-Dichloropropane (1)	82%	13 – 6,300	55%	410
1,2-Dichloropropane (2)	82%	7.7 – 6,100	55%	410
1,2-Dichloropropane (3)	55%	1,200 – 7,400	55%	410
Carbon Tetrachloride (1)	100%	54 – 2,300	55%	710
Carbon Tetrachloride (2)	100%	21 – 2,100	36%	710
Carbon Tetrachloride (3)	100%	22 – 2,900	55%	710
Chloroform (1)	100%	12 – 1,400	55%	170
Chloroform (2)	100%	12 – 1,700	64%	170
Chloroform (3)	91%	5.2 – 2,200	55%	170
cis-1,2-Dichloroethene (1)	55%	9.6 – 1,200	9%	820
cis-1,2-Dichloroethene (2)	55%	13 – 660	0%	820
cis-1,2-Dichloroethene (3)	36%	4.7 – 420	0%	820
Dibromochloromethane (1)	0%	ND	0%	170
Dibromochloromethane (2)	0%	ND	0%	170
Dibromochloromethane (3)	9%	190	9%	170
Ethylbenzene (1)	36%	6 – 2,000	9%	1600
Ethylbenzene (2)	18%	9.9 – 1,800	9%	1600
Ethylbenzene (3)	18%	4.4 – 3,400	9%	1600
PCE (1)	100%	2,600 – 140,000	91%	2700
PCE (2)	100%	1,400 – 120,000	91%	2700
PCE (3)	100%	960 – 160,000	82%	2700
TCE (1)	100%	290 – 9,500	100%	130
TCE (2)	100%	250 – 8,100	100%	130
TCE (3)	100%	53 – 11,000	82%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 304-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 304-2. Vapor Intrusion Evaluation for Building 304

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	Indoor Air Screening Level* (µg/m³)	Outdoor Air Result (µg/m³)
1,1,2-Trichloroethane (1)	0%	ND	0.62	ND
1,1,2-Trichloroethane (2)	0%	ND	0.62	ND
1,1,2-Trichloroethane (3)	0%	ND	0.62	ND
1,2-Dichloroethane (1)	0%	ND	4.6	ND
1,2-Dichloroethane (2)	45%	0.16 – 0.24	4.6	ND
1,2-Dichloroethane (3)	55%	0.13 – 0.2	4.6	ND

Table 304-2. Vapor Intrusion Evaluation for Building 304 (Continued)

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (μg/m³)	Indoor Air Screening Level* (μg/m³)	Outdoor Air Result (μg/m³)
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
Carbon Tetrachloride (1)	100%	0.37 – 0.42	22	0.38
Carbon Tetrachloride (2)	100%	0.6 – 0.89	22	0.51
Carbon Tetrachloride (3)	100%	0.54 – 0.76	22	0.54
Chloroform (1)	0%	ND	5.2	0.17
Chloroform (2)	73%	0.18 – 0.5	5.2	0.16
Chloroform (3)	100%	0.43 – 1.2	5.2	ND
cis-1,2-Dichloroethene (1)	9%	1.6	24	ND
cis-1,2-Dichloroethene (2)	45%	0.14 – 0.3	24	ND
cis-1,2-Dichloroethene (3)	18%	0.16 – 0.82	24	ND
Dibromochloromethane (1)	0%	ND	5	ND
Dibromochloromethane (2)	0%	ND	5	ND
Dibromochloromethane (3)	0%	ND	5	ND
Ethylbenzene (1)	18%	0.34 – 0.42	48	ND
Ethylbenzene (2)	100%	0.33 – 1.6	48	ND
Ethylbenzene (3)	100%	0.16 – 0.82	48	0.18
PCE (1)	100%	0.26 – 2.8	82	ND
PCE (2)	100%	3.3 – 12	82	ND
PCE (3)	100%	0.66 – 4.4	82	0.59
TCE (1)	9%	9	4	ND
TCE (2)	100%	0.31 – 0.92	4	ND
TCE (3)	73%	0.19 – 1.8	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

TCE was the only analyte detected above a screening level in indoor air during any of the three sampling events. Sub-slab soil gas and indoor air results for TCE by sample location are provided on Figure 5.3.1-3. TCE exceeded the $RIASL_{12}$ for indoor air during E1 at 304-IA-02. During subsequent sampling events, TCE was 0.37 μg/m³ and 0.29 μg/m³ at that location, respectively, which are below the screening level. Results in sub-slab soil gas at that location increased over time, but the indoor air concentrations did not, and in fact decreased, which implies that the E1 indoor air result for TCE was likely due to active workplace chemical use. That location is very near an active drum conveying area which may explain the result. Furthermore, if VI was significant at this location it is very likely other indoor air exceedances would have been observed, as six other analytes (including PCE) exceed the sub-slab soil gas screening level at that location. However, that was not the case and none of the other VOCs exceeded indoor air screening levels. The maximum result of TCE detected in indoor air at Building 304 was 9 μg/m³, which is <1% of the Dow OEL.

Table 304-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the seven analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 304-3. Non Detect Evaluation for Building 304

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0%-64% Detection Frequency, All detects & ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 304 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 304 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the single indoor air exceedance of TCE was likely due to workplace chemical use. The final seasonal confirmation sampling event is scheduled for February 2019. A full evaluation will be presented in the 2019 CAIP.

5.3.2 Vapor Intrusion Evaluation for Building 388

BACKGROUND

Building 388 is a Category 2 building located within the southeastern portion of the Midland facility designated as Zone 2 (see Figure 5.3.2-1). Building 388, known as the Fabrication Shop, was constructed sometime in the 1940s-1950s. It is presently used as an equipment shop/garage by a Dow contractor, but does contain the remnants of an old scale/track area in its northeastern corner. A small bathroom and office area are located on the south side of the 2,433 ft^2 structure. The building is roughly 1.5 to 2 stories tall (a loft is located on the southern side of the building above the office area) and is a slab-on-grade construction with no basement. The ground cover surrounding the building is mainly asphalt and gravel.

The building is heated via a ceiling-mounted space heater unit located on the western side of the building. There are three individual AC units located on either the west and east side of the building, and mechanical fans are sometimes used in conjunction with the bay door located on the eastern side of to cool the building in lieu of the individual AC units. The bay door is typically open during warmer months. Gas powered equipment and gasoline/fuels are used/sometimes temporarily stored inside the building.

The 10-20 transient occupants that come through on a given day are in the structure for roughly an hour or two at a time. The occupants use a contracted laundry service to clean any uniforms/work clothes.

PID readings of 0.0-0.8 ppm were observed in the ambient air throughout the building. A PID reading of 0.3-0.4 ppm was observed in the drain found in the small bathroom in the southeastern corner of the building.

DATA SUMMARY

Building 388 was sampled in November 2017. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 388	
Initial Sampling Event	**Completed**
E1	November 2017 (Fall)

Sub-slab soil gas samples were collected from three locations from within the building. Indoor air samples were collected at three locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.2-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.2-A and indoor and outdoor air on Table 5.3.2-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included degreasers, lubricants, adhesive sprays, spray paints, insecticides, bleach and various cleaners (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 388. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-two of the 65 analytes were ND in each of the samples. Twenty-three analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 25 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Eleven analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these 11 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

ND RLs for EDB exceed screening levels in both sub-slab soil gas and indoor air. EDB requires further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 388 is an insignificant exposure pathway based on current use. Building 388 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.3.3 Vapor Intrusion Evaluation for Building 593

EXPEDITED BUILDING SUMMARY

An Expedited Building Summary was submitted for Building 593 on August 24, 2018. MDEQ requested expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Therefore, each indoor air result was compared to the $TSRIASL_{12}$ from the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels. PCE was the only analyte in indoor air detected at Building 593 greater than the $TSRIASL_{12}$.

The VI findings concluded that the PCE detected in the indoor air at Building 593 is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop and spare parts area in the northwest corner of the building involving degreasers or other products. Interim response actions are not necessary to address the detections of PCE in indoor air at Building 593; however, seasonal confirmation sampling will continue.

BACKGROUND

Building 593 is located in the southeastern quadrant of the Midland facility and is known as the Fabrication Shop (see Figure 5.3.3-1). The building was constructed sometime between 1938 and 1952. The 95,544 ft^2 structure is a slab-on-grade L-shaped construction that is approximately 2-3 stories high. The building has no basement and no elevators. The L-shaped portion of the building is predominantly a large fabrication shop containing a variety of different work areas that is used by both Dow employees and various contractors. The longer portion of the L-shaped building has an east-west orientation with the shorter portion of the L-shape north-south oriented. A single story annex containing office space, locker rooms, storage, a conference room, and a large kitchen/break room is located to the southwest of the inside corner of the L-shaped fabrication shop area. The ground cover around the building consists of asphalt.

During the week, 50 to 100 people come through the building to work, take a break, or attend meetings. During the weekend, roughly 25 to 30 people may come through the structure to do similar activities. The locker room does have washer/dryers, but most work clothes used by the occupants are cleaned by a contracted laundry service. Gas-powered equipment and gasoline/fuels are stored throughout the building, but mainly in the large shop area.

In the office annex, the air is heated via hot air circulation/forced air. In the shop area there are unit heaters suspended from the ceiling. The office annex is cooled through a combination of central AC and individual AC units. The locker rooms and bathrooms have ventilation fans. There are also large mechanical fans used in the shop area that are typically used in conjunction with opened bay doors. The structure has nine bay doors that are shut on the weekend, but are otherwise opened, particularly during the warmer months. Fume extractors located near multiple work benches are often used for ventilation purposes while welding work is completed in the shop area. Two air handlers for the office annex are located on its roof and there are multiple exhaust fans/vents located on the roof of the shop area.

DATA SUMMARY

Building 593 has undergone three seasonal confirmation sampling events; however, the second event was a limited event to further investigate the area surrounding the indoor air exceedances of PCE. Seasonal confirmation sampling was conducted at Building 593 since results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 593	
Initial Sampling Event	**Completed**
E1	November 2017 (Fall)
Seasonal Sampling Event	**Completed**
E2 (Limited Event)	March 2018 (Spring)
E3	Aug 2018 (Summer)
E4	*Scheduled – February 2019 (Winter)*

For E1 and E3, sub-slab soil gas samples were collected from 39 locations from within the building. Indoor air samples were collected at 39 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations for E1 and E3 are shown on Figure 5.3.3-2. For the limited event (E2), sub-slab soil gas and indoor air samples were collected from

16 locations from within the building, along with an outdoor air sample from the main air intake. The sampling locations for E2 are shown on Figure 5.3.3-3. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.3-A and indoor and outdoor air on Table 5.3.3-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains, washrooms, drums and other openings were screened with a PID and the only PID reading observed (1.8 ppm) during the time of the survey was from the ambient air near a flammable cabinet found in the southeastern corner of the building near Bay J. The chemical inventory performed during the building survey identified hundreds of potential indoor emission sources. The inventory indicated that the chemicals of interest are stored and/or used within the building. For example:

- CRC Heavy Duty Degreaser MUO contains 80 – 90% PCE;
- Sprayon EL848 Flash Free Electrical Degreaser contains 97.5% TCE; and
- CRC Cable Clean Degreaser contains 90 – 100% 1-bromopropane.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 593-1:

1. During the initial event (fall 2017), five analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE, which were also detected above the $TSRIASL_{12}$;
2. During the second limited event (spring 2018), four analytes were detected above the draft project-specific $RIASL_{12}$ including TCE, which was also detected above the $TSRIASL_{12}$; and
3. During the third event (summer 2018), five analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE, which were also detected above the $TSRIASL_{12}$.

Table 593-1. Summary of Sub-Slab Soil Gas Exceedances for Building 593

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	24%	7 – 27	3%	20
1,1,2-Trichloroethane (2)	44%	5.3 – 73	13%	20
1,1,2-Trichloroethane (3)	8%	9.3 – 31	5%	20
1,2-Dichloropropane (1)	24%	4.2 – 98	0%	410
1,2-Dichloropropane (2)	50%	5.2 – 430	6%	410
1,2-Dichloropropane (3)	21%	5.9 – 73	0%	410
Chloroform (1)	73%	4 – 180	3%	170
Chloroform (2)	81%	4.6 – 93	0%	170
Chloroform (3)	82%	5.2 – 630	5%	170
Hexachlorobutadiene (1)	43%	56 – 2,800	30%	180
Hexachlorobutadiene (2)	81%	65 – 6,100	63%	180
Hexachlorobutadiene (3)	46%	41 – 6,400	26%	180

Table 593-1. Summary of Sub-Slab Soil Gas Exceedances for Building 593 (Continued)

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
PCE (1)	100%	14 – 18,000	16%	2,700
PCE (2)	100%	17 – 1,400	0%	2,700
PCE (3)	100%	26 – 54,000	23%	2,700
TCE (1)	59%	5.3 – 1,100	22%	130
TCE (2)	56%	33 – 3,300	38%	130
TCE (3)	72%	5.4 – 2,400	26%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 593-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 593-2. Vapor Intrusion Evaluation for Building 593

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
1,1,2-Trichloroethane (1)	13%	0.25 – 0.34	0.62	ND
1,1,2-Trichloroethane (2)	0%	ND	0.62	ND
1,1,2-Trichloroethane (3)	0%	ND	0.62	ND
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
Chloroform (1)	87%	0.17 – 14	5.2	ND
Chloroform (2)	88%	0.22 – 1.9	5.2	ND
Chloroform (3)	44%	0.29 – 5.2	5.2	ND
Hexachlorobutadiene (1)	0%	ND	5.4	ND
Hexachlorobutadiene (2)	0%	ND	5.4	ND
Hexachlorobutadiene (3)	0%	ND	5.4	ND
PCE (1)	100%	3.6 – 830	82	0.53
PCE (2)	100%	2.9 – 260	82	ND
PCE (3)	67%	0.23 – 7.5	82	ND
TCE (1)	62%	0.22 – 8.2	4	ND
TCE (2)	44%	0.18 – 0.86	4	ND
TCE (3)	8%	0.2 – 0.22	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

PCE was the only analyte detected in indoor air above the $TSRIASL_{12}$ of 82 $\mu g/m^3$. Sub-slab soil gas and indoor air results for PCE by sample location and sampling event are provided on Figure 5.3.3-4. PCE exceeded the indoor air $TSRIASL_{12}$ at 14 out of 39 sample locations during E1. The highest PCE concentrations in the indoor air occurred at locations 593-SS-01 through 593-SS-19. The indoor air sample locations with exceedances tended to be clustered together in two areas: the western most area of the fabrication shop and in the central area surrounding the carpenter shop, tool crib and storage area. The highest PCE concentrations in the sub-slab soil gas samples occurred at locations 593-SS-20 through 593-SS-34. The lack of correlation between the sub-slab soil gas values and the indoor air values, together with the size of the building, suggests VI is not the main source of what was detected in

indoor air. The maximum result of PCE detected in indoor air at Building 593 is 830 μg/m^3, which is <2% of the Dow OEL.

During E1, TCE exceeded the $RIASL_{12}$ in indoor air; however was not detected above the $TSRIASL_{12}$. Sub-slab soil gas and indoor air results for TCE by sample location and sampling event are provided on Figure 5.3.3-5. The locations with indoor air $RIASL_{12}$ TCE exceedances were 593-IA-17 through 593-IA-19. PCE and TCE appear to be correlated with analytes present due to indoor sources not related to VI. As discussed above, PCE was detected at 14 locations at concentrations above the $TSRIASL_{12}$ and these locations tended to be clustered together. For locations 593-IA-11 through 593-IA-19, the relatively high PCE values are associated with relatively high values for TCE and 1,2-dichloroethane. The 1,2-dichloroethane, however, is not present due to VI given that little or no 1,2-dichloroethane was detected in the sub-slab soil gas samples (36 of 38 sub-slab soil gas samples were ND for 1,2-dichloroethane). Therefore, the 1,2-dichloroethane detected in the indoor air is due to indoor sources and not attributable to VI. The detections of 1,2-dichloroethane are correlated with higher detected concentrations of PCE and TCE, suggesting a common indoor source, such as work within the shop involving degreasers or other products. The maximum result of TCE detected in indoor air at Building 593 is 8.2 μg/m^3, which is <1% of the Dow OEL.

Chloroform also exceeded the $RIASL_{12}$ in indoor air only during E1; however was not detected above the $TSRIASL_{12}$. Sub-slab soil gas and indoor air results for chloroform by sample location and sampling event are provided on Figure 5.3.3-6. The locations with chloroform exceedances during E1 were 593-IA-14, 15, 17, 18, and 19. Overall, the few sub-slab soil gas exceedances do not correlate with the indoor air exceedances and the indoor air results are likely due to workplace chemical use. The maximum result of chloroform detected in indoor air at Building 593 is 14 μg/m^3, which is <1% of the Dow OEL.

In March 2018, Building 593 underwent a partial confirmation sampling event (E2). Samples were collected at a subset of the locations previously sampled, including areas where indoor air results exceeded a $TSRIASL_{12}$. Samples were also collected at three new locations to better define air quality near a suspected indoor source. Once again, PCE was the only analyte detected at Building 593 above the $TSRIASL_{12}$ in indoor air (see Figure 5.3.3-4). TCE and chloroform did not exceed screening levels during E2. There was only one PCE exceedance during E2 and this occurred at a location adjacent to a previous exceedance during E1. The sub-slab soil gas concentrations were comparable to both E1 and E2. For locations where relatively high values were measured during the initial sampling effort, the results of the confirmation sampling were mostly within a factor of two. For most analytes, the indoor air results were also comparable; however, PCE exhibited a significant reduction in concentration at locations where the $TSRIASL_{12}$ was exceeded during E1. PCE was approximately lower by a factor of 10 at locations that previously had exceedances of the $TSRIASL_{12}$. TCE and 1,2-dichloroethane concentrations also exhibited a reduction at these same locations, which again suggests a common, non-VI source. The results for 1,1,1-TCA were comparable for both sampling events, which suggests that the insignificant rate of VI remained consistent. The reduced concentrations for PCE, TCE, and 1,2-dichloroethane are attributed to lesser impacts from indoor emission sources during E2, which indicates that the use of products in the warehouse and shop is likely to be intermittent.

All indoor air results during E3 in August 2018 were below screening levels. Therefore, it appears that the majority of PCE, TCE, and chloroform detected in indoor air during E1 were present due to sources other than VI. Outdoor air was not a significant contributor for any of these analytes.

Table 593-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the three analytes listed below, only two (EDB and

HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 593-3. Non Detect Evaluation for Building 593

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,2,4-Trichlorobenzene	0% Detection Frequency, >92% ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, >97% ND RLs > $RIASL_{12}$**
Naphthalene	0%-13% Detection Frequency, All Detects & ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 593 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 593 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the indoor air exceedances are likely due to workplace chemical use. The final seasonal confirmation sampling event is scheduled for February 2019. A full evaluation will be provided in the 2019 CAIP.

5.3.4 Vapor Intrusion Evaluation for Building 923

BACKGROUND

Building 923 is located within the southeastern quadrant of the Midland facility and is known as the Maintenance Contractor Building (Hydrochem) (see Figure 5.3.4-1). It was built between 1965 and 1982, with a small storage/shed-like area on its northwestern side built between 1982 and 1993. This building contains office space, locker rooms, a large shop area, storage areas, a wash bay, and a kitchen/break room. The shop portion of the building is two stories tall and takes up roughly two thirds of the building footprint. The first floor of the southeastern third of the building contains offices, a break room, a small bathroom, and a women's locker room. The second floor contains a conference room, kitchen/break room, a locker room, and offices. The structure is a slab-on-grade construction with no basement or elevator and has a footprint of 11,781 ft^2. The surrounding outdoor ground cover is asphalt.

The building is heated via hot air circulation and cooled via a combination of central and AC units. One intake is located on the roof and the other is located internal to the building just inside Door 5. This structure has five bay doors, with three of them being open nearly every day. Gas-powered equipment and cans are stored in the main shop area.

Building 923 is occupied by a Dow contractor. The occupants work 8 to 9 hour-long shifts five days a week. Approximately 10 to 20 people occupy this building at any given time. Occupants use a contracted weekly laundry service.

DATA SUMMARY

Building 923 has undergone three seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 923 since results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 923	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)
Seasonal Sampling Event	**Completed**
E2	March 2018 (Spring)
E3	Aug 2018 (Summer)
E4	*Scheduled – Winter 2019*

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.4-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.4-A and indoor and outdoor air on Table 5.3.4-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID. Three drain features were observed in this structure, one with a northwest-southeast orientation located on the southwest side of the shop, and two with a northeast-southwest orientation located on the east and west sides of the shop, respectively. A PID reading of 0.7 ppm was observed on the southeastern end of the northwest-southeast drain and PID readings of 0.5 and 3.4 ppm were observed on opposing ends of the eastern northeast-southwest oriented drain. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 923-1:

1. During the initial event (fall 2017), eight analytes were detected above the draft project-specific $RIASL_{12}$ including benzene and ethylbenzene, which were also detected above the $TSRIASL_{12}$;

2. During the second event (spring 2018), five analytes were detected above the draft project-specific $RIASL_{12}$ including benzene, which was also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), five analytes were detected above the draft project-specific $RIASL_{12}$ including benzene and ethylbenzene, which were also detected above the $TSRIASL_{12}$.

Table 923-1. Summary of Sub-Slab Soil Gas Exceedances for Building 923

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
1,2,4-Trimethylbenzene (1)	100%	6.8 – 17,000	22%	6,100
1,2,4-Trimethylbenzene (2)	100%	5.4 – 9,500	22%	6,100
1,2,4-Trimethylbenzene (3)	100%	4.8 – 11,000	22%	6,100
1,2-Dichloropropane (1)	33%	6.1 – 820	22%	410
1,2-Dichloropropane (2)	0%	ND	0%	410
1,2-Dichloropropane (3)	0%	ND	0%	410
1,3,5-Trimethylbenzene (1)	78%	4.2 – 7,400	11%	6,100
1,3,5-Trimethylbenzene (2)	56%	4.8 – 4,100	0%	6,100
1,3,5-Trimethylbenzene (3)	67%	5.6 – 4,300	0%	6,100

Table 923-1. Summary of Sub-Slab Soil Gas Exceedances for Building 923 (Continued)

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects (µg/m³)	% Detections > Screening Level	Screening Level* (µg/m³)
Benzene (1)	100%	12 – 260,000	22%	510
Benzene (2)	89%	4.5 – 170,000	22%	510
Benzene (3)	89%	3.8 – 180,000	22%	510
Cumene (1)	67%	4.4 – 7,100	22%	380
Cumene (2)	44%	4 – 1,400	11%	380
Cumene (3)	56%	4.1 – 1,800	11%	380
Ethylbenzene (1)	100%	13 – 73,000	22%	1,600
Ethylbenzene (2)	100%	6.9 – 11,000	11%	1,600
Ethylbenzene (3)	100%	4.2 – 19,000	22%	1,600
Naphthalene (1)	44%	18 – 19,000	22%	120
Naphthalene (2)	22%	19 – 3,300	11%	120
Naphthalene (3)	56%	13 – 5,700	22%	120
Total Xylenes (1)	100%	18.6 – 33,000	11%	22,000
Total Xylenes (2)	100%	16.5 – 18,000	0%	22,000
Total Xylenes (3)	100%	14 – 19,800	0%	22,000

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 923-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 923-2. Vapor Intrusion Evaluation for Building 923

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range (µg/m³)	Indoor Air Screening Level* (µg/m³)	Outdoor Air Result (µg/m³)
1,2,4-Trimethylbenzene (1)	100%	1.6 – 4	184	ND
1,2,4-Trimethylbenzene (2)	100%	11 – 47	184	ND
1,2,4-Trimethylbenzene (3)	22%	1.1 – 2	184	ND
1,2-Dichloropropane (1)	0%	ND	12.2	ND
1,2-Dichloropropane (2)	0%	ND	12.2	ND
1,2-Dichloropropane (3)	0%	ND	12.2	ND
1,3,5-Trimethylbenzene (1)	11%	2	184	ND
1,3,5-Trimethylbenzene (2)	100%	3.5 – 15	184	ND
1,3,5-Trimethylbenzene (3)	0%	ND	184	ND
Benzene (1)	100%	1.8 – 2.2	15.4	0.53
Benzene (2)	100%	11 – 20	15.4	0.45
Benzene (3)	100%	0.58 – 1.3	15.4	0.49
Cumene (1)	0%	ND	11.4	ND
Cumene (2)	100%	1.8 – 7.4	11.4	ND
Cumene (3)	0%	ND	11.4	ND
Ethylbenzene (1)	100%	1.4 – 2.5	48	0.27
Ethylbenzene (2)	100%	10 – 33	48	0.19
Ethylbenzene (3)	100%	0.19 – 0.35	48	0.18

Table 923-2. Vapor Intrusion Evaluation for Building 923 (Continued)

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Naphthalene (1)	33%	0.44 – 0.57	3.6	ND
Naphthalene (2)	100%	0.93 – 3.4	3.6	ND
Naphthalene (3)	11%	1.1	3.6	ND
Total Xylenes (1)	100%	6 – 13.2	680	0.77
Total Xylenes (2)	100%	39 – 122	680	0.84
Total Xylenes (3)	100%	0.6 – 1.6	680	0.49

*Screening level provided is the draft project-specific $RIASL_{12}$.

Benzene was the only analyte detected above a screening level in indoor air during any of the three sampling events. Sub-slab soil gas and indoor air results for benzene by sample location are provided on Figure 5.3.4-3. Benzene exceeded the $RIASL_{12}$ for indoor air during E2 at 923-IA-01 (20 $\mu g/m^3$). During the other sampling events, benzene was significantly below the screening level at that location, 1.9 $\mu g/m^3$ and 0.61 $\mu g/m^3$, respectively. Sub-slab soil gas results at that location were significantly below the screening level during all three sampling events, which indicates that the E2 indoor air result for benzene was likely due to active workplace chemical use. Furthermore, while only 943-IA-01 demonstrated a benzene exceedance of the $RIASL_{12}$, the indoor air results from each sampling location throughout the building during E2 was elevated when compared to results from E1 and E3 (see Figure 5.3.4-3). For each sample location, results from E2 had the highest indoor air concentration of benzene and most of these locations also had sub-slab soil gas results significantly below the screening level. Building 923 has a truck lane in the middle of the building and it's very likely that the benzene results are due to use of the truck lane or a maintenance activity that occurs infrequently, as all results for benzene during each of the subsequent sampling events were significantly below the $RIASL_{12}$.

Table 923-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. Also, if the analyte has already been identified as an AOI in sub-slab soil gas, no further ND evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 16 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 923-3. Non Detect Evaluation for Building 923

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	0%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dioxane	0%-44% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Carbon tetrachloride	100% Detection Frequency, All Detects < $RIASL_{12}$
Chloroform	89%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$

Table 923-3. Non Detect Evaluation for Building 923 (Continued)

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$, 78% SSSG ND RLs < $RIASL_{12}$**
Trichloroethene	0% - 100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 923 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 923 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the single indoor air exceedance of benzene was likely due to workplace chemical use or maintenance activities. The final seasonal confirmation sampling event is scheduled for February 2019. A full evaluation will be provided in the 2019 CAIP.

5.3.5 Vapor Intrusion Evaluation for Building 935

BACKGROUND

Building 935 is located in the southeastern quadrant of the Midland facility and is known as the Formerly Contractor Maintenance Building (see Figure 5.3.5-1). The large eastern garage area was built sometime between 1965 and 1982. A small office area containing a kitchen and locker rooms was built on the western side of the garage between 1982 and 1993. The 17,958 ft^2 building is a slab-on-grade structure with no basement or elevators. The office area on the west side of the building is a single story, and the garage portion of the structure is approximately two stories high. On the eastern side of the garage structure is a small bathroom in the northeastern corner, and a conference room located in the loft space above a caged storage area. The garage has nine bay doors, with the doors on the east and west side appearing to be open 24 hours a day and the remaining opened to facilitate parking when necessary. The ground cover around the building is asphalt.

The office space area is heated via hot air circulation and cooled via central AC. The conference room on the east side of the garage has AC as well. An intake for the conference room exists on the east side of the building, whereas the intake for the western side of the building is on the one-story roof on the southeastern corner.

At the time of the survey, the building was not occupied, but was indicated by the interviewee to be re-occupied in the near future. By the time the initial sampling was complete in the fall of 2017, the building was occupied with roughly 5 to 7 occupants.

PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building.

DATA SUMMARY

Building 935 was sampled in November 2017. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available).

Building 935	
Initial Sampling Event	**Completed**
E1	November 2017 (Fall)

Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.5-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.5-A and indoor and outdoor air on Table 5.3.5-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 935. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Thirty-three of the 65 analytes were ND in each of the samples. Thirty-two analytes were detected in sub-slab soil gas and all detected results with one exception were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available. Chloroform was detected in eight of nine sub-slab soil gas samples and only 2 results (location 935-SS-01 with 410 $\mu g/m^3$ and location 935-SS-05 with 210 $\mu g/m^3$) exceeded the $RIASL_{12}$ (170 $\mu g/m^3$). All results were less than the $TSRIASL_{12}$ (1,700 $\mu g/m^3$), shown on Table 935-1 below.

Table 935-1. Summary of Sub-Slab Soil Gas Exceedances for Building 935

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
Chloroform	89%	12 – 410	22%	170

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 935-2 summarizes the indoor air results for chloroform relative to the limited sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Table 935-2 below lists the results for chloroform in indoor air since it was the only analyte detected above applicable screening levels in sub-slab soil gas. The outdoor air sample result is also provided to determine if chloroform was present in indoor air due to migration from outdoor air.

Table 935-2. Vapor Intrusion Evaluation for Building 935

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform	100%	0.2 – 0.44	5.2	<0.17

*Screening level provided is the draft project-specific $RIASL_{12}$.

All results for analytes detected in indoor air were less than the indoor air screening levels. Chloroform was detected in all indoor air samples at consistently low concentrations below the $RIASL_{12}$. The indoor air results for corresponding locations 935-IA-01 and 935-IA-05 fall within the range of detections that are all an order of magnitude less than the $RIASL_{12}$.

RLs for EDB exceed screening levels in both sub-slab soil gas and indoor air. EDB requires further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 935 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 935 has been placed in VI Path Forward Building Group 2 and seasonal confirmation sampling will be conducted. A full evaluation will be provided in the 2019 CAIP.

5.3.6 Vapor Intrusion Evaluation for Building 499

EXPEDITED BUILDING SUMMARY AND RESULTS NOTIFICATION

An Expedited Building Summary was submitted for Building 499 on August 24, 2018 based on the results of the first two sampling events (October 2017 and March 2018). MDEQ requested expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Therefore, each indoor air result was compared to the $TSRIASL_{12}$ from the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels. TCE was the only analyte in indoor air detected at Building 499 greater than the $TSRIASL_{12}$.

The VI findings concluded that the TCE detected in the indoor air at Building 499 is due to indoor sources and not attributable to VI. The lack of correlation between the sub-slab soil gas and indoor air results suggest VI is not the main source of indoor air detections. The indoor air results suggest a common source, such as work within the instrument shop on the northwest corner of the building involving degreasers or other products. Interim response actions were not necessary to address the detections of TCE in indoor air at Building 499; however, seasonal confirmation sampling continued.

Email notification was also provided for Building 499 on October 25, 2018 based on the sampling results from the summer seasonal confirmation sampling event (E3). Results from E3 continue to indicate indoor air exceedances of the $TSRIASL_{12}$ for TCE. PCE also exceeded the $TSRIASL_{12}$ during E3. The findings concluded that the lack of correlation between the sub-slab soil gas and indoor air results continue to suggest VI is not the main source of indoor air detections. The indoor air results continued to suggest a common source such as work within the instrument shop on the northwest corner of the building involving degreasers or other products. Interim response actions were not warranted.

BACKGROUND

Building 499 is located in the southeastern quadrant of the Midland facility (see Figure 5.3.6-1) and was constructed sometime between 1938 and 1952. The 25,793 ft^2 structure (14,516 ft^2 is non-process area) is a slab-on-grade construction that is approximately three stories high in the process area. The office, lab, locker rooms/bathrooms, kitchen/break rooms, instrument shop, and control room area wrap around the process area in a single-story L shape on its northern and eastern side. This L-shaped area functions more as an annex to the process area. The building has no basement, but an elevator/lift is located in the southeast corner of the process area. The four bay doors on the building, which are all located on the south or southeastern side of the building, are predominantly left open during the summer months. The ground cover around the building is mainly asphalt with small patches of gravel and grass located to the north of the building. Railroad tracks are located just north of this gravel/grass area.

The L-shaped portion of the building that contains spaces where occupants would typically spend the bulk of their work day is heated via hot air circulation and is cooled via central AC and individual AC units. The main intake for this L-shaped area is located on the northern side of the building; however, the intake for the control room area is located in the process area. Air intakes for the process areas are located on its roof and the process area is heated via steam heat. Note that the control room floor is elevated/has a false floor to allow for various communication/utility lines to be run throughout the control room.

The occupants of Building 499 work four weekday shifts. The main shift of the day is from 7AM-2PM. The weekends have two 12-hour shifts each day. Typically 15-20 people occupy this building during the day, four of which are operators and the others are full-time staff. The staff has access to washer/dryers located in the building. Gas-powered equipment and gasoline/fuels are typically not stored within the portion of the building where occupants reside.

DATA SUMMARY

Building 499 has undergone three seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 499 since results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 499	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)
Seasonal Sampling Event	**Completed**
E2	March 2018 (Spring)
E3	Aug 2018 (Summer)
E4	*Scheduled – February 2019 (Winter)*

For each sampling event, sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.6-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.6-A and indoor and outdoor air on Table 5.3.6-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID. PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. The number of analytes detected above the sub-slab soil gas draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 499-1:

1. During the initial event (fall 2017), chloroform, PCE, and TCE were detected above the draft project-specific $RIASL_{12}$, and PCE and TCE were also detected above the $TSRIASL_{12}$;

2. During the second event (spring 2018), the same three analytes were detected above the draft project-specific $RIASL_{12}$, and PCE and TCE were also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), the same three analytes were detected above the draft project-specific $RIASL_{12}$, and PCE and TCE were also detected above the $TSRIASL_{12}$.

Table 499-1. Summary of Sub-Slab Soil Gas Exceedances for Building 499

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
Chloroform (1)	78%	7.9 – 570	33%	170
Chloroform (2)	78%	5.1 – 280	33%	170
Chloroform (3)	67%	7 – 240	22%	170
Tetrachloroethene (1)	100%	32 - 32,000	78%	2,700
Tetrachloroethene (2)	100%	15 - 18,000	78%	2,700
Tetrachloroethene (3)	100%	91 - 16,000	78%	2,700
Trichloroethene (1)	89%	7.6 - 3,000	78%	130
Trichloroethene (2)	78%	310 - 1,800	78%	130
Trichloroethene (3)	89%	8.8 - 2,600	78%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 499-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 499-2. Vapor Intrusion Evaluation for Building 499

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
Chloroform (1)	100%	0.89 - 2	5.2	0.62
Chloroform (2)	100%	0.41 - 3.4	5.2	ND
Chloroform (3)	100%	0.22 - 9.3	5.2	0.19
Tetrachloroethene (1)	100%	0.92 - 7.9	82	3.1
Tetrachloroethene (2)	100%	12 - 82	82	0.36
Tetrachloroethene (3)	100%	14 - 330	82	7.8
Trichloroethene (1)	78%	0.2 - 12	4	ND
Trichloroethene (2)	100%	0.47 - 14	4	ND
Trichloroethene (3)	100%	0.4 - 43	4	0.39

*Screening level provided is the draft project-specific $RIASL_{12}$.

Chloroform, TCE and PCE were the only analytes detected above a screening level in indoor air during any of the three sampling events. Sub-slab soil gas and indoor air results for chloroform, TCE and PCE by sample location are provided on Figures 5.3.6-3, 5.3.6-4 and 5.3.6-5, respectively. Chloroform only exceeded the indoor air $RIASL_{12}$ at a single sample location (499-IA-08) during E3 and did not exceed the $RIASL_{12}$ during any other events. PCE exceeded the indoor air $RIASL_{12}$ and $TSRIASL_{12}$ at two sample locations (499-IA-08 and 499-IA-09) during E3, but did not exceed either screening level during E1 or E2. TCE exceeded the indoor air $RIASL_{12}$ at a single sample location (499-IA-09) during each of the three events and exceeded the $TSRIASL_{12}$ at that same location during E2 and E3. As shown on the figures, sub-slab soil gas results at sample locations 499-SS-08 and 499-SS-09 were below screening levels for all analytes during each of the three sampling events. Sub-slab soil gas results did exceed screening levels for chloroform, PCE and TCE at sample locations 499-SS-01 through 499-SS-07.

The location of the highest indoor air results of TCE (499-IA-09) remained consistent for all three sampling events and is in the northwest corner of the building, where an instrument shop is located. The corresponding sub-slab soil gas sample results for TCE at that location are significantly below the screening level (range from ND to 8.8 µg /m^3 compared to $TSRIASL_{12}$ of 400 µg /m^3). Also, the sub-slab soil gas exceedances for TCE are located throughout the east side of the building and all of the corresponding indoor air results at those sample locations are significantly less than the indoor air screening level.

Similar to TCE, the sub-slab soil gas exceedances for PCE occur on the east side of the building and there is a lack of correlation with indoor air samples. During E2, PCE was detected in indoor air at a concentration equal to the $TSRIASL_{12}$ (82 µg/m3) in the northwest corner of the building between the instrument shop and lab (Sample 499-IA-08). During E3, PCE exceeded the $TSRIASL_{12}$ at sample locations 499-IA-08 and 499-IA-09 (200 µg /m^3 and 330 µg /m^3, respectively). The PCE result at those sample locations in E1 was 0.92 µg/m3 and 1.2 µg /m^3, respectively.

The building survey identified Lectra Clean Heavy Duty Electrical Parts Degreaser in several locations within the building. This product contains 90 to 100% PCE. A building IH representative was interviewed in the fall of 2018 regarding the workplace chemical use in the Instrument Shop at Building 499. It was confirmed that the indoor air results are likely due to use of degreasers in the Instrument Shop. The use of this product or similar products, in the shop or lab is likely to be intermittent, given that the measured concentrations during E1 were far lower. A specific source of TCE within the building has not been identified to date. Nonetheless, based on the various lines of evidence, the TCE detected in the indoor air is also largely due to indoor sources and not attributable to VI. The maximum result of TCE detected in indoor air in Building 499 is 43 µg/m^3, which is less than 1% of the Dow IH Occupation Exposure Level (OEL). The maximum result of PCE detected in indoor air in Building 499 is 330 µg/m^3, which is also less than 1% of the Dow OEL.

Table 499-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. Also, if the analyte has already been identified as an AOI in sub-slab soil gas, no further ND evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the eight analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 499-3. Non Detect Evaluation for Building 499

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$, 78% SSSG ND RLs > $RIASL_{12}$ in E2**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 499 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future

VI, Building 499 has been placed in VI Path Forward Building Group 4A, as lines of evidence indicate that VI is insignificant and the indoor air exceedances of chloroform, PCE, and TCE were likely due to workplace chemical use in the instrument shop in the northwest corner of the building. The final seasonal confirmation sampling event is scheduled for February 2019. A full evaluation will be presented in the 2019 CAIP.

5.3.7 Vapor Intrusion Evaluation for Building 779

BACKGROUND

Building 779 is a Category 2 building located within the southeastern portion of the facility designated as Zone 2 (see Figure 5.3.7-1). It is known as the Miscellaneous Shipping Building and was constructed between 1958 and 1965 per aerial photography. A small storage area on the northern end of the building was constructed between 1982 and 1993. The 25,793 ft^2 building consists of predominantly warehouse space used to facilitate shipping throughout the facility, with a small office and shipping coordination area located on the western side of the building. Locker rooms, a kitchen, and a large conference room are located in the northeast corner of the building. A small bathroom is located near the northwest corner of the building. The ground cover outside the building is predominantly concrete and asphalt.

The building is a slab-on-grade construction with no basement. The building is roughly 1.5 to 2 stories tall, with loft space present on the northern end of the building and above the office area located on the western side of the building. The building is heated via gas heat. The northeast corner of the building is cooled via a central AC unit. The western office space has multiple individual AC units that are used to cool this office area. Mechanicals fans are also used to facilitate in air movement/cooling in the building. The building has eight bay doors (seven of them on the south side of the building, and one of them on the north side of the building). The bay doors are opened frequently during work hours, but are closed more often during the winter.

Approximately 10-20 people work an 8AM-4:30PM shift during the week. The occupants used a contracted laundry service to wash any uniforms/work-specific clothing.

PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building.

DATA SUMMARY

Building 779 was sampled in October 2017. Results indicated that seasonal confirmation sampling was not warranted for this building. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 779	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from 11 locations from within the building. Indoor air samples were collected at 11 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.7-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.7-A and indoor and outdoor air on Table 5.3.7-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the

building, each listed in the survey, primarily included adhesives and various cleaners (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 779. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-four of the 65 analytes were ND in each of the samples. Twenty-one analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available. All sub-slab soil gas RLs met the sub-slab soil gas screening levels.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 31 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Thirteen analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these 13 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 779 is an insignificant exposure pathway based on current use. Building 779 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.3.8 Vapor Intrusion Evaluation for Building 826/494

BACKGROUND

Building 826/494 is located in the southeastern quadrant of the Midland facility and is known as the Maintenance Shops (see Figure 5.3.8-1). The northern portion of this building, which was constructed sometime between 1938 and 1952, is labeled “494” and is predominantly a storage warehouse with some work benches located in its western half. Along the southern wall is a wall opening/enclosed pathway that connects Building 494 to Building 826. Building 826 is a brick-façade structure that was built between 1965 and 1982 and consists of office space, a shop, a locker room, and kitchen. Both portions of the combined 7,914 ft^2 single story building are slab-on-grade with no basement or elevator. Although the buildings are considered one structure, different areas within the structure will be defined as being in “Building 826” or “Building 494 for clarity. The ground cover outside the combined building is predominantly asphalt.

The combined structure is predominantly used by operations controlled by Building 1130 and contractors that support Building 1130 operations. It is typically used on an intermittent/as needed basis. If the building is being used/occupied, an occupant would likely be working an 8-hour shift. There is a washer/dryer setup located in the Building 826 locker room. The shop portion of Building 826 can allow a car to pull into the shop bay. Gas-powered equipment and gasoline/fuels are stored in the Building 826 shop area.

The combined building is predominantly heated via hot air circulation. There are electric baseboards present in some of the Building 826 offices, and the Building 826 shop area has some ceiling-mounted heating units. The eastern portion of Building 826 is cooled via central AC. Some individual AC units were observed for the office spaces located to the northwest of the Building 826 shop area and also for

the Building 826 kitchen. However, one of the office spaces on the south side of Building 826 has an individual AC unit even though that area of the building is cooled via central AC. The combined structure has three bay doors, two of the doors are located on the eastern and western sides of the Building 494, and the third bay door is located on the western side of the Building 826 shop.

Minor PID readings (0.1-0.3 ppm) were observed in the ambient air measured in Building 826 locker room, the southeastern conference room, the northwestern conference room, the small bathroom in the northeastern corner, in the east-west hallway leading to the locker room, and in the drain in the small bathroom found in northeastern corner of Building 826.

DATA SUMMARY

Building 826/494 has undergone three seasonal confirmation sampling events. Seasonal confirmation sampling was conducted at Building 826/494 since results from the initial sampling event exceeded screening levels. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 826/494	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)
Seasonal Sampling Event	**Completed**
E2	March 2018 (Spring)
E3	Aug 2018 (Summer)
E4	*Scheduled – Winter 2019*

For each sampling event, sub-slab soil gas samples were collected from six locations from within the building. Indoor air samples were collected at six locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.8-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.8-A and indoor and outdoor air on Table 5.3.8-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey (included in Appendix E).

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. As shown below, the results in sub-slab soil gas were consistent throughout the three rounds of sampling. The number of analytes detected above the sub-slab soil gas draft project-specific $RIASL_{12}$ or $TSRIASL_{12}$, if available, are discussed below by sampling event and shown on Table 826/494-1:

1. During the initial event (fall 2017), three analytes (CFC-12, PCE, and TCE) were detected above the draft project-specific $RIASL_{12}$ and both PCE and TCE were also detected above the $TSRIASL_{12}$;

2. During the second event (spring 2018), the same three analytes were detected above the draft project-specific $RIASL_{12}$ including PCE and TCE, which were also detected above the $TSRIASL_{12}$; and

3. During the third event (summer 2018), CFC-12, PCE, and TCE were detected above the draft project-specific $RIASL_{12}$ and both PCE and TCE were also detected above the $TSRIASL_{12}$.

Table 826/494-1. Summary of Sub-Slab Soil Gas Exceedances for Building 826/494

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
CFC-12 (1)	100%	520 - 280000	50%	34000
CFC-12 (2)	100%	160 - 520000	50%	34000
CFC-12 (3)	100%	410 - 70000	33%	34000
Tetrachloroethene (1)	100%	5400 - 29000	100%	2700
Tetrachloroethene (2)	83%	3900 - 36000	83%	2700
Tetrachloroethene (3)	100%	5300 - 36000	100%	2700
Trichloroethene (1)	83%	310 - 3200	83%	130
Trichloroethene (2)	83%	200 - 5100	83%	130
Trichloroethene (3)	100%	260 - 4400	100%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 862/494-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 862/494-2. Vapor Intrusion Evaluation for Building 862/494

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
CFC-12 (1)	100%	2.1 - 3.7	1020	2
CFC-12 (2)	100%	3 - 4.1	1020	2.4
CFC-12 (3)	100%	2.3 - 4.8	1020	2.4
Tetrachloroethene (1)	67%	0.47 - 1.6	82	0.96
Tetrachloroethene (2)	100%	0.81 - 1.3	82	1.8
Tetrachloroethene (3)	83%	0.27 - 1.9	82	ND
Trichloroethene (1)	17%	0.22	4	ND
Trichloroethene (2)	83%	0.29 - 0.39	4	0.23
Trichloroethene (3)	100%	0.25 - 2.6	4	0.34

*Screening level provided is the draft project-specific $RIASL_{12}$.

All indoor air results in Building 826/494 were less than screening levels. The indoor air results for the three sub-slab soil gas AOIs (CFC-12, PCE, and TCE) were all at least one order of magnitude below screening levels. All three analytes were detected in outdoor air at concentrations similar to those detected in indoor air indicating that the outdoor air may be contributing to indoor air concentrations.

Table 826/494-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 26 analytes listed below, only 2 (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 826/494-3. Non Detect Evaluation for Building 826/494

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,1-Dichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2-Dichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2-Dichloropropane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dioxane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
2-Hexanone	0% Detection Frequency, All ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Benzene	33%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromoform	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Carbon Tetrachloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Chloroform	67%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
cis-1,2-Dichloroethene	0%-17% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Cumene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Ethylbenzene	50%-100% Detection Frequency, All detects and ND RLs < $RIASL_{12}$
Hexachlorobutadiene	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Vinyl Chloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 826/494 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 826/494 has been placed in VI Path Forward Building Group 2. The final seasonal confirmation sampling event is scheduled for February 2019. A full evaluation will be provided in the 2019 CAIP.

5.3.9 Vapor Intrusion Evaluation for Building 921

BACKGROUND

Building 921 is located in the southeastern quadrant of the Midland facility and is known as the Road and Yard Maintenance Shop (see Figure 5.3.9-1). The building was built between 1965 and 1982 per aerial photography. This building contains office space, conference rooms, locker rooms, a shop area, and kitchen/break rooms. The shop portion of the building is two stories tall and takes up roughly two thirds of the building footprint. The southern third of the building is also two stories tall and contains offices, a kitchenette, a locker room, and storage area on the first floor; and a conference room, kitchen/break room, and locker rooms on the second floor. The structure is a slab-on-grade construction with no basement or elevator and has a footprint of 16,000 ft^2. The surrounding outdoor ground cover is asphalt.

The building is heated through a combination of hot air circulation and steam via forced air. There is central AC for the office portion of the structure through three separate units (one for the first floor office

space and two for the second floor conference room, kitchen/break room, and locker rooms). Ventilation fans are located in the bathrooms/locker rooms. The shop area has five bay doors, and two of them are open nearly 24 hours a day, 7 days a week. Gas-powered equipment and cans are stored in the main shop area.

Building 921 is occupied by site services personnel. The occupants work 8 hours shifts (7AM-3PM, 3PM-11PM) during the week. During the weekend, one person is on duty and works from 7AM-3PM. At any given time, approximately 11-13 people are in the building. Occupants use a contracted weekly laundry service or use washer/dryers located in the locker rooms.

PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building.

DATA SUMMARY

Building 921 was sampled in November 2017. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 921	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from nine locations from within the building. Indoor air samples were collected at nine locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.9-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.9-A and indoor and outdoor air on Table 5.3.9-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 921. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Thirty-nine of the 65 analytes were ND in each of the samples. Twenty-six analytes were detected in sub-slab soil gas and all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available.

EVALUATION OF VAPOR INTRUSION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. All detections in sub-slab soil gas were less than screening levels. In indoor air, TCE was detected at concentrations that exceeded the $RIASL_{12}$ (4 $\mu g/m^3$) in six of nine samples with two sample locations in the parts room and crib and others within office space that is directly linked to the shop floor. The detected indoor air concentrations only slightly exceeded screening levels and ranged from 4.1 – 5 $\mu g/m^3$. TCE was not detected in sub-slab soil gas and the RLs met the $RIASL_{12}$ (130 $\mu g/m^3$). TCE was also ND in the outdoor air sample.

With no detected concentrations of TCE in the sub-slab soil gas, there is no evidence of VI and the presence of TCE in indoor air is most likely related to workplace chemical use. A comparison to OELs is appropriate and the TCE detections in indoor air are < 0.02% of the Dow OEL.

Table 921-1 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the eight analytes listed below, only two (EDB and HCB) require further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

Table 921-1. Non Detect Evaluation for Building 921

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	0% Detection Frequency, All ND RLs > $RIASL_{12}$, 67% of SSSG ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	0% Detection Frequency, All ND RLs > $RIASL_{12}$, 89% or more of SSSG ND RLs < $RIASL_{12}$
Naphthalene	69% E3 Detection Frequency, All Detects & ND RLs < $RIASL_{12}$

CONCLUSIONS AND RECOMMENDATIONS

Based on the sub-slab soil gas results, the VI pathway at Building 921 is an insignificant exposure pathway based on current use. However, based on the indoor air results, Building 921 has been placed in VI Path Forward Building Group 3 and further investigation into the indoor air results will be conducted.

5.3.10 Vapor Intrusion Evaluation for Building 922

BACKGROUND

Building 922 is a Category 2 building located within the southeastern portion of the Midland facility designated as Zone 2. It is known as the Garage/General Trucking Building and was built between 1965 and 1982 (see Figure 5.3.10-1). The predominantly two-story structure is a slab-on-grade construction with no basement or elevator and has a footprint of 23,009 ft^2. The surrounding outdoor ground cover is asphalt with some gravel to the southeast of the building.

The northern quarter of this building is a single story office annex that contains office space, bathrooms, a conference room, and a kitchenette. A doorway on the south side of the annex connects to the stock room area. Just south of the stock room area are offices, a kitchen/break room, a bathroom, and stairwells to the second floor. The stairwells lead to a second floor break room area and locker rooms. The stock room area, offices, bathrooms, and kitchen/break room take up another quarter of the building. The remainder of the building is a large shop area, tool crib, and truck/car wash area.

This building is occupied by three different Dow contractors. The occupants of this building work 8 to 9 hour shifts five days a week, Monday through Friday. Approximately 10-20 people occupy this building at any given time. Occupants use a contracted weekly laundry service.

The building is heated through a combination of hot air circulation and steam via forced air. There is central AC for the annex portion of the building and for the office areas located to the south of the annex and stock room. There is an outdoor intake located on the east side of the building. The bathrooms also have ventilation fans. The shop area and truck/car wash area have a combined total of eight bay doors, and many of them are open nearly 24 hours a day, 7 days a week. Gas-powered equipment and cans are stored in the main shop area.

An ambient air PID reading of 0.1 ppm was observed in the kitchenette located in the annex. Otherwise, ND PID readings were observed from drain features noted in the building.

DATA SUMMARY

Building 922 was sampled in October 2017. Results indicated that seasonal confirmation sampling was not warranted for this building. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available).

Building 922	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from 10 locations from within the building. Indoor air samples were collected at 10 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.10-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.10-A and indoor and outdoor air on Table 5.3.10-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included various cleaners and an insecticide (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 922. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Thirty-seven of the 65 analytes were ND in each of the samples. Twenty-eight analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 28 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Ten analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these 10 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

All sub-slab soil gas ND RLs met screening levels, with the exception of EDB. All ND RLs for EDB in indoor air were also greater than the screening level. EDB requires further investigation that will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 922 is an insignificant exposure pathway based on current use. Building 922 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.3.11 Vapor Intrusion Evaluation for Building 1130

BACKGROUND

Building 1130 is a Category 1 building located within the southeastern portion of the Midland facility designated as Zone 2 (see Figure 5.3.11-1). It is known as the Styrene Monomer Offices and Control Room and was built sometime between 1965 and 1982. Per aerial photography, the present-day structure is 13,280 ft^2. The building consists of offices, a conference room, a lab, an instrument shop, locker rooms, a kitchen, and control room. The building is a single story slab-on-grade construction with no basement and no elevator. The ground cover immediately surrounding the building is either asphalt or concrete.

There is one bay door located on the west side of the building, and is frequently open all day during the summer. The building is heated via hot air circulation and cooled via one central AC unit. The intake for the building is located on the western side of the roof. The kitchen, locker rooms, and lab all have ventilation fans or ventilation hoods.

Approximately 20 to 30 occupants work in three 8-hour shifts. The occupants of this building use washer/dryers found in the building for cleaning uniforms.

Minor PID readings (0.1-0.2 ppm) were observed during the building survey from the drains in the women's locker room showers and in the ambient air in the women's locker room. All other PID readings observed during the survey were 0.0 ppm.

DATA SUMMARY

Building 1130 was sampled in October 2017. Results indicated that seasonal confirmation sampling was not warranted for this building. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1130	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from 10 locations from within the building. Indoor air samples were collected at 10 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.11-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.11-A and indoor and outdoor air on Table 5.3.11-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the

building, each listed in the survey, primarily included adhesive spray, spray paint, and various cleaners (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1130. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-four of the 65 analytes were ND in each of the samples. Twenty-one analytes were detected in sub-slab soil gas but all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 19 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Eight analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these eight analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

Sub-slab soil gas ND RLs for all but one analyte (EDB) met the sub-slab soil gas screening levels. All ND RLs for EDB in indoor air are also greater than the screening level. EDB requires further investigation which will be conducted once the facility-wide priority buildings have been sampled and evaluated.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 1130 is an insignificant exposure pathway based on current use. Building 1130 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.3.12 Vapor Intrusion Evaluation for Building 1215

BACKGROUND

Building 1215, is a single story slab-on-grade construction used as the 52 Gate gatehouse off of South Saginaw Road, in Zone 2 (see Figure 5.3.12-1). The present-day structure was constructed between 1982 and 1993. The structure contains a main open area where guards sit, two bathrooms, an electrical room, and a back training room. The ground cover surrounding the outside of the building is predominantly asphalt, with a concrete sidewalk immediately adjacent to the building on its north, east, and west sides. A small grassy median is located to the north approximately 8 meters away from the structure.

The building is predominantly heated by a combination of electric baseboards and central heated forced air and is cooled via central AC. The AC unit and air intake are located on the southern side of the roof. The structure has no bay doors and has a footprint of approximately 1,463 ft^2.

The gatehouse is open from 6AM to 6PM Monday through Thursday. Half of the staff works 12-hour shifts on Monday and Tuesday, and a half shift on Wednesday. The other half of the staff works 12-hour shifts Thursday and Friday and a half shift on Wednesday. The staff cleans their uniforms at home.

The only PID reading observed during the survey (0.1 ppm) was from the sink drain located in the northern bathroom.

DATA SUMMARY

Building 1215 was sampled in October 2017. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1215	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from three locations from within the building. Indoor air samples were collected at three locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.12-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.12-A and indoor and outdoor air on Table 5.3.12-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1215. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Fifty-four of the 65 analytes were ND in each of the samples. Eleven analytes were detected in sub-slab soil gas and all detected results with two exceptions were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available. Table 1215-1 presents the results for CFC-12 and ethylbenzene.

Table 1215-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1215

Analyte (Sampling Event)	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
CFC-12	100%	120,000 – 200,000	100%	34,000
Ethylbenzene	100%	5,400 – 17,000	100%	1,600

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 1215-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1215-2. Vapor Intrusion Evaluation for Building 1215

Analyte (Sampling Event)	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
CFC-12	100%	28 - 34	1,020	2.1
Ethylbenzene	100%	0.39 - 0.52	48	0.15

*Screening level provided is the draft project-specific $RIASL_{12}$.

CFC-12 and ethylbenzene were detected in all sub-slab soil gas and indoor air samples. While CFC-12 and ethylbenzene were detected in sub-slab soil gas at concentrations greater than screening levels, the detections of both analytes in indoor air were two orders of magnitude less than screening levels.

Table 1215-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one event, no further ND evaluation is warranted. Of the 25 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 1215-3. Non Detect Evaluation for Building 1215

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RL < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2-Dichloropropane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dioxane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
2-Hexanone	0% Detection Frequency, All ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Benzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromoform	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Carbon tetrachloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Chloroform	0% Detection Frequency, All ND RLs < $RIASL_{12}$
cis-1,2-Dichloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Cumene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Trichloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Vinyl chloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1215 is an insignificant exposure pathway based on current use. However, based on the sub-slab soil gas results and given the potential for future VI, Building 1215 has been placed in VI Path Forward Building Group 2 and seasonal confirmation sampling will be conducted. A full evaluation will be presented in the 2019 CAIP.

5.3.13 Vapor Intrusion Evaluation for Building 1255

BACKGROUND

Building 1255 is located in the southeastern quadrant of the Midland Facility and is known as the EH&S Offices building (see Figure 5.3.13-1). The present structure was built approximately 25-35 years ago between 1982-1993 per building occupants and aerial photography. The 8,163 ft^2 building is a single story slab-on-grade construction with no basement. The building is predominantly office space with locker rooms and a kitchen. The ground cover around the building is predominantly asphalt or concrete; however some flower beds/boxes are located on the west side of the building.

The building is heated via hot air circulation and is cooled via central AC. The locker rooms also have ventilation fans and the outside air intake is located on the eastern side of the building.

Approximately 22-30 people work in this building from 8AM-5PM for five days a week (Monday through Friday). There are washer/dryers available in the building; however a contracted laundry service is predominantly used for any uniforms. The building has no garage or bay doors.

No PID readings were observed in the ambient air or any drain features noted during the survey.

DATA SUMMARY

Building 1255 was sampled in October 2017. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1255	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from six locations from within the building. Indoor air samples were collected at six locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.13-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.13-A and indoor and outdoor air on Table 5.3.13-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building are listed in the survey (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1255. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Sixty of the 65 analytes were ND in each of the samples. Five analytes were detected in sub-slab soil gas and two of those analytes had results that exceeded the sub-slab soil gas draft project-specific $RIASL_{12}$, but were less than the $TSRIASL_{12}$, if available. Table 1255-1 presents the results for CFC-12 and chloroform.

Table 1255-1. Summary of Sub-Slab Soil Gas Exceedances for Building 1255

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
CFC-12	100%	53,000 – 1,300,000	100%	34,000
Chloroform	17%	1,200	17%	170

*Screening level provided is the draft project-specific $RIASL_{12}$.

EVALUATION OF VAPOR INTRUSION

Table 1255-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 1255-2. Vapor Intrusion Evaluation for Building 1255

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
CFC-12	100%	29 - 52	1,020	2.3
Chloroform	100%	1 - 5.3	5.2	0.33

*Screening level provided is the draft project-specific $RIASL_{12}$.

Chloroform was the only analyte with an indoor air exceedance at a single sample location. The indoor air exceedance is correlated with a sub-slab soil gas exceedance. Sub-slab soil gas and indoor air results are shown by sample location on Figure 5.3.13-3. The correlated exceedance occurred at 1255-xx-05 in the kitchen area. The indoor air result was 5.3 $\mu g/m^3$ compared to a $RIASL_{12}$ of 5.2 $\mu g/m^3$ ($TSRIASL_{12}$ is 52 $\mu g/m^3$). The sub-slab result was 1,200 $\mu g/m^3$ compared to a $RIASL_{12}$ of 170 $\mu g/m^3$ ($TSRIASL_{12}$ is 1,700 $\mu g/m^3$). It is important to note that chloroform was detected in outdoor air at 0.33 $\mu g/m^3$ and outdoor air could be contributing to the indoor air result. Furthermore, as this sample location is in the building's kitchen area, it is likely that the treated water used in the kitchen is contributing to the result. Chloroform is ubiquitous in indoor air and often found in soil gas samples. Chloroform is one of the trihalomethanes produced by chlorination of water supplies. It has long been known that chloroform and other VOCs in tap water can be emitted into indoor air (McKone, 1987). Washing machines and kitchen sinks also may be significant sources (Howard and Corsi, 1998) (Howard and Corsi, 1996).

Table 1255-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. If an analyte was identified as an AOI in sub-slab soil gas (detected results > screening level), it is excluded from the ND evaluation. Also, if an ND analyte has an 0% detection frequency for all sampling events and all ND RLs met the screening level during at least one

event, no further ND evaluation is warranted. Of the 28 analytes listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 1255-3. Non Detect Evaluation for Building 1255

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2,2-Tetrachloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1,2-Trichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,1-Dichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, All ND RLs < $TSRIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
1,2-Dichloroethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,2-Dichloropropane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,3-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dichlorobenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
1,4-Dioxane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
2-Hexanone	0% Detection Frequency, All ND RLs < $RIASL_{12}$
alpha-Chlorotoluene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Benzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromodichloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromoform	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Bromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Carbon Tetrachloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Chloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
cis-1,2-Dichloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Cumene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromochloromethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Dibromomethane	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Ethylbenzene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Naphthalene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Tetrachloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Trichloroethene	0% Detection Frequency, All ND RLs < $RIASL_{12}$
Vinyl chloride	0% Detection Frequency, All ND RLs < $RIASL_{12}$

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

Based on the indoor air results, the VI pathway at Building 1255 is an insignificant exposure pathway based on current use. However, based on a single correlated exceedance of the $RIASL_{12}$ for chloroform, Building 1255 was preliminarily identified as Group 4B, as sample results demonstrate one correlated sub-slab soil gas and indoor air $RIASL_{12}$ exceedance. Based on this preliminary grouping, as an interim response action, the building has been included for seasonal confirmation sampling and the second sampling event is scheduled for February 2019. As screened results from the second event become available, Dow will provide a high-level email summary update and will discuss during the next Corrective Action Status meeting. If a correlated sub-slab soil gas and indoor air is identified above $TSRIASL_{12}$, Dow will implement an IM.

5.3.14 Vapor Intrusion Evaluation for Building 1312

BACKGROUND

Building 1312 is a Category 5 building located within the southeastern portion of the Midland facility designated as Zone 2 (see Figure 5.3.14-1). Category 5 buildings are not typically sampled for VI due to limited to no occupancy; however, it is possible that this building may be staffed in the future. Therefore,

this gatehouse was evaluated for VI. It is known as the 17 Gatehouse and was constructed between 1982 and 1993. The 264 ft^2 single story structure is a slab-on-grade construction with no basement. The building was previously used as a gatehouse/guard shack and is no longer in operation; however, the security personnel interviewed about this building said it may be used again in the near future. The ground cover around the building consists of concrete sidewalk and asphalt. The building is heated via a space heater and there is a wall-mounted AC unit on the north side of the building. The structure has no bay doors. PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building.

DATA SUMMARY

Building 1312 was sampled in October 2017. Results indicated that seasonal confirmation sampling was not warranted for this building. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1312	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from two locations from within the building. The Indoor air samples were collected at two locations corresponding to the soil gas sample location, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.14-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.14-A and indoor and outdoor air on Table 5.3.14-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included various cleaners and insecticide (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1312. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-five of the 65 analytes were ND in each of the samples. Twenty analytes were detected in sub-slab soil gas and all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available. All sub-slab soil gas RLs were less than the sub-slab soil gas screening level.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 12 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Seven analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these seven analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 1312 is an insignificant exposure pathway based on current use. Building 1312 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.3.15 Vapor Intrusion Evaluation for Building 1314

BACKGROUND

Building 1314 is located in the southeast quadrant of the Midland facility off of South Saginaw Road within Zone 2 (see Figure 5.3.15-1). Building 1314 is the Truck Traffic Control Center (TTCC) and was constructed between 1982 and 1993 per aerial photography. The building is a slab-on-grade single story construction with no basement and no elevator. The building consists of office space, small locker rooms and a public bathroom, a conference room, and a switch room. The ground cover around the building consists of grass to the north, east and south and a combination of grass and concrete is seen to the west of the building.

The 3,358 ft^2 building is heated via electric heat. The structure is cooled via central AC and has bathroom ventilation fans along with an outside air intake located on the north side of the building. The structure has no bay doors.

Approximately 10-12 people are in the building at a given time. The occupants of this building are predominantly Dow contractors, with the exception of the operators that work in this building. The main work shift observed by the occupants of this building is from 8AM-5PM. Two operators are present at the building at night. The occupants have their uniforms cleaned via a contracted laundry service.

PID readings collected during the survey showed no detections of VOCs in the ambient air or from any drain features observed in the building.

DATA SUMMARY

Building 1314 was sampled in October 2017. Results indicated that seasonal confirmation sampling was not warranted for this building. The analytical results from each of the sampling events were compared to the June 22, 2018 MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$ and $TSRIASL_{12,}$ if available).

Building 1314	
Initial Sampling Event	**Completed**
E1	October 2017 (Fall)

Sub-slab soil gas samples were collected from three locations from within the building. The Indoor air samples were collected at three locations corresponding to the soil gas sample location, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.3.15-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.3.15-A and indoor and outdoor air on Table 5.3.15-B. The analytical data is presented in Appendix C. Field sampling forms are provided in Appendix D.

The building survey completed before the initial sampling event can be found in Appendix E. Drains and other openings were screened with a PID and no soil gas entry points were identified. A chemical inventory was completed during the building survey and the chemicals found to be stored within the building, each listed in the survey, primarily included various cleaners and WD-40 (included in Appendix E).

Based on the screened results, no indoor air analytes were detected above the $TSRIASL_{12}$ during any of the sampling events at Building 1312. Therefore, no Expedited Building Summary was necessary.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan. Forty-six of the 65 analytes were ND in each of the samples. Nineteen analytes were detected in sub-slab soil gas and all detected results were below the sub-slab soil gas draft project-specific $RIASL_{12}$ and $TSRIASL_{12}$, if available. All sub-slab soil gas ND RLs were less than the sub-slab soil gas screening level.

VAPOR INTRUSION RESULTS EVALUATION

VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. There were no exceedances of the sub-slab soil gas screening levels. For the 21 analytes detected in indoor air, all results were below the draft project-specific indoor air $RIASL_{12}$ and $TSRIASL_{12}$, if available. Fourteen analytes were detected in the outdoor air sample collected immediately upwind of the building and each of these 14 analytes were detected in indoor air, which indicates the potential for the presence of detected analytes to be attributed to outdoor air.

CONCLUSIONS AND RECOMMENDATIONS

Based on the sampling results, the VI pathway at Building 1314 is an insignificant exposure pathway based on current use. Building 1314 was placed into VI Path Forward Building Group 1 and no further VI evaluation is warranted at this time.

5.4 Zone 3

As discussed in Section 5.0, the Dow facility has approximately 700 existing buildings and structures on-site; therefore, VI at the facility is being evaluated in a phased approach during the corrective action implementation effort. Zone 3 (Figure 5-1) covers approximately 390 acres and is generally located along the northern perimeter of the facility.

As presented in the August 24, 2018 Revised Vapor Intrusion Workplan, there are 214 structures identified within Zone 3. Each one was preliminarily evaluated and categorized for a determination of further evaluation during the initial Zone 3 assessment activities. In December 2017, sampling activities were completed for Building 564 as part of a Baseline Environmental Assessment (BEA) (AECOM, January 2018) and it is located in Zone 3. In addition to Building 564, 47 other buildings were classified as Category 1 or 2 priority buildings, which were identified for sampling during the Zone 3 evaluation. Due to the quantity of priority buildings requiring sampling, it is anticipated that the sampling will be completed during at least three phases of work. In September 2018, Zone 3 Phase 1 sampling was initiated for nine buildings. In the September 20, 2018 Corrective Action status conference call between Dow and MDEQ and documented in an email to MDEQ dated September 26, 2018, Dow indicated it was reprioritizing resources to focus on VI Path Forward Group 2 and 4 buildings identified during Zone 1 and Zone 2 sampling efforts. As a result, the schedule for the Zone 3 building investigations discussed in the August 2018 Revised Vapor Intrusion Work Plan has been modified.

The sections below provide the evaluation for Building 564, as well as information for the nine Zone 3 Phase 1 buildings that were sampled in September 2018. Results from the September 2018 sampling efforts will be communicated to MDEQ during a monthly Corrective Action meeting in early 2019, unless results warrant notification and expedited reporting, as agreed upon in the September 20, 2018 conference call (see Table 5-1).

5.4.1 Preliminary Evaluation and Categorization

Table 5.4-1 lists the buildings identified in Zone 3 by building number and provides information regarding occupancy and use. There are 47 priority buildings in Zone 3 identified for further evaluation, including the completion of a building survey and future sampling activities.

Surveys for Building 564 and the nine Zone 3 Phase 1 priority buildings were conducted in December 2017 and March through May 2018, respectively. As part of the surveys, a brief kick-off meeting was conducted with primary building contacts to complete the survey questionnaire and obtained any pertinent information, such as floor plans. After this meeting, the building survey was completed which included a chemical inventory (if one was not provided) and the collection of PID readings from ambient air and any preferential pathways and drain features.

The Zone 3 Phase 1 priority building surveys are included in Appendix E and include the survey, floorplan, chemical inventory and PID readings. Figure 5.4-1 presents the Priority Buildings in Zone 3 Phase 1.

5.4.2 Zone 3 Phase 1 Buildings

Zone 3 Phase 1 priority buildings are as follows:

Category 1 Buildings:

- Building 800 – Dow Automotive/Daytona Control Room;
- Building 887 – Butadiene Sphere Lab;

- Building 954 – MI Division Chemical Distribution;
- Building 1038 – Dow Automotive; and
- Building 1131 – Methocel.

Category 2 Buildings:

- Building 100 – Dow Automotive Glass Bonding Building;
- Building 881 – Dow Automotive Equipment Storage;
- Building 1037 – Dow Automotive Beta Plant;
- Building 1042 – Maintenance Warehouse; and
- Building 564 – Saran Building.

The results of the sampling conducted in December 2017 at Building 564 is presented in Section 5.4.3 below. Following that presentation, a summary of the findings of the surveys completed for each of the Zone 3 Category 1 and 2 priority buildings that were sampled in September 2018 are presented.

5.4.3 Building 564 – Saran Building

EXPEDITED BUILDING SUMMARY

An Expedited Building Summary was submitted for Building 564 on August 24, 2018. MDEQ requested expedited reporting if an indoor air result exceeds the $TSRIASL_{12}$. Therefore, each indoor air result was compared to the $TSRIASL_{12}$ from the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels. TCE was the only analyte in indoor air detected at Building 564 greater than the $TSRIASL_{12}$.

The VI findings concluded that the TCE detected in the indoor air at Building 564 is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop and spare parts area in the northwest corner of the building involving degreasers or other products. Interim response actions are not necessary to address the detections of TCE in indoor air at Building 564; however, seasonal confirmation sampling will occur.

BACKGROUND

In December 2017, sampling activities were completed for Building 564 as part of a Baseline Environmental Assessment (BEA) (AECOM, January 2018). Building 564 is a Category 2 building located within the northern portion of the facility designated as Zone 3. It is known as the Saran Building and is approximately 121,100 ft^2 in size. The building includes manufacturing, warehouse, laboratory area, and office space (see Figure 5.4.3-1). The building survey form is attached in Appendix E.

The portion of the building containing the southern warehouse and shipping office, the main office area, locker rooms, and the final processing and packaging areas was built sometime between 1938 and 1952. The remainder of the building (additional warehouse space the shop space/lab space in the northwestern corner of the building) was built sometime between 1952 and 1958. It has slab-on-grade construction and the building is predominantly one to two stories tall but in the central part of the building, there are five stories. The office areas are on the west side of the building. There are at least five AC units with inlets that mostly pull from inside the building or on the west side of the building. The warehouse office

has an individual AC unit. The building has 26 bay doors which remain open during the summer (and for receiving shipments) and could affect ventilation rates and air mixing.

DATA SUMMARY

The results of the initial sampling event (E1) were reported in the January 2018 Baseline Environmental Assessment (BEA) and in the August 24, 2018 Expedited Building Summary.

Building 564	
Initial Sampling Event	**Completed**
E1	Dec 2017

The analytical results from the sampling event were compared to the MDEQ August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, the MDEQ draft project-specific 12-hour Soil Gas screening values and AACs (draft project-specific $RIASL_{12}$), and the Dow OELs.

Sub-slab soil gas samples were collected from 48 locations from within the building. Indoor air samples were collected at 48 locations corresponding to the soil gas sample locations, along with an outdoor air sample from the main air intake. The sampling locations are shown on Figure 5.4.3-2. Summary statistics and screening comparison results are presented for sub-slab soil gas on Table 5.4.3-A and indoor and outdoor air on Table 5.4.3-B. The analytical data is presented in Appendix C. Field sampling forms are included in Appendix D.

A survey using a portable analyzer with a PID found no detectable VOCs at various drains, offices, lunch room, warehouse, and shop area. Readings of 0.5 and 0.8 parts per million by volume (ppmv) occurred at the drains in two bathrooms within the large building.

The chemical inventory performed during the building survey identified hundreds of potential indoor emission sources. The inventory indicated that chemicals of interest are stored and/or used within the building. For example:

- Sprayon EL848 Flash Free Electrical Degreaser contains 97.5% TCE;
- Sprayon S20848 Flash Free Safety Solvent & Degreaser contains 97.5% TCE;
- 3M Super 77 Multipurpose Adhesive contains 20-30% acetone;
- Lock-Ease Lock Fluid contains 15-20% acetone & alkanes;
- CRC Chain & Wire Rope Lubricant contains various hydrocarbons;
- Sprayon S00601 Red Insulating Varnish contains ethylbenzene, MEK and methyl isobutyl ketone (MIBK);
- Sprayon EL-601 contains CFC-134 and 2-propanol;
- CRC Zinc-It Instant Cold Galvanize contains xylenes and ethylbenzene; and
- Urinal/deodorizer cakes contain 1,4-DCB.

The chemical inventory and the building survey are presented in Appendix E.

SUB-SLAB SOIL GAS RESULTS EVALUATION

Analytical results were evaluated based on methodologies presented in the 2018 Revised Vapor Intrusion Work Plan (August 24, 2018). During the initial event (December 2017), PCE and TCE in sub-slab soil gas were detected above the draft project-specific $RIASL_{12}$. The detections for PCE were also greater than the $TSRIASL_{12}$ (the $RIASL_{12}$ and $TSRIASL_{12}$ are both equal to 2,700 $\mu g/m^3$ for PCE).

The sub-slab soil gas results for the analytes that exceed the applicable screening level are summarized for each sampling event in Table 564-1.

Table 564-1. Summary of Sub-Slab Soil Gas Exceedances for Building 564

Analyte	Detection Frequency	Measured Range of Detects ($\mu g/m^3$)	% Detections > Screening Level	Screening Level* ($\mu g/m^3$)
PCE	96%	5.5 – 12,000	6%	2,700
TCE	29%	5.1 - 140	2%	130

*Screening level provided is the draft project-specific $RIASL_{12}$.

Table 564-2 summarizes the indoor air results relative to the sub-slab soil gas exceedances, since VI only potentially occurs if the analyte is present in both sub-slab soil gas and indoor air. Therefore, the table below provides the analytes detected above applicable screening levels in sub-slab soil gas as well as the corresponding indoor air sample results. The outdoor air sample results are also provided to determine if the analytes were present in indoor air due to migration from outdoor air.

Table 564-2. Vapor Intrusion Evaluation for Building 564

Analyte	Indoor Air Detection Frequency	Indoor Air Measured Range ($\mu g/m^3$)	Indoor Air Screening Level* ($\mu g/m^3$)	Outdoor Air Result ($\mu g/m^3$)
PCE	21%	0.26 - 1	82	ND
TCE	71%	0.19 - 63	4	ND

*Screening level provided is the draft project-specific $RIASL_{12}$.

Figure 5.4.3-3 shows the sub-slab soil gas and indoor air results by sample location and event for TCE. TCE was the only analyte at Building 564 with detected results above its indoor air $TSRIASL_{12}$ (12-$\mu g/m^3$). TCE exceeded the $TSRIASL_{12}$ at 3 of 48 sample locations. The three indoor air sample locations with exceedances were found in a spare parts and shop area in the northwest corner of the building. All of the TCE results in sub-slab soil gas are below the $TSRIASL_{12}$ (400 $\mu g/m^3$). The maximum detection of TCE in sub-slab soil gas at Building 564 is 140 $\mu g/m^3$. Detected concentrations of PCE in sub-slab soil gas exceed the $TSRIASL_{12}$ (2,700 $\mu g/m^3$) at three locations; however, the maximum detected concentration of PCE in indoor air is only 1 $\mu g/m^3$, which is below the $TSRIASL_{12}$ (82 $\mu g/m^3$).

There is additional evidence that indicates the presence of indoor sources not related to VI:

- The highest TCE concentrations in the indoor air occurred at locations 564-IA-31, 564-IA-36, and 564-IA-37. At these locations, there was relatively high PCE detected in the sub-slab samples. Nonetheless, there were minimal levels of PCE in the indoor air at these (and other) locations, indicating that VI at these locations is not significant. The data suggest that VI is not the main source of any TCE detected in indoor air.

- The highest TCE concentrations in the indoor air occurred in the shop and spare parts areas in the northwest corner of the building. The building survey found that TCE-containing materials are

stored in both the shop and spare parts room in the northwest corner of the building. The correlation of the TCE-containing materials and the relatively high TCE concentrations in indoor air suggest that the detected values are the result of the indoor emission sources.

The maximum indoor air result of TCE detected in Building 564 is 63 $\mu g/m^3$, which is <0.5% of the Dow IH OEL.

Table 564-3 below lists the analytes in sub-slab soil gas that have ND RLs greater than the screening levels. The table also includes the indoor air results for each of the analytes. If a sub-slab soil gas analyte has ND RL exceedances, but all results and ND RLs in indoor air are below the screening levels, no further evaluation is warranted. Of the four analytles listed below, only two (EDB and HCB) require further evaluation and will be evaluated after the seasonal confirmation sampling is complete.

Table 564-3. Non Detect Evaluation for Building 564

Soil Gas Analytes with ND RL > SL	Indoor Air Result Summary
1,1,2-Trichloroethane	0% Detection Frequency, All detects < $RIASL_{12}$
1,2,4-Trichlorobenzene	0% Detection Frequency, >44% ND RLs < $RIASL_{12}$
1,2-Dibromoethane (EDB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**
Hexachlorobutadiene (HCB)	**0% Detection Frequency, All ND RLs > $RIASL_{12}$**

Note: Analytes in **BOLD** will undergo further evaluation after seasonal confirmation sampling is complete.

CONCLUSIONS AND RECOMMENDATIONS

An Expedited Building Summary was prepared for Building 564 and submitted to the MDEQ on August 24, 2018. The Expedited Building Summary concluded that the TCE detected in the indoor air at Building 564 is due to indoor sources and not attributable to VI. The indoor air results suggest a common source, such as work within the shop and spare parts area in the northwest corner of the building involving degreasers or other products. Interim response actions are not necessary to address the detections of TCE in indoor air at Building 564; however, seasonal confirmation sampling will occur.

Building 564 was placed in VI Path Forward Building Group 4A. Group 4 is a designation for buildings that have sub-slab soil gas and indoor air AOIs and Group 4A indicates that there is a lack of correlated sample exceedances and other lines of evidence indicate that VI is insignificant and IA exceedances are likely due to routine workplace chemical use. Seasonal confirmation sampling will be implemented in 2019 to confirm results. A full evaluation will be presented in the 2019 CAIP.

5.4.4 Category 1 Buildings

5.4.4.1 Building 800 – Dow Automotive/Daytona Control Room

Building 800 was constructed in the 1970s and is located in the northwestern quadrant of the Midland facility. This building contains office space, conference rooms, bathrooms, and a control room for the Dow Automotive Glass Bonding process area in Building 100. The building is slab-on-grade construction with no elevator or basement and has a footprint of approximately 6,000 ft^2.

The building's heat is produced by steam radiation, and the air is cooled via a central AC system consisting of two chillers. There are two intakes on the building: one is located near the northwest corner of the building at ground level, and the other is located on the roof near the northwest corner. No bay doors/overhead doors exist on this structure. Occupants use the washer/dryers in Building 881 located next door to the east and also use a contracted weekly laundry service. The ground cover outside the building is predominantly asphalt.

No PID detections were observed in the ambient air or from any drain-like features in the building at the time of the survey.

5.4.4.2 Building 887 – Butadiene Sphere Lab

Building 887 was constructed in the 1970s and is located in the southwestern quadrant of the Midland facility. The building is a one-story structure of slab-on-grade construction with no basement or elevators and has a footprint of approximately 1,449 ft^2. This building contains lab space and a large switch room with a bathroom. The building is used as a lab where operators from Building 954 perform material testing.

The building's heat is produced via a small gas-powered furnace, and an AC unit is located on the roof. The building also contains some small space heaters and a lab hood. The intake for this building is located on the roof. No bay doors/overhead doors exist on this structure. The concrete flooring in the lab portion of the building is painted. The ground cover outside of the building is predominantly concrete or asphalt, with some patches of gravel located to the south, west, and east. Occupants use the washers and dryers that are available at Building 954.

No PID readings were detected in the ambient air or from drains in the building at the time of the survey.

5.4.4.3 Building 954 – MI Division Chemical Distribution

Building 954 was built in the 1970s and is located in the southwestern quadrant of the Midland facility. The building contains offices, a control room, permit writing room, kitchen/break room, locker rooms, a laundry area, and general PPE storage area (also referred to as the "old shop area"). The building is a one-story structure of slab-on-grade construction with a footprint of approximately 9,560 ft^2. No bay doors/overhead doors exist on this structure, nor does this structure have an elevator or basement.

Building 954 is heated via hot air circulation and is cooled via two AC units. The building has two air intakes; one intake is located at ground level on the west side of the building, and one is located on the roof. The locker rooms have an epoxy coating on the floor, and the permit room and old shop area have paint on the concrete floors. The immediate area surrounding the building is predominantly covered by concrete or asphalt, with the exception of some gravel to the north of the building along the railroad tracks.

PID detections from 0.1-0.4 ppm were observed in the ambient air throughout the hallway outside the control room, the ambient air in the locker rooms, the janitor's closet, the safe work permit area, and old shop area.

5.4.4.4 Building 1038 – Dow Automotive

Building 1038 was built in the 1970s and is located in the southwestern quadrant of the Midland facility. This building is primarily used for storage and is "unoccupied" according to the building contacts; however, the building appears to have some level of consistent occupancy and has office areas, a library, bathrooms, a large break area, and an old lab space being used as storage. It appears the building is used as additional work/break areas for the occupants in Building 1037, which is located next door to the east. The building is a one-story structure of slab-on-grade construction with no basement or elevator and has a footprint of approximately 3,235 ft^2.

The building is heated via steam radiation, and a central AC unit is associated with an air handler located in the southern mechanical room. The outdoor intake is located on the southern side of the building just outside of the southern mechanical room. This building has no overhead/bay doors and the surrounding outdoor ground cover is either asphalt or gravel.

No PID detections were observed in the ambient air throughout the building, and no PID readings were detected from any drain features noted at the time of the survey.

5.4.4.5 Building 1131 – Methocel

Building 1131 was constructed in the early 1980s and is located in the northeastern quadrant of the Midland facility. This building contains office space, conference rooms, locker rooms, a kitchen/break room, a control room, a safe work permit writer room, a shop/laundry area, and a product lab. The building is a one-story structure of slab-on-grade construction with no basement or elevator and has a footprint of 14,913 ft^2.

The building is heated by hot air circulation and is cooled via four AC units located around the building. Outside air intakes are associated with all four AC units, which are located on the north side of the building, the northwestern corner of the building, the southeastern corner of the building, and the south side of the building. One bay door exists on the west side of the building near the northwestern corner of the shop area and is open for roughly two thirds of the year. This bay door does allow for gas/diesel-powered vehicles and equipment to be pulled into the building. The outdoor ground cover surrounding the building is asphalt. Although washers and dryers are present in the building, some occupants use a contracted laundry service twice a week.

No PID detections were observed in the ambient air throughout the building or from any drain-like features noted at the time of the survey.

5.4.5 Category 2 Buildings

5.4.5.1 Building 100 – Dow Automotive Glass Bonding Building

Building 100 was constructed 13 years ago, is located in the northwestern quadrant of the Midland facility, and has a footprint of approximately 64,155 ft^2. This building contains office space in its southeastern corner/annex portion, a warehouse, and large process area. Roughly 38,796 ft^2 of the footprint is process area that ranges from being fully enclosed to open-air. The warehouse, office area, and a portion of the process area are slab-on-grade construction with no basements or elevators. The office portion of the structure is one-story and the warehouse structure is roughly two to three stories tall.

The warehouse is heated via steam radiation and the office area is heated by hot air circulation. The office area is cooled by a central AC system. An outside intake for the office area is located on the north side of the office annex and an intake for the warehouse is located on the roof and points northward. The warehouse portion of the structure has 16 bay doors, four of which are open frequently for shipping purposes, but are typically open for a short period of time. However, during the summer months these bay doors are left open more frequently. The surrounding ground cover outside the building consists of primarily concrete and asphalt. Propane-fueled forklifts are used in the warehouse area. Occupants either use a contracted weekly laundry service or use the washers and dryers located in Building 881.

During the survey, no PID detections were observed in the ambient air throughout the office area or warehouse, but PID detections from drains found in the janitor's closet, women's bathroom, and men's bathroom ranged from 13.2 ppm to 520.1 ppm. The higher PID readings detected from drain features are believed to be false positive readings. False positive readings on a PID may occur in the presence of excess water vapor. High humidity can cause lamp fogging and decreased sensitivity. This can be significant when moisture levels are high in the general area to be measured.

5.4.5.2 Building 881 – Dow Automotive Equipment Storage

Building 881 is located in the northwestern quadrant of the Midland facility. The northern half of the building was built in the 1970s and the southern half of the building was built in the 1990s. This building contains large locker rooms with washer/dryers used by the Dow Automotive group, two shops (one

which has an office setup), a storage area, and a server room. The entire structure has a footprint of approximately 5,391 ft^2 and is a one-story slab-on-grade construction with no elevator or basement. The shop portions of the building have a ceiling height equivalent to two stories.

The building is cooled via one central AC unit with an associated intake located on the east side of the building near the southeastern corner. The shop portions of the building are heated via steam radiation, but the locker room areas are heated via hot air circulation. There are two bay doors on this structure, which are associated with the northwestern shop/garage area. The bay doors are only open when accessing equipment or dropping off materials. The outside ground cover surrounding the building consists of asphalt and gravel. Fuel-powered equipment is frequently stored in the northwest shop/garage area. Occupants of the building do use the washer/dryers in the locker rooms, but an outside laundry service is also provided on a weekly basis.

No PID detections were observed in the ambient air throughout the building, but a PID detection of 1.2 ppm was observed from the drain located in the northwestern garage/shop area.

5.4.5.3 Building 1037 – Dow Automotive Beta Plant

Building 1037 contains a control room with a kitchen, but otherwise the remainder of the structure is predominantly warehouse or process space, with some of the process space being located outdoors. A structure has existed on this plot since pre-1938 per aerial photographs. The present structure, with a footprint of 19,396.65 ft^2 was constructed in the 1970s and is located in the southwestern quadrant of the Midland facility. The structure is slab-on-grade construction (with the grade having been built up approximately 3 ft above natural ground surface), with no basement or elevator. The floor in the building is predominantly painted concrete. The building is predominantly one-story with the exception of a small area located on the western side of the building; however, the ceiling heights throughout the majority of the structure are comparable to the height of a two-story structure.

The building has seven bay doors, many of which are open more frequently during warmer months and are open during colder months only for loading trucks and moving materials and equipment in and out of the building. The control room area located in the western portion of the building has a central AC unit, and another unit is located on the northern side of the building. The entire structure is heated via steam radiation. The building has two intakes: one is located near the southwestern corner and the other is located on the northern side of the building. There are also two large vents located on the south and east sides of the building. The surrounding ground cover outside of the building is predominantly concrete or asphalt with some gravel areas located to the south. Propane-fueled fork trucks are used in the building and occupants use a washer/dryer on site.

No PID detections were observed in the ambient air or from any drain features at the time of the survey.

5.4.5.4 Building 1042 – Maintenance Warehouse

Building 1042 was built in the 1970s and is located in the southwestern quadrant of the Midland facility. This structure, with a footprint of 5,600 ft^2, is predominantly warehouse space aligned with/used by the chemical distribution operation positioned in Building 954, but it also has two small office spaces located in the southeastern corner that are used by an insulator contractor. The building is a slab-on-grade construction with no elevator and no basement.

The only area of the building with any climate control is the office area, which has two individual AC units for cooling and electric baseboards for heating. The building has three bay doors and one railcar door, which are open when moving materials or the track mobile in and out of the building. The bay doors are large enough to allow a fuel-operated vehicle to pull in and out of the warehouse portion of the building. The outdoor ground cover surrounding the building consists of grass and gravel to the north, and asphalt and gravel to the east, south, and west.

No PID detections were observed in the ambient air throughout the building or from the drain feature observed northwest of the offices at the time of the survey. Of note, the office area is on a slightly raised floor.

5.5 Zone 3 Phase 1 Sampling Plans

The sampling plans for the nine priority buildings for Zone 3 Phase 1 that were sampled in August 2018 can be found in Appendix F. Each sampling plan indicates the footprint of each building in square feet, the proposed co-located ambient air/sub-slab soil gas sampling locations, and notes about the locations of outdoor intakes around the building. Table 5.4-2 provides a brief summary of the categorization of Zone 3 Phase 1 priority buildings, in addition to the square footage and minimum number of proposed indoor air/sub-slab soil gas sample locations. Results of the Zone 3 Phase 1 sampling effort will be presented to MDEQ in a Corrective Action meeting early in 2019 unless results indicate that notification and expedited reporting is warranted.

5.6 Zone 3 Phase 2

The 2018 Revised VI Work Plan included the sampling plans for priority buildings in Zone 3 that were initially referred to as Zone 3 Phase 1. As stated in the September 26, 2018 email to the MDEQ (see Section 5.4), only nine Zone 3 buildings were sampled in the Fall of 2018. The additional Zone 3 buildings presented in the workplan were reprioritized so that Dow could focus on additional investigations for priority buildings in Zones 1 and 2. The remainder of the buildings initially identified as Zone 3 Phase 1 will become Zone 3 Phase 2 and are tentatively scheduled to be sampled in Fall 2019. All remaining priority buildings identified in Zone 3 will be presented and investigated in future Zone 3 Phases.

Buildings	Sampled in Zone 3 Phase 1	Scheduled for Zone 3 Phase 2
Category 1 Buildings		
677		X
734		X
800	X	
887	X	
938		X
954	X	
990		X
1018		X
1038	X	
1131	X	
1385		X
439/T-1411		X
732/1300		X
759/1350		X
Category 2 Buildings		
49		X
100	X	
146		X
180		X
298		X
374		X
464		X
638		X
774		X
881	X	
1037	X	
1042	X	
1269		X
27/313/803		X
458/963		X
542/561		X
719/1360		X
564*	X	

*Sampled previously in December 2017 as part of a BEA.

6.0 On-Site Outdoor Air Pathway

This section presents an evaluation of the soil volatilization to ambient air and particulate soil inhalation pathways using the data collected to support the DC pathway evaluation.

6.1.1 Soil Volatilization to Ambient Air

The soil volatilization to ambient air exposure pathway applies to all land uses where hazardous substance vapors may emit from soils to ambient air. The outdoor air at the facility is monitored by the Ambient Air Monitoring Program (Attachment 16 of the License). Dow will continue to monitor and review ambient air as part of future corrective action efforts (Appendix G of Attachment 19 of the License).

Construction workers can potentially encounter vapors when working with subsurface soils or in a trench scenario; however, exposure is not reasonably expected to be significant since the exposure routes are managed by the required use of PPE and air monitoring specified in the Worker Exposure Control Plan, Appendix C of Attachment 19 of the License.

To evaluate this exposure pathway, results from the DC sampling for each zone were compared to the December 30, 2013 Part 201 Non-Residential Infinite Source Volatile Soil Inhalation Criteria (VSIC). The results of the screening comparison are discussed by zone below.

Zone 1

Zone 1 represents approximately 300 acres that were evaluated by soil sampling in 2016. Zone 1 encompasses sites such as the 1925 Landfill, LELs II and III, and borders the river. The Campus Area and Greenbelt Areas were also included for evaluation in Year 1 in order to expedite sampling in those areas. The following land use categories were sampled in Zone 1:

- Category 1, Laydown Areas – 11 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Historic Grass Areas – 6 DUs for Aerial Dispersion TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 3 DUs for Imported Soils TAL;
- Category 5, Stormwater Basins – 6 DUs for Imported Soils, Aerial Dispersion via Run-off TALs;
- Category 6, Vegetated Cap Closed by Dow – 9 DUs for Aerial Dispersion, Leachate Breakout, and Imported Soil TALs; and
- Category 7, Vegetated Cap Closed with DEQ or EPA Oversight – 6 DUs.

Summary statistics and screening comparisons of results to the Part 201 non-residential infinite source VSIC are presented on the following tables:

- Table 6-1 presents the Zone 1 Campus Area results;
- Table 6-2 presents the Zone 1 Greenbelt Area results;
- Table 6-3 presents the Zone 1 Category 1 results;
- Table 6-4 presents the Zone 1 Categories 2, 4, 5 and 6 results;
- Table 6-5 presents the Zone 1 MDEQ-requested DUs Category 1 results; and

- Table 6-6 presents the Zone 1 MDEQ-requested DUs Category 4, 5, 6, and 7 results.

Based on a comparison to the MDEQ 2013 non-residential infinite source VSIC, all results were less than criteria; therefore, no further evaluation is proposed at this time in Zone 1 for the soil volatilization to ambient air exposure pathway.

Zone 2

Zone 2 covers approximately 280 total acres and encompasses an area in the east (approximately 245 acres) and a small area in the west of the facility (approximately 35 acres). The following land use categories were sampled in Zone 2:

- Category 1, Laydown Areas and Gravel Areas (Historical Process Area) – 54 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Historic Grass Areas – 16 DUs for Aerial Dispersion TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 6 DUs for Imported Soils TAL; and
- Category 5, Stormwater Basins – 19 DUs for Imported Soils, Aerial Dispersion via Run-off TALs.

In addition, approximately 8.3 acres of the railroad property adjacent to proposed IMs for the Zone 2 Laydown Yard were evaluated by soil sampling in December 2017. The following land use category was sampled in Zone 2:

- Category 1, Railroad DUs Adjacent to Laydown Areas – 8 DUs for Aerial Dispersion Point Source Release and Historic Area Operations TALs.

Summary statistics and screening comparisons of results to the Part 201 non-residential infinite source VSIC are presented on the following tables:

- Table 6-7 presents the Zone 2 Category 1 results;
- Table 6-8 presents the Zone 2 Categories 2, 4, and 5 results; and
- Table 6-9 presents the Zone 2 Category 1 Railroad results.

Based on a comparison to the MDEQ 2013 non-residential infinite source VSIC, all results were less than criteria; therefore, no further evaluation is proposed at this time in Zone 2 for the soil volatilization to ambient air exposure pathway.

Zone 3

Zone 3 encompasses approximately 284 total acres of the site. Further discussion of Zone 3 is presented in Section 4.0. The following areas were included for sampling across the on-site area of Zone 3.

- Category 1, Laydown Areas and Gravel Areas (Historical Process Area) – 33 DUs for Aerial Dispersion and Other Sources TALs;
- Category 2, Historic Grass Areas – 19 DUs for Aerial Dispersion TAL;
- Category 4, Relocated Soils covered with Imported Top Soil – 8 DUs for Imported Soils TAL; and
- Category 5, Stormwater Basins – 70 DUs for Imported Soils, Aerial Dispersion via Run-off TALs.

Summary statistics and screening comparisons of results to the Part 201 non-residential infinite source VSIC are presented on the following tables:

- Table 6-10 presents the Zone 3 Category 1 results; and
- Table 6-11 presents the Zone 3 Categories 2, 4, and 5 results.

Based on this evaluation, all non-dioxin results were less than criteria; therefore, no further evaluation is proposed at this time in Zone 3 for the soil volatilization to ambient air exposure pathway.

6.1.2 Particulate Soil Inhalation

The particulate soil inhalation exposure pathway addresses the emission and dispersion of contaminated soil particles into the ambient air (inhalation of fugitive dust particles). Exhaust constituents from process vents, power generation, and thermal incineration processes may have deposited onto plant soils. During dry periods, these soils may have been disturbed by equipment or vehicles and blown by the wind, resulting in fugitive dust emissions.

Fugitive dust control has been in progress at the Midland Plant since 1986. Dow is currently required by the 2015 Operating License and its Renewable Operating Permit (Section 1, IX.5) to provide and regularly update an operating program to control fugitive dust sources or emissions. The current fugitive dust control program requires semi-annual review and updates. In addition, fugitive dust emissions from the facility are monitored for dioxin emissions on an ongoing basis along the plant perimeter pursuant to the "Soil Box Data Evaluation Plan," approved by MDEQ on September 25, 2015. Monitoring began in 2002 and continues to show the fugitive dust control program for the facility is effective.

In order to limit the generation of fugitive dust and particulates, Dow has placed surface cover on surface soil in certain areas of the facility. The covers include clean top soil and vegetation, gravel, and/or asphalt. Existing covers are managed and maintained. Based on current conditions, this pathway is likely to be adequately controlled.

To evaluate this exposure pathway, non-dioxin and 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD) results from the DC sampling for each zone were compared to the December 30, 2013 Part 201 Non-Residential Particulate Soil Inhalation Criteria. The non-dioxin summary statistics and screening comparison are presented on the following tables:

- Table 6-1 presents the Zone 1 Campus Area results;
- Table 6-2 presents the Zone 1 Greenbelt Area results;
- Table 6-3 presents the Zone 1 Category 1 results;
- Table 6-4 presents the Zone 1 Categories 2, 4, 5 and 6 results;
- Table 6-5 presents the Zone 1 MDEQ-requested DUs Category 1 results;
- Table 6-6 presents the Zone 1 MDEQ-requested DUs Categories 4, 5, 6, and 7 results;
- Table 6-7 presents the Zone 2 Category 1 results;
- Table 6-8 presents the Zone 2 Categories 2, 4, and 5 results;
- Table 6-9 presents the Zone 2 Category 1 Railroad results;

- Table 6-10 presents the Zone 3 Category 1 results; and
- Table 6-11 presents the Zone 3 Categories 2, 4, and 5 results.

The 2,3,7,8-TCDD summary statistics and screening comparisons are presented on the following tables:

- Table 6-12 presents Zone 1 results;
- Table 6-13 presents Zone 2 results; and
- Table 6-14 presents Zone 3 results.

As shown in the tables listed above, all results for non-dioxins and 2,3,7,8-TCDD are below the non-residential particulate soil inhalation criteria. Therefore, no further evaluation is proposed at this time in Zones 1, 2 or 3 to address the particulate soil inhalation exposure pathway.

6.1.3 Conclusions and Recommendations

A comparison to MDEQ 2013 Part 201 non-residential Infinite Source VSIC and Particulate Soil Inhalation criteria demonstrated that no further evaluation is warranted at this time for Zones 1, 2 and 3. Dow will perform this evaluation on Zone 4 data in the *2019 Annual Corrective Action Implementation Summary Report and 2020 Work Plan* (2019 CAIP). In addition, Dow will maintain current ambient air and fugitive dust monitoring programs until further evaluation is completed and it is determined that further action is warranted.

7.0 Sludge Dewatering Facility

The SDF is a closed land-based disposal located on the corner of Saginaw Road and Salzburg Road in Midland County. It was used in the 1970's and 1980's for dewatering and disposal of wastewater treatment sludge generated at Dow's Midland Plant site. The unit is currently maintained under the Post-Closure Plan (modified 2015) and routine sampling is currently conducted in accordance with Condition II.K. and IX.A.1. of the Act 451 Part 111 Operating License (Operating License) issued to The Dow Chemical Company, Michigan Division, effective September 25, 2015.

7.1.1 Overview of Site Characterization and Interim Measures

As detailed in the Environmental Monitoring Program Sampling and Analysis Plan (SAP) for the Operating License, samples and field parameters are obtained from the SDF Groundwater Detection monitoring wells on a quarterly basis. Samples and field parameters are obtained from Perimeter Wells every four years, or in response to Hydraulic Monitoring Performance Criteria not being met (Figure 7-1). SWLs are collected from SDF wells on a quarterly basis.

The *2015 Operation and Maintenance Inspection Report for the Sludge Dewatering Facility (SDF)* (Inspection Report) conducted by the MDEQ noted an outward gradient identified at Cell 1. This report also noted that water levels in the internal piezometer (6143) within Cell 1 and external well 3775 appeared to be tracking. As an immediate action in response to the noted outward gradient in Cell 1, Perimeter Monitoring Well 3916 was added to 2016 quarterly sampling events and will continue as such until determined otherwise. In further response to the conditions of concern noted in the MDEQ Inspection Report, Dow submitted a *Response to 2015 Operation and Maintenance Inspection Report*, dated November 19, 2015.

Dow then initiated a drilling and hydraulic profiling tool (HPT) investigation at Cell 1 and Cell 7 on July 12, 2016. HPT borings were conducted along the north and west perimeter of Cell 1 (SDF-1 through SDF-7; and SDF-15 through 19). An additional two locations were pushed within the central area of Cell 1 (SDF-8 and SDF-9), including one adjacent to the existing internal piezometer (6143). Another three locations were advanced outside Cell 1 along the northeastern perimeter (SDF-11, SDF-12, and SDF-13) and one other near the center of Cell 7 (SDF-10) (Figure 7-2). Fisher Contracting cut the existing 30-mL HDPE liner to facilitate the borings. NAL Services, Inc. completed the repairs to the liner by extrusion welding the full perimeter of an HDPE patch to the existing liner at each boring location, and each weld was vacuum box tested and visually inspected. The repairs were certified by a Registered Professional Engineer in the State of Michigan and the certification was submitted to the MDEQ in October 2016.

Single well pump tests were completed at both Cell 1 and Cell 7 in September 2016. The pump tests were conducted at the existing internal piezometer locations in both cells. Evaluations of the data collected in 2016 were then completed in 2017.

7.1.2 Work in 2018

Based on the data evaluations performed in 2017, the planned priority actions for SDF during 2018 included the installation of an approximately 100-ft long section of permeable backfill and perforated collection tile that would be tied into the existing manhole within Cell 1. The demonstration-scale system is intended to be monitored for drawdown and will then be used to design a full-scale implementation for Cell 1 to reduce the head inside the cell to an elevation below that of the external piezometers.

A CSM of Cell 1 was completed and site characteristics were entered into MODFLOW to run simulations to demonstrate the effectiveness of the proposed pilot (Figure 7-3). The model was calibrated and by validating simulated groundwater heads compared to site measured groundwater levels and site gradients; comparing calculated versus observed heads, and completing a water balance model showing water in and water out (Figures 7-4 through 7-6). The model demonstrated that the pilot project at Cell 1

should produce the desired result by generating the required drawdown and controlling the gradient (Figure 7-7).

Because the demonstration scale dewatering system within Cell 1 would necessarily disturb the final cover at the closed SDF in Cell 1, Dow submitted a request to the MDEQ to review a liner repair plan to facilitate installation of the demonstration scale dewatering system for Cell 1 at the SDF on December 19, 2017. DEQ staff provided comments on February 28, 2018, and the plans were discussed during a meeting in Lansing on March 1, 2018. Additional information was then prepared and submitted in a correspondence dated July 13, 2018.

The pilot tile installation and liner repair was completed in late October 2018. The monitoring well installation is currently scheduled for early 2019 in accordance with the milestone schedule provided in Section 15.0.

7.1.3 Path Forward

Once the monitoring wells are completed, Dow anticipates an evaluation period of approximately six months. If the monitoring data proves that the demonstration-scale system is effective preliminary design for Cell 1 will be completed during 2019 with construction anticipated in 2020, after agency approval of design plans. If the system is determined to not be effective, alternative designs will need to be considered and evaluated.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

8.0 7th Street Purge Wells Area (Fuel Oil Tank Farm)

The former fuel tank farm AOC, known as 7th Street Purge Wells AOC, is located in an upland area on the west bank of the Tittabawassee River, approximately 520 ft upstream of the Dow Dam. Historically, two above-ground fuel oil storage tanks were located in the area. The tanks provided fuel oil to a backup boiler located in Building 879. Historic release(s) from the operation of this above-ground storage tank system and associated piping have impacted the soil and groundwater. The area has been extensively backfilled with ash, sand, gravel, bricks, crushed concrete, asphalt, coal, and various other man-made materials. The shallow perched groundwater exhibits an easterly hydraulic gradient towards the Tittabawassee River. Thin silts and clays underlie the fill material. The silts and clays form a thin aquitard over the large sand inclusion in the till that is in hydraulic communication with the Tittabawassee River channel. Work has been focused on managing both the shallow perched groundwater as well as the deeper groundwater hydraulic zones.

8.1 Overview of Site Characterization and Interim Measures

The 7th Street Purge Well Area is located in Sections 21 of T14N, R2E, within the City of Midland, Midland County, Michigan. The area is east of Poseyville Road, along the western bank of the Tittabawassee River, just upstream of The Dow Dam at the Dow Michigan Operations Plant. The location is identified on Figure 8-1. The 7th Street Purge Well Area is currently an industrial area including paved and gravel roadways, a service water pump house, and above ground utility truss supporting utilities which cross the Tittabawassee River via either of two bridges spanning the River at the eastern extent of the study area (Figure 8-2). Groundwater pumping wells (purge wells) are operated in the area as stipulated by RCRA License operating conditions. Along the eastern margin of the study area, the Tittabawassee River flows from north to south at levels generally around 597 ft NAVD 29. A service water intake basin was constructed along the west portion of the Tittabawassee River within the study area, partially separated from the main flow channel by a steel sheet pile wall.

8.1.1 Hydrology

The Tittabawassee River runs along the eastern edge of the study area. It has a drainage area of 2,400 square miles. The river has an average discharge of 1,750 cubic feet per second (cfs) (average of 1936 to 2011), with the peak streamflow of 38,700 cfs measured in 1986, at a gauge height of 33.89. The National Weather Service has established 'flood stage' at a gauge height of 24 ft (measured at the United States Geological Survey (USGS) gauging station, roughly 1,000 ft downstream of the study area). The National Weather Service has also established a 'moderate flood stage' at a gauge height of 25 ft. Immediately downstream of the study area, the Dow Dam maintains the river level above the spillway elevation of 596.4 ft, to facilitate intake pumping for fire protection at the site.

During April and May of 2013, prolonged rains resulted in a peak discharge on April 20 of 25,900 cfs at a gauge height of 28.34. During this high water event, the water level stayed above the 'moderate flood stage' for eight days. Continued rainfall during May resulted in a second high water event on May 30 of 16,700 cfs at a gauge height of 23.61 ft (just below flood stage).

Groundwater in the study area is generally present in two strata, the surface sands (generally miscellaneous fills from 0-18 ft in the study area, generally referred to as the shallow perched groundwater) and the deep sand area. Previous study (URS Corporation, 2007) of the shallow groundwater concluded that the shallow perched groundwater is flowing easterly toward the Tittabawassee River at an approximate hydraulic gradient of 0.03 feet per foot (ft/ft). The perched groundwater flow is restricted and/or retarded along the bank by the presence of silts and clays present adjacent to the river. Although the sediments in this immediate area have a relatively low hydraulic conductivity, a hydraulic connection to the Tittabawassee River is present.

Previous studies (McDowell and Associates, 1986 and Radian International, 2000) of the deep sand area have concluded that a hydraulic connection between the groundwater in the deeper sand till and the Tittabawassee River exists. The geometric mean of hydraulic conductivity utilized in this portion of the deep sand is 9.11×10^{-3} centimeters per second (cm/sec) (25.82 feet per day [ft/day]) (Revetment Groundwater Interception System Hydraulic Loading and Flow Study, 1996). This value was determined by various aquifer test analyses of wells 2925, 2927, 2930, 2931, 3141, 4175, 3863, 3308, 4174, 3305, 3304, 3688, 3289, 3689, and 3690. The potentiometric gradient measured between 3141 and 3549A (located 578.3 ft apart) on February 25, 2002 was 0.0043 ft/ft (Michigan Operations Shallow Groundwater Elevation Contours for the First Quarter 2002; EPA Facility ID Number MID 000 724 724, submitted March 13, 2002). The assumed porosity for the deep sand in the area is 20%, which is reasonable for a glacial till sand. Applying the above values to Darcy's equation for groundwater velocity yields an estimated groundwater velocity potential at this portion of the deep sand of 0.553 ft/day from 3141, adjacent to Poseyville Road eastward to the 7th Street Purge Well Area.

8.1.2 Shallow Zone Interim Measures

An IRA Work Plan was submitted December 13, 2005, and a Completion Summary Report provided September 28, 2007. The IRA investigation included the installation of a number of groundwater monitoring wells in the shallow zone (see Figure 8-3). Groundwater sampling identified chromium, lead, and various volatile organic hydrocarbons including naphthalene. The highest groundwater concentrations of the COCs were detected in MW-4 and MW-7. The groundwater concentrations in MW-4 and MW-7 occasionally exceeded the GSI criteria.

Measureable free product was identified in monitoring wells MW-9, MW-10, MW-11, and MW-13. An intermittent heavy sheen of free product has been noted in MW-7. The free product is dark brown to black in color and highly viscous (e.g., not mobile). Analytical data confirms the oil is viscous and lighter than water. A map indicating the estimated extent of the area impacted by free product is attached as Figure 8-4.

The silt and clay aquitard undulates across the site, is generally at a higher elevation along the riverbank and is restricting or retarding the movement of groundwater towards the river. The aquitard is present at the highest level along the riverbank near MW-17 and MW-18 and lowest along the riverbank near MW-1 and MW-6.

During routine monitoring, seven compounds were detected at concentrations above their GSI Cleanup criterion, following the April 2, 2013 sampling of corrective action wells MW-15S, MW-14S, MW-18, and MW-17. The MDEQ was verbally notified on June 10, 2013, and the wells were re-sampled on June 13 and 17, 2013. Detected concentrations of 1,2,4-trimethylbenzene, ethylbenzene, and naphthalene were confirmed to be at concentrations exceeding their GSI Cleanup Criterion. 1,2,4-Trimethylbenzene was identified in one sample at concentrations that also exceed the Michigan Rule 57 Final Acute Value. MDEQ was notified of the confirmation on July 8, 2013.

In response to the chemical detections in the corrective action monitoring wells that exceeded generic MDEQ Cleanup Criterion, an IRA Work Plan was submitted August 2, 2013, summarizing the IMs that included targeted removal of ‘source’ material in the area. The interim response was designed in order to improve the groundwater quality sufficiently enough that generic Cleanup Criterion will not be exceeded. During the fall of 2013, soil was excavated to the top of the aquitard and impacted soil was removed from the area. Approximately 5,000 cubic yards of ‘source’ material was removed (Figure 8-5). The area was backfilled with excess soils re-located from other areas on-site. Immediately following the source removal detections of arsenic, 1,2,4-trimethylbenzene, ethylbenzene, isopropylbenzene, o-xylene, naphthalene, and cyanide were detected above the generic GSI cleanup criteria, but were either not confirmed in follow-up sampling or the wells were dry.

8.1.3 Deep Zone Interim Measures

Dow conducted additional IMs during 2013 and 2014 in the 7th Street Purge Well Area to improve the performance of hydraulic controls during extended flood events similar to those observed during the spring of 2013. Included in the IRA was the installation of a 365-ft long section of 8-inch diameter stainless steel screen horizontal well that was installed at an approximate elevation of 583 ft and a centralized lift station (LS #121). The new horizontal well has a demonstrated capability to greatly out-perform the vertical wells in the area, effectively making them obsolete. As outlined in the IRA for the 7th Street Purge Well Area, submitted August 2, 2013 and the Horizontal Well Design for the 7th Street Purge Well Area, submitted April 15, 2014, the horizontal well installed during 2014 was intended to replace the existing Purge Wells #5, #6 and #7 (Figure 8-6); and Dow reviewed their initial plans to do so with MDEQ during a meeting on October 11, 2016.

8.2 Shallow Zone Current Status

Existing shallow monitoring wells 14S, 15S, 17, and 18 routinely dry or they go dry during sample collection except when seasonally induced higher water levels (snow melt, rain, etc.) exist, which presents a significant challenge to routinely and effectively evaluate the shallow groundwater against Performance Criteria. Historically, groundwater samples collected from MW-18 in second quarter have exceeded the Michigan Part 201 GSI cleanup criteria for VOCs, SVOCs and occasionally metals.

In the second Quarter of 2017, a sample was obtained from MW-18 and 1,2,4-trimethylbenzene, ethylbenzene, o-xylene, naphthalene, and m,p-xylene was detected (with results of 74 micrograms per Liter (μg/L), 220 μg/L, 22 μg/L, 43 μg/L, and 44 μg/L, respectively) above the performance criterion for each of these analytes. Per the requirements of the SAP, MW-18 was then resampled in quadruplicate on August 2, 2018 and the results confirmed the VOC exceedances.

Water was again observed in MW-18 during the Q3 2018 chemical monitoring sampling event completed on August 28, 2018. The results reported that arsenic, and additional organic constituents in the sample collected at MW-18 did not meet Performance Criteria established in Table 2-F of the SAP (Table 8-1).

Table 8-1. Constituents Detected Above Performance Criteria in MW-18 in 3rd Quarter 2018

Analyte	Result (μg/L)	Criteria (μg/L)
1,2,4-Trimethylbenzene	310	17
1,3,5-Trimethylbenzene	51	45
Ethylbenzene	510	18
Isopropylbenzene	83	28
o-Xylene	500	41
2-Methylnapthalene	31	19
Naphthalene	380	11
m,p-xylene	260	41
Arsenic	36.7	10

MDEQ was notified of the Q2 exceedances in a letter sent to MDEQ on September 7, 2018 and of the other GSI exceedances via a phone call on September 24, 2018 followed by a confirmation email sent the same day. Per the requirements of the SAP, MW-18 was resampled in quadruplicate on October 3, 2018 and the results confirmed the exceedances.

8.3 2018 Purge Well Shutdown Pilot

Pursuant to the Midland Plant SAP, Table 2-F, performance monitoring is performed by measuring water levels in 10 piezometers on a monthly basis, developing a groundwater contour map and determining if groundwater at the site is being captured by the purge wells (preventing upland groundwater from flowing to the Tittabawassee River), within seven calendar days. As detailed in the 2017 CAIP, Dow planned to cease pumping wells PW-5, PW-6, and PW-7 beginning in 2018. During the initial shutdown of the wells, water levels were to be taken from the piezometers listed in Table 2-F of the SAP on a daily basis for a period of one week. Provided performance criteria were still met, routine monthly monitoring would resume, and PW-5, PW-6, and PW-7 will be properly abandoned.

On June 18, 2018, the pilot shutdown of PW-5, PW-6, and PW-7 began. Water levels were gauged from the piezometers listed in Table 2-F of the SAP on at least a daily basis for a period of seven days, with the exception of two weekend days, June 23 and 24, 2018. For the three days following the initial shutdown, the water levels in the piezometers were measured twice a day to ensure no problems were occurring. The frequency of the gauging decreased to once a day on June 22, 2018, and all the wells were gauged one additional time the following Monday, June 25, 2018.

Transducers that were placed in three of the piezometers listed in Table 2-F (6170, 4183, and 4181) captured data over the weekend (June 23 and 24, 2018). Included as attachments are the groundwater contour maps for each gauging event (Figures 8-7 through 8-15), a table containing the groundwater elevations and river level elevation for each gauging event (Table 8-2), and hydrographs of the data collected from the three transducers from the time of shutdown through June 25, 2018 in comparison to the river levels (Figures 8-16 through 8-18).

The water levels observed during the pilot shutdown indicate a gradient toward the horizontal well; therefore the hydraulic control was maintained during the shutdown and the performance criteria outlined in the SAP was still met when purge wells PW-5, PW-6, and PW-7 were not in operation. DEQ was updated on the status of the pilot periodically through the trial, at the June monthly status meeting, and subsequent to its completion provided data and a summary on August 31, 2018.

The purge wells remain shut down and routine monthly monitoring has continued. Pursuant to Condition IX.B.1.(g).(i) PW-5, PW-6, and PW-7 will be properly plugged and abandoned. It is anticipated that this will occur in early 2019 (in accordance with the schedule provided in Section 15.0) and as a result these wells will no longer be included in the annual sampling event of purge wells in the 7th Street Purge Well Area. This plan was previously approved in the 2017 CAIP; however, a minor modification request letter will be submitted to DEQ prior to the abandonment in order to modify the SAP.

8.4 Path Forward

As discussed in the previous section, for the deep zone purge wells, work in 2019 focus on the completion of the minor modification request to the SAP to remove purge wells PW-5, PW-6, and PW-7 from the 7th Street Chemical Monitoring Program and the subsequent abandonment of these wells. The wells be abandoned consistent with the procedures outlined in Appendix K of Attachment 15 of the Operating License.

For the shallow zone criteria exceedances at MW-18, pursuant with Condition IX.B.2.(c).(iii) and (iv) of the Operating License, the following work plan has been developed. This work planned for 2019 is in support of the development of more complete CSM in order to design an effective remedial strategy to address the GSI exceedances found in MW-18. Dow plans to perform the following work in 2019 and 2020:

- Historical Boring Logs Review and Cross Section Development - Historic boring logs in the 7th Street Purge Well Area and in the Tittabawassee River will be reviewed. Dow will generate cross sections using the historical and current lithology data across the 7th Street Purge Well Area.

- Historical Aerial Photograph and Drawing Review - Dow will review historical aerial photographs going back as far as 1938 to gather insight on historical activities in the 7th Street Purge Well Area. Dow will also search records for historical drawings of the area. The location of former bulk tanks, dispensing facilities, and power houses will be determined.

- Groundwater and Surface Water Date Review - Dow will gather and plot groundwater and surface water elevation data from the 7th Street Purge Well Area. The plots will be utilized to observe the interaction between the Tittabawassee River and the shallow groundwater found in MW-18 and the deep groundwater in the glacial till sands in the 7th Street Purge Well Area.

- Soil and Groundwater Analytical Data Review - Dow will review the soil and groundwater analytical data available in the 7th Street Purge Well Area.

- Data Gap Analysis - After completing the data review and analysis of the currently available data, Dow will identify additional data that could be beneficial to completing a CSM. Dow will then gather the additional data needed to strengthen and complete the CSM.

- GSI Compliance Point Determination - After completing the CSM and filling in the data gaps, Dow will determine the point where the groundwater and surface water mix adjacent to MW-18. Dow will them propose an appropriate GSI compliance monitoring point.

- Once the CSM has been created and a GSI compliance point has been determined, Dow will develop a remediation plan to address the groundwater GSI exceedance found in MW-18. It is anticipated that this will occur in early 2020.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

9.0 Poseyville Landfill

PLF is within the contiguous property boundary of Dow, located west of the Dow industrial complex and southwest of the City of Midland in Midland Township (Figure 9-1). The landfill is bordered on the east by the Dow complex, and by Dow property to the north. The landfill was operated as a municipal landfill by the City of Midland, beginning in 1940. Dow purchased the landfill and began operations in 1955. Landfill operations were discontinued on January 5, 1981 (The Dow Chemical Company, 1989).

9.1 Overview of Site Characterization and Interim Measures

A draft compliance and final closure schedule for PLF, was submitted to Michigan Department of Natural Resources **(**MDNR) by Dow on August 18, 1981. The proposed schedule for closure included details regarding the installation of additional monitoring wells to be sampled and analyzed for specific parameters. Dow also committed to defining the hydrogeological conditions in the northeast corner of the site including the flow direction, aquifer thickness, and water quality. In addition, Dow committed to further defining the flow direction in the upper aquifer in the southeast corner of the site, which included a groundwater contour map for the eastern portion of the landfill.

Dow was issued a hazardous and solid waste amendment (HSWA) permit on October 12, 1988, and has since been involved in the required submittal of corrective action requirements including closure packages and Corrective Action Monitoring Plans for the SWMUs. Dow was required to submit a RCRA Facility Investigation (RFI) Phase I Environmental Monitoring Report (Phase I) for the PLF SWMU within 365 days of the effective date of the permit. This report was submitted October 12, 1989 and details past monitoring requirements, an apparent leakage in the northeast corner of the facility, and corrective action measures taken.

In 1996, Dow submitted the final two sections of the PLF RFI Phase II Release Assessment (Phase II). The report focused on chemical and hydraulic monitoring data of the isolated plume on the northeast corner of the facility, and analysis of the chemical data from groundwater within the plume to evaluate the possibility of a continuing release from the landfill. The data was evaluated in order to provide a comprehensive hydraulic picture of the effectiveness of the purge wells employed to contain and remediate the groundwater in the plume.

Routine sampling at PLF is currently conducted in accordance with the Operating License SAP. Hydraulic information, as well as groundwater and leachate samples are collected and analyzed. Samples are regularly collected for Leak Detection Chemical Monitoring, Corrective Action Chemical Monitoring, and Corrective Action Hydraulic Monitoring. Four purge wells in the northeast corner of the landfill (2690A, 2917, 2960, and 2961), were installed to mitigate the plume in the northeast corner, are part of the Corrective Action Chemical Monitoring program, and are sampled quarterly for benzene, chlorobenzene, chloroform, and ethylbenzene.

The four purge wells are screened at the base of the Eastern Till Sand Body, which lies beneath the northeast corner of the PLF and extends beyond the landfill boundaries (Figure 9-2). A slurry wall, keyed into clay till beneath the Till Sand, is present to isolate that portion of the Till Sand present beneath the landfill. The well pumps are controlled by water level probes in the well casings in order to maintain a consistent drawdown profile into the well. The volume of water pumped from each of the four purge wells is recorded.

Hydraulic monitoring is conducted for the Eastern Till Sand outside of the landfill perimeter slurry wall using an array of piezometers as shown in Figure 9-1. The hydraulic monitoring is utilized to observe groundwater drawdown into the four purge wells, and ensure that existing contaminants do not migrate away from the landfill perimeter.

9.2 Northeast Corner

In 2016, Dow contracted with EarthCon Consultants, Inc. (EarthCon) to perform groundwater plume analytical services to further assess the groundwater plume in the northeast corner of the PLF. EarthCon initially performed the plume analytics to help provide a better understanding of the overall behavior of the plume dynamics by conducting a stability analysis looking at the center of the mass over time, the areal extent of the plume, and the overall spatial difference of the plume from 1995 to August 2016.

EarthCon found that in the earlier period of the analysis, the dissolved plume in the northeast corner was centered near well 2917 and extended to the east near purge well 2961 and west near purge well 2960. Sustained pumping from peripheral purge wells 2960 and 2961 appears to have resulted in cleanup of the dissolved plume in the eastern and western portions by about 2010 and until the end of the period of analysis (Figure 9-3). Also during this period, the dissolved plume exhibited patterns of continued attenuation in the eastern portions of the plume area, including the vicinity of 2917.

The evaluation also demonstrates that:

1. The release of constituents was likely not a one-time release. It appears that there may be an on-going sourcing of constituents into the study area. However, with the recent pumping regime at the site and the recent site data, it appears that the plume was at or near a point of hydrodynamic equilibrium (e.g., the rate of pumping is such that the plume is stable).

2. The data analyses suggests that there is an apparent dynamic between purge wells 2690A and 2917, whereby the plume behaves differently depending on the ratio of flow rates between these two wells. For example, based on observation of site data from 1995 through 2016, plume attenuation rates were better when the flow rate from 2960A far exceeded the flow rate from 2917 and were sub-optimal when flow rates from 2917 exceeded those from 2690A.

3. Purge wells 2960 and 2691 have exhibited generally ND or below maximum contaminant level (MCL) concentrations. Their continued pumping appears to be serving to expand (or retard the collapse of) the present dissolved plume.

Based on evaluation and other analysis conducted in 2016, priority actions planned for 2017, included the following:

1. Development of a Pilot Purge Well Optimization Study - Since purge wells 2960 and 2961 exhibited generally ND or below MCL concentrations, and their continued pumping may be serving to expand (or retard the collapse of) the present dissolved plume. Work for 2017 included the development of a pilot optimization study to include a trial period during of one to two years, depending on observable trends, during which wells 2960 and 2961 would be shut down and pump rates of the remaining two purge wells would be optimized.
2. Investigation of Continued Potential Sourcing of Plume Area – The 2016 evaluations suggest the continued release of COCs in the northeast corner of the landfill. Additional investigation into the sourcing occurring in the northeast corner was planned and was anticipated to include direct push drilling and membrane interface probe **(**MIP) around the perimeter of the slurry wall and additional environmental samples collected for laboratory analysis to confirm the nature and extent of the modeled plume.

9.2.1 Purge Well Optimization Pilot

In March 2017, details of the Purge Well Optimization pilot study were shared with MDEQ at the regular monthly coordination meeting. The implementation of the optimization study began November 13, 2017 by shutting off the pumps at 2960 and 2961. Purge wells 2690A and 2917 were inspected and

refurbished in late 2017 so that flow rates for these two wells could be easily modified as needed throughout the pilot.

While the 2690A/2917 flow ratio is expected to be modified over time depending on plume behavior and resulting trends, it is the intent that the rate of 2917 be kept well below 2690A so as not to “pull” the plume from 2690A toward 2917. Optimal conditions in the past were observed when 2917 pumped much less than 2690A, approximately one fourth to one fifth of the 2690A flow rate; and were sub-optimal when flow rates from 2917 exceeded those from 2960A. The purge wells will continue to be monitored and sampled in accordance with the SAP throughout the pilot.

Although the purge wells had been refurbished in late 2017 so that the desired flow rates could be achieved, attempts to modify the pump settings to achieve the desired rates throughout early 2018 were unsuccessful (Table 9-1). Additionally, in Q1 2018, 2917 was pumping at a rate higher than 2690A (Figure 9-4). Due to the low pump rates and a reverse in the primary and secondary pump rates, the plume began to spread to the east and southeast.

By Q2 2018, the 2917 rate dropped below that of 2690A; however, it was still pumping at approximately 90% of the rate of 2690A (Figure 9-5). In the Q3 2018, the pump at 2917 failed and needed to be replaced. This quarter the pump rate of 2690A was significant higher than that of 2917 (Figure 9-6).

Due to the inadequate pump performance, the wells were re-inspected in June 2018. A downhole camera was utilized to inspect the screen and integrity of casing. The inspection found that both screens and casings appeared to be in good condition and the columns were clear; however both wells showed considerable precipitation and/or microbial growth which appeared to be effectively clogging the both screens. As such, redevelopment was planned for both locations.

Wells 2690A and 2917 were redeveloped in late October through early November 2018. Since redevelopment the pump rates have increased substantially with the rate at 2690A increasing about 5.3 gallons per minute (gpm) and 2917 increasing approximately 0.9 gpm from pre-development settings (Table 9-1). Post redevelopment, the pump in well 2690A is again able to serve as the primary with an average pump rate of approximately 7.33 gpm with a rate of 2.82 gpm at 2917.

9.2.2 Slurry Wall Investigation

As reported in the 2017 CAIP, a total of 27 borings were advanced throughout the northeast corner of the PLF during the 2017 membrane hydraulic profiling tool (MiHPT) Investigation (Figure 9-7). The MiHPT investigation was also supplemented through the collection of groundwater samples at existing piezometers, monitoring wells, and purge wells as well as grab water samples collected at MiHPT locations to assist in the interpretation of results and confirm specific analyte concentrations. Based upon the MiHPT boring responses and the confirmatory water quality data, the apparent breach in the slurry wall was identified between MiHPT boring locations PLF-14 and PLF-16, centered approximately on MiHPT boring PLF-15 (Figure 9-8). Impacts were observed to extend to the north of the slurry wall.

The executed groundwater sampling portion of the investigation was generally consistent with the findings of the MiHPT boring program. Specifically, four primary constituents of interest (COIs) are migrating out of the landfill in the vicinity of existing well PLFT-3 and that the downgradient migration of the COIs appears to be controlled by the operation of the purge wells (Figure 9-9).

9.3 PLF Leachate Collection System Upgrades

During 2018, upgrades to the PLF leachate collection system began. For 2018, the planned upgrades included the the southside of the tile from Lift Station #203 to MH203L (Figure 9-10). Work began in October 2018 and by December 2018, the 2,300 ft of tile and manholes along the southern perimeter of the landfill were upgraded. Approximately 1,200 ft of this length has been completed with geosynthetic

clay liner and backfilled. In early 2019, work on the remaining 1,100 ft will be completed with geosynthetic clay liner and backfilled.

Additional upgrades to the leachate collection system are planned for 2019 and 2020. Planned upgrades for 2019 include the northern perimeter section of the tile system.

9.4 Path Forward

In order to continue progress in the northeast corner of the landfill, work in 2019 will focus on continued optimization of the purge well network, addressing the apparent continued sourcing through the slurry wall in the northeast corner of the landfill, and completing leachate tile system upgrades along the northern perimeter of the landfill.

With the redevelopment of both the 2690A and 2917, it is anticipated that the planned rates will be achieved. Once these rates have been established, continued work will focus on optimization of pump rates based on collected water quality data. In accordance with the milestone schedule provided in Section 15.0, throughout 2019 Dow will:

- Conduct monthly monitoring of well conditions;
- Continue routine quarterly monitoring in purge wells;
- Collect additional samples from wells 2549, 5924, and 5923 in order to support understanding of the plume migration;
- Continue to examine trends in purge wells and in sentinel wells;
- Take appropriate actions if the plume is not behaving as expected; and
- Adjust flow rates as appropriate to optimize performance.

While optimization of the purge wells northeast of the landfill continue, additional actions will be focused on repair of the slurry wall in 2019 including:

- Collect additional pre-design data as necessary to complete designs to fix the apparent breach in the slurry wall;
- Prepare design drawings for slurry wall repair; and
- Conduct construction activities to complete the repair design.

Additionally, Dow plans to conduct a preliminary remedial technology screening to assess the feasibility of management strategies to address any remaining plume outside the slurry wall once the repair is complete.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

10.0 Northeast Perimeter

The NEP is located along the north and east of the Midland Plant (Figure 10-1). Shallow groundwater in this area has been identified as having the potential for seasonal off-site migration and possible venting to storm sewers located along Washington Street, Bay City and South Saginaw Roads. Historic releases of organic contaminants have been identified by detection in groundwater monitoring wells, including benzene, trichlorofluoromethane (CFC-11), dichlorofluoromethane (CFC-21) and the organic daughter products and inorganic byproducts from natural attenuation of chlorinated ethenes.

10.1 Overview of Site Characterization and Interim Measures

A federal HSWA permit was originally issued to the Midland Plant on October 12, 1988. Included in the conditions of the permit were provisions that Dow was required to contain all contaminated groundwater on-site, and properly treat it through the WWTP. In addition, the corrective action plan for the facility at that time included maintaining old closed WMUs in-place, intercepting and treating shallow groundwater flowing underneath the Midland Plant, and continuing to study the hydrogeology as needed to develop a full understanding of groundwater flow relationships and potential environmental impacts of the Midland Plant and contiguous properties.

As part of the on-going study, EDI Engineering and Science completed a hydrogeologic study of the Midland Plant in March of 1989. Groundwater modelling performed as a part of this study identified areas where shallow groundwater could flow off-site from the Midland Plant, including the NEP of the Midland Plant along Saginaw Road and Bay City Road. A groundwater collection system was presumptively proposed for the area in May of 1990. Study of the area continued into 1993 to fill data gaps identified by MDEQ. Groundwater samples collected from the area were found to be free of contamination, so the plans to construct the groundwater collection system were withdrawn.

Development of a groundwater monitoring program for the NEP was outlined in the Operating License. Dow proposed to conduct additional investigation needed to finalize and implement a routine groundwater monitoring program. A groundwater monitoring program was developed and submitted to MDEQ on July 22, 2005. Based on MDEQ comments to the proposal, an addendum to the Monitoring Program was submitted on October 14, 2005. The groundwater monitoring program for the NEP was added to the RCRA Facility SAP in April 2006 and received MDEQ approval on September 27, 2007.

During implementation of the approved groundwater monitoring program at the NEP, vinyl chloride was detected in two monitoring wells (MW-6178 and MW-6175). Additional groundwater investigations were developed and implemented to determine the extent of the groundwater impacts. Summary reports for both the 6175 and 6178 Area studies were submitted to the MDEQ on September 14, 2007. Corrective Action Plans were submitted for these two areas (Area 6178 and Area 6175) on January 18, 2008.

Results of the 2007 study of the 6178 Area indicate that the vinyl chloride is a daughter product of higher chlorinated ethenes that are being naturally dechlorinated. At the downgradient boundary of the plume, the concentrations of the COCs were below the generic GSI criterion. Results of the 6175 Area study also indicate that the vinyl chloride is a daughter product of higher chlorinated ethenes that are being naturally dechlorinated; however, observations indicated that the dechlorination process may not progress to ethenes and ethanes, as observed in the 6178 Area, prior to entering the backfill of an existing storm sewer. This storm sewer eventually discharges to the Tittabawassee River, so corrective action was proposed and included a GSI criterion mixing zone determination.

In both areas, the initial source was determined to likely be a relatively small, historic release of higher chlorinated ethenes that have naturally dechlorinated in the groundwater and diffused into the lower clay soils. Monitoring wells from both areas were added to the existing bi-annual NEP groundwater monitoring program in the area. The purpose of the monitoring programs is to demonstrate on-going natural attenuation, and ensure that concentrations of COCs are not increasing over time.

Dow also completed an investigation in 2008 near monitoring wells 3540A and 4358 (CFC Area) in the NEP due to detectable concentrations of trichlorofluoromethane (CFC-11) and dichlorofluoromethane (CFC-21). A GSI criterion has not formally been developed for CFC-11 or -21; however, the available toxicity data suggested that the criterion, if developed, may be lower than the concentrations detected in this area (URS, 2011).

Further investigation was proposed in the *Work Plan for CFC-11 and -21 Evaluation Near Wells 3450-A and 4358* submitted September 30, 2010 and the *Work Plan Addendum for the Northeast Perimeter Groundwater Monitoring Program* submitted for MDEQ review and approval on December 21, 2011.

Dow has continued to assess results from the on-going groundwater monitoring program for the NEP since its implementation. To assist with the assessment of the historical data, in 2016 Dow contracted with EarthCon to perform groundwater plume analytical services to help characterize the conditions in the NEP. Findings of their analyses conducted coupled with additional analyses of the monitoring data further defined additional investigation for the NEP to address the groundwater detections measured above generic MDEQ GSI and the concentrations of CFC-11 and CFC-21.

The 2016 CAIP described the planned work activities for 2017, including the primary objectives of the work in each area. The planned activities included additional drilling work using a MiHPT and follow-up laboratory analyses to assess each area (Figure 10-2). The initial plan included the potential completion of MiHPT at regular intervals along investigative tracks, dependent upon the MiHPT and analytical results. Additionally, MiHPT borings were planned to be advanced at locations to the north of the facility to delineate the extent of the plume areas.

Each MiHPT boring included the use of multiple detectors (e.g. PID, flame ionization detector [FID], electron capture detector (ECD), HPT, halogen-specific detector (XSD), stratigraphy, etc.). Further, groundwater samples were planned to be collected from selected MiHPT borings in order to determine the relative distribution of target constituents based upon the MiHPT technology responses. A mobile laboratory was on-site to provide analytical services.

The target constituents for the 6175 and 6178 Areas included:

- Vinyl chloride;
- Cis-1,2-DCE;
- Trans-1,2-DCE;
- 1,1-DCE;
- TCE; and
- PCE.

The target constituents for the CFC Area were:

- Trichlorofluoromethane (CFC-11); and
- Dichlorofluoromethane (CFC-21).

As the plume areas were hypothesized to perhaps overlap or intersect, all analytes were analyzed in each groundwater sample.

The methodology and results of the 2017 investigative work was detailed in the 2017 CAIP. The findings defined the limits of impacts of site COIs for each of the investigative areas: 6178 Area; 6175 Area; and CFC Area. The impacts in each of the NEP investigative areas were delineated through the implementation of MiHPT borings and focused groundwater sampling.

The MiHPT investigative program identified a DNAPL source area south of the 6175 Area in the vicinity of Building 433 to the northwest and Building 1268 to the southeast. Based upon the limited TAL, the DNAPL appeared to be predominantly comprised of PCE. Based upon review of the available hydrogeologic data for this portion of the NEP, this identified DNAPL area is likely the source of the impacts in the 6175 Area and could possibly also be the source of the impacts to the 6178 Area. The primary COIs identified for the 6175 Area included PCE, TCE, cis-1,2-DCE and vinyl chloride while the 6178 Area COIs were limited to cis-1,2-DCE and vinyl chloride. For DCE detections, cis-1,2-DCE comprises a significant percentage of the total DCE, therefore, it is inferred to represent a reductive dechlorination by-product of a PCE or TCE source.

For the CFC Area, the MiHPT investigative program and associated focused groundwater sampling program successfully delineated the impacts of the target CFCs. Both the sampling and MiHPT results identified the source of the primary CFC-11 impacts to be located in the area between and north of Buildings 719 and 872, with lower level impacts in the area north of Building 564, which may be due to migration from the apparent source area based upon variable groundwater flow conditions in this portion of the NEP. The distribution of CFC-11 and its reductive dechlorination by-product CFC-21 are nearly coincident and appear to be bounded by hydrogeologic conditions in this portion of the NEP.

10.2 Conceptual Site Models

Based on the results of the 2017 investigation, refined CSMs were constructed for each of the areas.

10.2.1 6178 Area

For the 6178 Area, the developed CSM (Figure 10-3) depicts the coincidence of the impacts of COIs with an area of depressed elevation in the surface of the stiff clay unit, which serves as the base of the uppermost sand unit monitoring well network. Based upon the orientation of the clay surface, the monitoring network screened intervals, the observed localized groundwater flow conditions, and the proximity of the identified DNAPL source area to the southeast of the 6178 Area, the potential for impacts emanating from the DNAPL area to the 6178 Area exists. Further evidenced by the developed CSM is the likely presence of impacts within the clay unit, based upon the detections of COIs within monitoring wells screened predominantly below the uppermost sand unit (e.g. within the stiff clay unit).

With respect to data gaps for the 6178 Area, an area of limited data points exists between Building 433 and the existing monitoring network. Additionally, several of the existing monitoring network well locations (MW-I, MW-J) possess screened intervals above the clay unit while others (MW-A, MW-B, MW-C) have a majority of the screened interval within the clay unit. Further, no monitoring wells are located to the west of monitoring wells MW-J and MW-K, an area suggested to coincide with depression in the surface of the clay unit (e.g. uppermost sand thickening).

10.2.2 6175 Area

The developed CSM (Figure 10-4) for the 6175 Area also depicts the influence of hydrogeologic conditions on the distribution of COI impacts. The identified DNAPL source area was found to be present between elevation 612-616 ft, 3 to 5 ft below the uppermost sand and stiff clay unit contact. Downgradient (northerly) migration of dissolved phase impacts and potentially DNAPL appears to be controlled by several factors, including the slope of the clay unit, the thickening of the uppermost sand unit, and the resulting northerly groundwater flow pattern between the source area and the 6175 Area.

Based upon these observations, the DNAPL area likely constitutes a continuing source area for the impacts to the 6175 Area.

With respect to COI fate, the MiHPT investigation identified a localized area near monitoring well MW-3 in which current vinyl chloride concentrations in excess of the GSI criteria (15 μg/L) likely extends beyond the northern property line of the Facility. However, based upon further downgradient groundwater sampling, the migration appears to attenuate to ND levels within 200-300 ft. Further delineation of the northernmost extent of the COIs may be warranted. Additional data gaps include optimization of the monitoring well network as several monitoring wells (MW-2, MW-5, MW-7, MW-8, and MW-9) possess screened intervals above the clay unit.

10.2.3 CFC Area

The CSM prepared for the CFC Area (Figure 10-5) was developed based upon the results of the MiHPT investigation and limited to CFC-11 and CFC-21 COIs. The CFC impacts were also determined to be largely controlled by the hydrogeologic conditions in this portion of the Facility. Specifically, the migration of CFCs is northeast, consistent with the observed groundwater flow direction before forming two distinct dissolved phase lobes to the northwest and east-southeast in the vicinity of monitoring well MW-3540A where the uppermost sand unit thins due to an apparent ridge-like feature in the stiff clay unit in this portion of the Facility. This assessment can be confirmed as monitoring well MW-4359, installed within the ridge-like feature, is periodically noted to be dry.

The results of the MiHPT investigation successfully delineated the CFC impacts and noted that impacts were observed within both the uppermost sand unit as well as the stiff clay unit, suggestive of a surface source.

Therefore, identified data gaps for the CFC Area are limited to optimization of the CFC Area monitoring network and the collection of pre-design sampling data in order to facilitate remedial technology screening and selection, if warranted.

10.3 Current Status

Work in 2018 has focused on assessing potential remedial technologies, developing the work plan to gather additional site data to fill data gaps, collect remedial design data, and develop the well network optimization plan.

Preliminary remedial technology screenings were performed for the 6175 and 6178 areas and alternative technologies were explored for the CFC area. A preliminary well network optimization plan was put together in 2018 and discussed with the DEQ during the monthly status meetings; however, plans have not yet been finalized due to the need to collect additional data.

10.4 Path Forward

Work in 2019 will focus on achieving the following objectives for the NEP:

- Complete work plan for the collection of additional data necessary to fill CSM data gaps and for bench studies;
- Evaluate 2019 data collected to finalize the well network optimization plan;
- Implement well network optimization plan; and
- Complete bench studies as appropriate for selected remedial technologies.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

11.0 Mark Putnam Road AOC

A new AOC south of Mark Putnam Road and east of South Saginaw Road extending to the south and east an indeterminate distance was confirmed on October 25, 2018 when analytical results were received for a soil sample taken after an odor was detected during the removal of a tree in the area. The extent of the impacted areas has not yet been defined; however, the location of the AOC based on the soil sample results is found on Figure 11-1. Pursuant to Condition XI.F.1 of the Act 451 Part 111 of the Operating License Dow communicated the identification of this new AOC to the DEQ on November 16, 2018.

11.1 Summary of Initial Findings

The new AOC is not a release from any known WMU. The nature and extent of the contamination identified has not been fully characterized. Analytical data from initial sampling of the impacted soil encountered during construction activities in the AOC are summarized in Table 11-1. Dow has so far been unable to identify any specific process or WMU operation associated with this area. A review of aerial photographs suggests that some type of industrial activity took place in the area of the new AOC at some point after 1952 and before 1983. No information is currently available on the specific industrial activity that took place in this area.

Table 11-1. South of Mark Putnam Road Soil Testing Results

Sample Name	Analytical Method	CAS	Compound Name	Result Value	Reporting Limit	Unit
MARK PUTNAM RD SOIL	SM2540B	SOLID	% SOLIDS	85.3	0.1	%
	SW6020	7440-38-2	ARSENIC	1400	1100	ug/kg
	SW6020	7440-39-3	BARIUM	30000	1100	ug/kg
	SW6020	7440-47-3	CHROMIUM, TOTAL	10000	450	ug/kg
	SW6020	7439-92-1	LEAD	11000	230	ug/kg
	SW8260B	120-82-1	1,2,4-TRICHLOROBENZENE	150000	17000	ug/kg
	SW8260B	95-50-1	1,2-DICHLOROBENZENE	55000	17000	ug/kg
	SW8260B	541-73-1	1,3-DICHLOROBENZENE	3500	340	ug/kg
	SW8260B	106-46-7	1,4-DICHLOROBENZENE	28000	17000	ug/kg
	SW8260B	71-43-2	BENZENE	3200	340	ug/kg
	SW8260B	156-59-2	CIS-1,2-DICHLOROETHYLENE	1000	340	ug/kg
	SW8260B	100-41-4	ETHYLBENZENE	1600	340	ug/kg
	SW8260B	127-18-4	TETRACHLOROETHYLENE(PCE)	28000	17000	ug/kg
	SW8260B	108-88-3	TOLUENE	590	340	ug/kg
	SW8260B	79-01-6	TRICHLOROETHYLENE (TCE)	4300	340	ug/kg
	SW8260B	XYLENES	XYLENES, TOTAL	1900	690	ug/kg
	SW8270C	634-66-2	1,2,3,4-TETRACHLOROBENZENE	260000	7000	ug/kg
	SW8270C	95-94-3	1,2,4,5-TETRACHLOROBENZENE	170000	23000	ug/kg
	SW8270C	92-52-4	BIPHENYL (DIPHENYL)	11000	580	ug/kg
	SW8270C	118-74-1	HEXACHLOROBENZENE	1600	170	ug/kg
	SW8270C	91-20-3	NAPHTHALENE	180	170	ug/kg

11.2 Path Forward

Initial work in 2019 will focus on the development of a work plan for the AOC. It is anticipated that additional investigation will commence early to mid 2019 in accordance with the milestone schedule in Section 15.0. It is expected that the investigation will include borings down to approximately 20 ft bgs and the collection of soil and water samples; however, greater detail will be specified once the work plan is fully developed.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic

progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

12.0 Chemical Disposal Well 3

The potential for off-site groundwater flow at the western boundary of the facility was identified and reported to the MDEQ in the Compliance Schedule Task H-11 West Side Shallow Groundwater Investigation Summary Report dated August 7, 2009. The closed Chemical Disposal Well #3 (CD3) is located on the west side of the facility, east of Poseyville Road within the Midland Plant (Figure 12-1). The well was formerly used for injection of wastewater and was closed in 1985. Off-site flow was determined to have the potential to vent to storm sewers that were present at that time that drained southwards, eventually discharging to the Tittabawassee River downstream of the Dow Dam.

12.1 Overview of Site Characteristics and Interim Measures

Work completed in association with the H-11 project included a characterization of groundwater quality in the area by collecting a groundwater sample from facility shallow monitoring well MW-6172 and analyzing it for the presence of constituents listed in 40 Code of Federal Regulations (CFR) Appendix IX. Chlorobenzene was detected at a concentration exceeding generic criteria. Supplemental soil and groundwater characterization was then completed in 2011 and early 2012. Results were used to evaluate the exposure pathways at the relevant properties affected by this contamination. An IRA Work Plan was submitted on March 16, 2012 to address venting to surface water and dermal contact to groundwater and the work described in the Plan was completed in the summer and fall of 2012.

The 2012 IRA included a source removal activity and approximately 5,280 cubic yards of existing contaminated soil was removed and disposed of at Salzburg Landfill. The source removal areas are identified on Figure 12-2. Due to the presence of three existing active utilities that remain in place (8-inch Consumer's Gas Main, 12-inch High Pressure BreitBurn Management Company, LLC High Pressure Gas Main, City of Midland 10-inch Water Main), contaminated soils remained in place after completion of the IRA.

Four cross-ties linking the sewers on each side of the road potentially acted as preferential flow paths. Three cross-ties were subsequently physically removed, and the fourth (4^{th}) cross-tie, a 60-inch culvert, was plugged with flow fill. A 30-ft clay plug was also installed on the eastern boundary of the culvert to minimize flow along the backfill. To provide for proper drainage after removal of the sewers, the following drainage enhancements were completed:

- Relocated the north branch of the Hardy Drain to drain beneath Poseyville Road (north of the subject site);
- Regraded the Dow West Property to direct roadway and other surface drainage to the north towards the newly relocated north branch of the Hardy Drain; and
- Regraded the Dow East Property to direct roadway runoff northwards to the newly relocated north branch of the Hardy Drain.

The historic release from former refinery related pipelines was addressed at the Poseyville Road Property by conducting soil and pipeline removal during roadway construction in 2012. Excavation activities were conducted simultaneously with road closures planned for the re-paving of Poseyville Road by the City of Midland. The pipeline removal activities included not only removing the pipelines, but also the impacted soils that were encountered surrounding the pipelines.

Supplemental soil and groundwater characterization have been on-going in 2016 and 2018 to evaluate the exposure pathways at the relevant properties affected by these impacts. The objective of the continuing work is to determine if impacted groundwater exceeding the MDEQ GSI criteria is flowing offsite with the potential of impacting GSI receptors in the area.

12.2 Work Completed in 2018

In order to assess the GSI pathway and develop further actions as necessary, the following actions were conducted during 2018.

12.2.1 Groundwater Samples and Static Water Levels

In late March to early April of 2018 groundwater samples were collected from shallow wells 2925, 8815, 8816, 8817, 8818, 8819, 8820, 2926A, 2927A and deep wells 2925A, 2926, 2927, 3142, 3143, 3144. The samples were analyzed for a suite of analytes including metals, pesticides, PCBs, herbicides, VOCs, and SVOCs. A full list of parameters and detections is found detailed in Table 12-1.

In August of 2018, the collection of SWLs levels began and are anticipated to continue into early 2019. Monitoring well top of casings (TOCs) were resurveyed on September 19, 2018 to 0.01-inch. A topographic survey was also completed.

12.2.2 Slug Tests

In early March of 2018, slug tests were performed at each shallow piezometer 8815, 8816, 8817, and 8818 to determine the hydraulic conductivity of the shallow formation. Four slug tests were performed at each piezometer consisting of two falling head and two rising head tests varying the slug displacement between each test.

12.3 Path Forward

Work in 2019 will focus on evaluating the data collected in 2018 and achieving the following objectives for CD3:

- Analyze data collected from groundwater samples to determine a TAL and identify if any trends are evident;
- Assess groundwater data to determine if impacted groundwater exceeding the MDEQ GSI criteria is flowing offsite with the potential of impacting GSI receptors in the area;
- Analyze samples from deeper wells to determine if the chloride impacts are limited to the area around deep well 3143;
- Process slug test data to establish representative hydraulic conductivity value;
- Based on results of these actions, identify the area or parcels that would need an institutional control agreement to address the residual issues at the site; and
- Develop further remedial actions and/or a corrective action groundwater monitoring program for the area, if necessary.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested, plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

13.0 Ash Pond AOC

The Former Ash Pond was a vacant, unused area of the Midland Plant that was surrounded by berms for stormwater detention (Figure 13-1). The desired end use for this site is a natural wetland area. This type of site restoration improves natural habitat, restores important ecological functions in the area, supports natural diversity and improves water and air quality.

Future plans for the site include moving the perimeter fencing so that the Former Ash Pond area would be outside of the Midland Plant fence line, also making the fence outside of the floodplain. The site is adjacent to a river front property that is owned by the City of Midland. The City is currently planning the restoration of this 14-acre property to a natural area with public access. The restoration design for the Former Ash Pond area incorporated the goals of the City of Midland and other stakeholders for a comprehensive restoration of the entire area, which would provide one mile of riparian restoration along the river and a nearly 45-acre natural area with public access, while also improving the aesthetics of a property that is visible from the downtown area and as you enter the City from the south.

13.1 Overview of Site Characterization and Interim Measures

Multiple studies were completed in accordance with the requirements of the License for the Former Ash Pond beginning in 2004 and continuing through 2013. These studies included an RFI Phase-I Type Investigation/Preliminary Assessment, Surface Water Protection Monitoring Evaluation, Hydrogeologic Study, Groundwater Monitoring and Terrain Conductivity Survey. Summaries of these studies are included in the 2016 CAIP. Further site characterization was completed in 2015-2016, including 24 soil borings and groundwater sampling with the installation of 6 new monitoring wells. The results of the soil and groundwater sampling have previously been submitted. The results were compared to relevant criteria to evaluate and identify COIs. The summary of COI screening is included in the 2016 CAIP.

To achieve the goals for the Former Ash Pond AOC, the comprehensive remedial approach addressed the potential soil and groundwater exposure pathways and intended future use.

Site Cleanup Criteria were developed for the Former Ash Pond based on the DEQ Generic Cleanup Criteria, Statewide Default Background, Modified Urban Background and site characteristics. Soil samples collected at various depths in the 24 soil boring locations were compared to the Site Cleanup Criteria to identify the source areas and develop the remediation plan for the site. The remediation plan included removing material with concentrations exceeding the Site Cleanup Criteria, removing all visible ash, and some additional cut to provide for the restoration design specifications. In order to confirm that the excavation of the site achieved the goals of the remediation plan, cut elevation surveys, visual inspections for removal of ash, and verification sampling were completed.

While it was estimated that approximately 90,000 cubic yards of material would be removed from the site, based on the additional verification sampling and removal of visual ash the final excavation resulted in approximately 148,000 cubic yards of ash and soil being removed. This material was taken to the City of Midland Landfill, with the exception of 10,000 cubic yards that was taken to Salzburg Landfill.

Approximately 124,000 cubic yards of clean soil were placed on site to construct the wetland. This soil was obtained from fourteen different locations. Samples were collected from each of these sources and analyzed for VOCs, SVOCs, metals, herbicides, pesticides, and PCBs. The results were compared to the Removal Target Criteria and relevant DEQ Generic Cleanup Criteria prior to the soil being placed on site. The backfill was placed on the site beginning in September 2016 and continued behind the excavation and verification sampling process, decision unit by decision unit. Final grading was completed in November 2016. Installation of plants started in late September 2016 and continued through November 2016. Trees and shrubs that were planned for the existing slope along the perimeter of the Midland Plant were moved to along the river, which provides additional riparian buffer along the river.

13.2 Current Status

Routine groundwater monitoring at the site has continued to be performed as specified in the current SAP at the groundwater detection wells (Figure 13-2). Five monitoring wells located between the Former Ash Pond and the river are sampled on a quarterly basis and have been since November 2006, in accordance with License as part of the surface water protection program. The groundwater from these wells is analyzed for a list of primary organic constituents, as well as arsenic and boron. No VOCs have been detected above the RL. Results indicated that boron concentrations are below GSI in all five monitoring wells. Concentrations of arsenic are below GSI in MW-6166, MW-6167, and MW-6168. Arsenic concentrations have exceeded the current generic GSI in MW-6165 and MW-6169 during recent monitoring events.

Due to the arsenic exceedances, Dow has undertaken additional site characterization activities during 2018 to refine the CSM. Dow is also finalizing a mixing zone assessment to determine the assimilative capacity of the Tittabawassee River resulting from arsenic flux in groundwater discharge from the former Ash Pond area.

13.3 Path Forward

Dow will submit a Remedial Action Plan/Corrective Measures Implementation Report (RAP/CMI) for the Former Ash Pond in 2019 in accordance with the milestone schedule presented in Section15.0. Dow's intent is to achieve a determination of no further action according to Section XI.J, and at the time where the remedial objectives have been completed, will request a license modification to terminate Corrective Action for the Ash Pond.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

14.0 B-Sewer Manhole B108 Area AOC

The B-Sewer Manhole (MH) B108 Area AOC is located along the 10th Street corridor, south of E Street, and west of the pipe rack near 1385 Building. The NAPL-impacted area is estimated to be approximately 37,500 square feet in size. The location of the new AOC is shown in Figure 14-1.

14.1 Site History and Characterization

The B-Sewer system includes multiple sewer legs that are tied together and discharge through MH B100 before discharging to the Michigan Operations (MiOps) WWTP and ultimately to the National Pollutant Discharge Elimination System (NPDES) permitted outfall. Sewer samples have been collected from MH B100 since 2008 as part of the NPDES Permit Pollution Minimization Program (PMP). Samples continue to be collected from the B-Sewer system because data indicates the system is a potential source of PMP environmental COIs.

During a sewer survey conducted in the Fall of 2015, surveyors noted elevated PID readings at five manholes in the B-Sewer system upstream of MH B100 location (Figure 14-2). The five manholes; B108, B110, B110A, B111, and B119.06; were sampled in the second quarter of 2016 (2Q 2016). Based on the 2Q 2016 analytical results from samples collected at the five B-Sewer manholes, MH B108 may be a potential source of 2,3,7,8-TCDD and 2,3,7,8-TCDD toxicity equivalent concentration (TEC); pentachlorobenzene; and hexachlorobenzene to the WWTP. In addition, MH B108 had the highest concentrations of several other volatile and semivolatile constituents out of the five manholes sampled.

Additional samples were collected quarterly through the remainder of 2016 from MH B108. In the fourth quarter of 2016 (4Q 2016), sampling was extended to include the manholes B108.01, B108.07, and B109, which are directly upstream from MH B108, to determine if one of the sewer legs discharging into MH B108 was the source of the contaminant concentrations observed in B108 or if the source was centralized around MH B108. The 4Q 2016 results indicated elevated PMP analyte concentrations in manholes B108.01, B108.07, and B109. In addition to the sampling, a sewer cleaning program was executed in the sewers upstream of MH B108. Findings included debris in the sewers and elevated VOC air monitoring results.

Ultimately, it was concluded that the elevated concentrations seen in MH B100 originated from infiltration into the sewer from the MH B108 area.

14.1.1 Site Conditions

A review of historical soil boring logs indicate the soils in the general area of MH B108 consist of sand with some vegetation and possible fills that may include debris. These soils are generally found near the surface and extend to a depth of 7 to 14 ft deep. Some descriptions included “discolored medium sand fill,” “discolored sand and cinder fill,” “discolored sand” and “miscellaneous fill”. Below that, the soils are described as a plastic clay or silty clay that would generally be classified as a lakebed clay. Some sands have been observed below the clay/silty clay, but they are generally not described as having an odor or staining. Groundwater depths indicated on the historical borings range from an elevation of 618 to 614 ft NAVD29, which generally correlates to be between 5-9 ft bgs depending on the location. The groundwater table slopes towards the southwest in the area.

The leg of the B-Sewer in this area is installed at a depth where it is beneath the water table and can sometimes intersect the base of the upper sand. As a result, the B-Sewer connected to MH B108 could intercept or collect shallow groundwater or possible NAPL.

The only relevant analytical groundwater data from the area prior to the 2018 investigation was from a sample collected in March 2017 from monitoring well 3337 (Figure 14-3). This well included elevated concentrations of a number of potential contaminants of interest (PCOIs), such as o-phenyl phenol

(9,200 μg/L), 4-tert-butylphenol (3,100 μg/L), benzene (19,000 μg/L), chlorobenzene (220,000 μg/L), phenol (10,000 μg/L), diphenyl ether (360 μg/L), 1,2,4-trichlorobenzene (50 μg/L), 1,2-dichlorobenzene (2,700-3,700 depending on the analytical method used), 1,4-dichlorobenzene (410-570 μg/L depending on the analytical method used), and n-nitrosodiphenylamine (720 μg/L):

A list of the PMP environmental COIs to the WWTP, in addition to PCOIs are included in Table 14-1.

14.2 2018 Source Area Investigation

The source area investigation field activities completed in 2018 consisted of soil, groundwater, and DNAPL sampling in order to meet the following objectives for the B-Sewer MH B108 Area:

- Finalize the list of relevant PMP COIs and PCOIs;
- Determine the presence/absence of NAPL;
- Identify the specific location of the source area(s);
- Determine the extent of the source area(s);
- Collect data for establishing the hydrogeological conditions of the area;
- Determine the nature/mechanism of the possible migration routes; and
- Collect site media to conduct a bench scale study of potential remedial treatments.

The investigation consisted of advancing 23 borings in a proposed grid-like manner around MH B108 (Figure 14-3). Prior to advancing tooling, each selected location was cleared utilizing air knife soil vacuum technology. This method uses high-pressure air to loosen subsurface material coupled with a vacuum to remove the material from the borehole. Each location advanced was excavated to 5 ft bgs to an approximate diameter of twice the tooling to be used (e.g. 4 inches clearance). Underground utility maps were also re-reviewed to confirm the location of utilities near each proposed boring. Boring locations were adjusted based on site conditions encountered to avoid obstructions, underground, and overhead utilities.

Borings were typically advanced to a depth of approximately 15-20 ft bgs. This depth correlated with the first encounter of competent clay/lakebed clay in the area. The borings were continuously sampled for lithological logging by a field geologist using the Unified Soil Classification System nomenclature and descriptors, and soil samples were collected based on field observations and PID readings. Field observations noted during the investigation activities consisted of the first encounter of saturated soil, any staining/discoloring, presence/absence of NAPL, and visual conditions of the soil above and slightly into the underlying clay.

Fifty-five soil samples were analyzed for VOCs via a mobile laboratory positioned within the MiOPs fence line during the investigation (Pace Analytical Services) and for SVOCs by an off-site contracted laboratory (TestAmerica). The direction of the investigation was driven by field observations and/or the quick turn analytical results. The nomenclature schema for the sample identifiers were as follows:

B108SS##-92##-TDBD-MMDDYYYY

Where

B108 indicates the sample was taken in the MH B108 area

SS## is the soil boring number

92## is the boring ID number

TD indicates the top of sampling interval in relation to the ground surface

BD indicates the bottom of the sampling interval in relation to the ground surface

MMDDYYY is the date of sample collection (the dates are left off in Table 14-2 for brevity)

Five ft x 1-inch diameter 10-slot schedule 40 PVC screens were temporarily placed at the bottom of each borehole after the completion of soil sampling and were connected to the surface via 5' x 1" diameter schedule 40 PVC risers. The annular space between the well and the formation was either open or filled via the collapse of the natural formation. Static water levels were measured in each well and grab water samples were collected through a peristaltic pump. The intake of the tubing was placed approximately in the middle of the screened interval. Water samples were collected following a short well purge to obtain a representative sample of groundwater. Groundwater samples were collected from all 23 borings advanced in January 2018. Samples were analyzed for VOCs via a mobile laboratory positioned within the MiOps fence line during the investigation (Pace Analytical Services) and for SVOCs by an off-site contracted laboratory (TestAmerica). The nomenclature schema for the sample identifiers were as follows:

B108GW##-92##-MDDYYYY

Where

B108 indicates the sample was taken in the MH B108 area

GW## is the temporary well number

92## is the boring ID number where the temporary well was placed

MMDDYYY is the date of sample collection (the dates are left off in Table 14-3 for brevity)

Samples of the DNAPL encountered during the investigation were collected from two of the boring/temporary well locations sampled: 9263 and 9258. The DNAPL samples were analyzed for VOCs, SVOCs, and dioxins/furans by the Dow Environmental Analytical Chemistry laboratory.

All 23 temporary wells were pulled and the borings backfilled with grout containing a cement additive by the end of the January 2018 investigation. Each location was recorded with a GPS unit.

Extra soil was collected from an additional boring (9289) advanced during a subsequent mobilization in April 2018 for use in completing a bench scale study for potential remedial treatment (Figure 14-3). A permanent 2-inch diameter schedule 40 PVC groundwater monitoring well was also installed in this boring to facilitate data collection during future remedial activities. The well has a 5-ft long x 2-inch diameter 10-slot schedule 40 PVC screen placed at 9-14 ft bgs and is connected to the ground surface with 5-ft long x 2-inch diameter schedule 40 PVC risers. The risers above the ground surface are surrounded with a protective casing, bollards, and a concrete pad.

Analytical data from this investigation is included in Appendix G. The boring and well installation logs from the 2018 investigation are included in Appendix H.

14.3 Summary of 2018 Source Area Investigation Findings

The general geologic conditions observed in the B-Sewer MH 108 Area during the 2018 investigation aligned with the observations noted in historical boring logs reviewed prior to the investigation. The subsurface consists of a silty, fine grained, medium dense sand from ground surface to a depth of approximately 15 ft bgs, underlain by a clay unit. Groundwater was typically encountered at 5-6 ft bgs with the saturated zone extending from approximately 6 ft bgs to the top of the clay unit (15-20 ft bgs). The groundwater flow direction is generally towards the west-southwest.

The field investigation delineated an area consisting of DNAPL of approximately 100 ft x 40 ft in area and a 150 ft x 250 ft area where a DNAPL sheen/high analyte concentrations were observed. The main DNAPL area is centered around borings 9253 and 9258. DNAPL impacts were observed in the 1-3 ft of saturated soil located above the underlying clay at the noted borings. The DNAPL impacts observed at 9263 are believed to be associated with another AOC, the Historical Manufacturing Area AOC, located to the south and east of the noted boring. The detected VOC and SVOC analytes and associated analytical data results from the soil and groundwater samples collected during this investigation are summarized in Tables 14-2 and 14-3.

Samples of the DNAPL were collected from two of the boring/temporary well locations sampled during the 2018 investigation (9263 and 9258). These results are summarized in Tables 14-4 and 14-5. The percentage of the total TEC for each dioxin/furan isomer from the 4Q 2017 sample collected from MH B108 were compared to the percentage of the total TEC for each dioxin/furan isomer from the DNAPL sample collected from 9258 and 9263 (Figure 14-4 and Table 14-6). The dioxin/furan isomer fingerprint for each sample are similar, indicating that the DNAPL area identified around borings 9253 and 9258 is likely the source of the PMP COIs observed at elevated concentrations in MH B108. Although the dioxin/furan fingerprint for the DNAPL at 9263 is similar to MH B108 and the 9258 DNAPL, due to the spatial separation between 9263 and the DNAPL area around 9253 and 9258 along with its proximity to another AOC, the DNAPL found at 9263 is assumed to be part of the Historical Manufacturing Area AOC located to the south and east.

14.4 Results of Bench Scale Study

As defined by Mueller et al., 2002 in-situ (bio)geochemical stabilization (ISGS) entails the use of modified permanganate solutions for the purposes of mass removal and flux reduction (i.e., NAPL stabilization). As the oxidant migrates through the treatment area, various (bio)geochemical reactions destroy the targeted compounds present in the dissolved phase (Mueller et al, 2003-2014). This causes a “hardening” or "chemical weathering” of the NAPL as it steadily loses its more labile components. This causes a net increase in viscosity of the organic material, which yields a more stable, recalcitrant residual mass. In addition, both the insoluble MnO_2 precipitate that results from permanganate oxidation and other mineral species included in the ISGS formulation accumulate along the NAPL interface, physically coating the NAPL and thereby reducing the flux of dissolved-phase COIs into the groundwater.

The bench-scale study performed on impacted site media indicated that treating the DNAPL-impacted soils with the proposed ISGS amendment, Provect-GS®, which is produced/marketed/sold by Provectus Environmental Products, resulted in significant hydraulic conductivity decreases and the encapsulation of DNAPL. The hydraulic conductivity decreases and encapsulation of the DNAPL will ultimately result in notable reduction in mass flux of contaminant into groundwater and into the B-Sewer when the technology is applied at the field scale. The following summarizes the findings of the bench-scale study:

- Impacted soils treated with the Provect-GS® amendment exhibited reduced hydraulic conductivity values by more than two orders of magnitude compared to the untreated control samples;

- Varying the loading and composition of the Provect-GS® amendment (i.e., 4.5% and 10% permanganate and/or the addition of 5% organic carbon material) did not significantly change the hydraulic conductivity results in the treated soils;

- The Provect-GS® 10% permanganate + 5% organic carbon material formulation realized lower K value by an additional 20 times;

- The Provect-GS® amendment demonstrated the ability to induce the primary component of the DNAPL stabilization process; and

- The Provect-GS® amendment addition also indicated reduced total VOC concentrations, of between 15 - 66%, compared to the control sample.

14.5 Path Forward

There are currently no complete exposure pathways or receptors. Dow's efforts with addressing this new AOC are in line with the obligation to reduce PMP COIs where historical contamination is infiltrating into the sewer system and subsequently entering the MiOps WWTP.

Based on the successful completion of a recent bench-scale study, a field-scale pilot study is planned for 2019 in the B-Sewer MH B108 area. The study is designed to meet the following objectives:

- Confirm field-scale applicability of ISGS to stabilize NAPL material in the study area.

- Evaluate the field-scale implementation issues.

- Provide an overall proof-of-concept for potential application of this technology in other areas of the facility.

- Demonstrate the ability/efficacy of ISGS amendment to:

    - Provide for comparable hydraulic conductivity and resultant mass flux decreases on a field scale (compared to bench-scale),

    - Provide comparable contaminant concentration decreases on a field scale (compared to bench-scale), and

    - Effectively address the entire B-Sewer MH B108 area and resulting impacts.

- Evaluate field scale application methodology for ISGS amendment with respect to:

    - Injection spacing;

    - Radius of influence;

    - Overall ability to implement the technology; and

    - Costs related to future full-scale projects.

The Provect-GS® ISGS technology is not a contaminant laboratory treatability destruction approach. The primary mechanism that is being relied upon is the encapsulation/stabilization of DNAPL and residual DNAPL in the subsurface. This treatment approach provides long-term stabilization and encapsulation of NAPLs. Due to significant reductions in soil permeability at the DNAPL-groundwater interface, the dissolved phase flux from the source area is minimized. Additionally, since the technology is

permanganate-based, there will be some incidental or secondary contaminant reduction due to oxidation. This occurs during the formation of the MnO_2 precipitate as the permanganate is consumed (reduced).

The ISGS treatment areas have been designed to overlay the DNAPL and residual DNAPL area proximal to the B-Sewer. Based on the existing geologic conditions in the pilot study area, the soils underlying this area will be treated from the water table at approximately 5 ft bgs to approximately 15 ft bgs. Details of the implementation of the field-scale pilot study, such as injection grid maps, dosage calculations, and safety data sheets for the materials to be used, are included in Appendix I.

A Groundwater Discharge Permit Exemption Request was submitted to the MDEQ November 15, 2018 for approval to inject the amendments to be used as part of the field-scale pilot study.

The ISGS field-scale pilot study includes a planned pre- and post- treatment performance monitoring program including soil permeability testing (i.e. slug tests) along with soil and groundwater sampling. The schedule shown in Table 14-7 includes a summary of the types of monitoring, and the frequency at which the monitoring will be conducted following the completion of the field injections. Slug testing will be completed both pre- and post-ISGS injection on monitoring wells to be installed in the study area to verify the reduction of permeability from the amendment addition. Soil samples will be collected both pre- and post-ISGS injection to verify the stabilization of DNAPL and the reduction of organic constituent concentrations. Groundwater from monitoring wells in the study area will be sampled and analyzed for VOCs, SVOCs, and metals, as well as for general chemistry and field data parameters.

Work in 2019 is anticipated to be completed in accordance with the milestone schedule presented in Section 15.0. Unless otherwise necessary or requested plans or findings will be provided during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Annual updates detailing the work completed and projected for the next year will be presented in the annual CAIP.

15.0 Schedule

The project as a whole is anticipated to proceed according to the updated Corrective Action Implementation Plan High Level Overview, provided as Figure 1-4. Work on this project during 2019 is anticipated to progress consistent with the timelines provided in Table 15-1 below. MDEQ and Dow have tentatively scheduled monthly Corrective Action working meetings to facilitate discussions on the topics outlined in this Work Plan, review relevant data or findings and revisit the schedule on an on-going basis throughout the year. A SharePoint website was launched in 2016 to track progress, provide data and other electronic deliverables to MDEQ, as needed for decision-making and to help MDEQ fulfill their oversight function. As additional information becomes available, other corrective action goals may be identified in cooperation with MDEQ.

The anticipated timelines provided below are guidelines to be used for planning purposes only. They are highly dependent on weather and other issues, which may necessitate changes. Work scheduling and the planning process, described in Appendix G of Attachment 19 to the current Operating License, will be an iterative process that will incorporate changes, as warranted, through adaptive management.

Unless otherwise necessary or requested, plans or findings will be provided to MDEQ during periodic progress meetings, which are scheduled to occur on an approximately monthly basis. Presentations and notes from those meetings will be posted to the Microsoft SharePoint® website approximately two weeks after the meeting. Environmental data collected will continue to be provided each quarter through the Environmental Monitoring Report unless otherwise requested.

Table 15-1. 2019 Corrective Action Workplan Anticipated Milestone Schedule

Report Section	Program	Milestones	Anticipated 2019 Timeline
4	DC	Complete Construction for Remaining Z1 and 954 Area Interim Measures	Q1
4	DC	Provide Soil Sampling and Laboratory Testing Protocol Memorandum for DEQ Review for Testing of Former Fire Training Area (Zone 1 DU 1D-1)	Q2
4	DC	Prepare Soil Sampling Plans (maps of each DU and increment locations) for Zone 4	Q2
4	DC	Collect Soil Samples for Zone 4	Q2 and Q3
4	DC	Complete Construction for Remaining Z2 Interim Measures	Q2
4	DC	Complete Construction for Remaining Z3 Interim Measures (except 954 area)	Q3
4	DC	Review results of Zone 4 Direct Contact Soil Sampling with MDEQ	Q4
5	VI	Review Zone 3 Phase 2 Building Categorization and Prioritization for Vapor Intrusion with MDEQ	Q2
5	VI	Conduct Zone 3 Phase 2 VI Sampling	Q3
5	VI	Present and provide a Summary of initial Zone 3 sub-slab, indoor air and outdoor air sampling to MDEQ	Q1
5	VI	Collect seasonal confirmation sub-slab, indoor and outdoor air samples for selected buildings in Z1, Z2, and Z3 Phase 1	Q1-Q4
6	Ambient Air	Complete Ambient Air Pathway Evaluation for Zone 4	Q4
7	SDF	Complete Monitoring Wells	Q1
7	SDF	Evaluate Cell 1 Pilot	Q3
7	SDF	Submit Cell 1 Construction Drawings for DEQ Review	Q4
8	7th Street	Abandon Purge Wells 5, 6, and 7	Q1
8	7th Street	Review of Existing Data and Gap Analysis	Q2
8	7th Street	Compliance Point Determination	Q4
9	PLF	Collect Additional Samples from wells 2549, 5924, and 5923	Q1-Q4
9	PLF	Adjust Pump Rate in Purge Wells 2690A and 2917	Q1-Q4
9	PLF	Complete Southern Leachate Tile Upgrade	Q1

Table 15-1. 2019 Corrective Action Work Plan Anticipated Milestone Schedule (Continued)

Report Section	Program	Milestones	Anticipated 2019 Timeline
9	PLF	Prepare Design Drawings for Slurry Wall Repair	Q2
9	PLF	Prepare Design Drawings for Northern Leachate Tile Upgrade	Q2
9	PLF	Complete Slurry Wall Repair	Q4
9	PLF	Complete Northern Leachage Tile Upgrade	Q4
10	NEP	Complete Work Plan for Additional Data Collection	Q2
10	NEP	Finalize and Implement Well Network Optimization Plan	Q3
10	NEP	Complete Bench Studies for Potential Remedial Technologies	Q4
11	Mark Putnam AOC	Work Plan Completion	Q1
12	CD3	Analyze 2018 Data, Prepare findings and Path Forward	Q1
13	Ash Pond	Submit Former Ash Pond Corrective Measures Implementation Plan	Q2
14	B-Sewer	Conduct Field-Scale Pilot Study	Q2
ALL	ALL	Submittal of 2019 Corrective Action Summary Report and 2020 Corrective Action Implementation Work Plan	Q4

16.0 References

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