

REGULATORY-DIRECTED COMBINED REMEDY APPROACH FOR CHLORINATED VAPOR INTRUSION/MITIGATION AND GROUNDWATER REMEDIATION UNDER A RESIDENTIAL NEIGHBORHOOD

Thomas R. Szocinski, CEP

Director of Vapor Intrusion

Land Science

and

David L. Harn, Jr.

Michigan Department of Environmental Quality

October 11, 2017

RemTech 2017



REGENESIS™



Land Science™
a division of REGENESIS

SITE BACKGROUND

In 2009, the Michigan Department of Environmental Quality (MDEQ) began state-funded activities at an industrial plating facility in southwest Michigan to determine the nature and extent of contamination emanating from an area of the facility where degreasing agents were previously used.



INITIAL ASSESSMENT RESULTS

- Chlorinated volatile organic compound (CVOC) in groundwater
- ¼ mile long plume
- Shallow - 2-5 feet below ground surface
- Migrating through a residential area.

Residential neighborhood

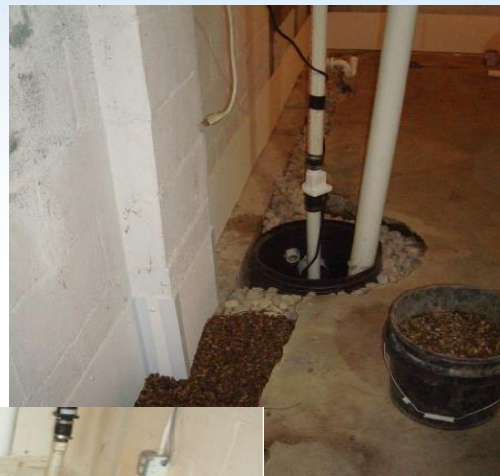
CVOC groundwater plume



ASSESSMENT CONTINUED AND KEY FINDINGS

Further investigation of the residential structures identified:

- CVOC Groundwater Plume with concentrations above MDEQ's vapor intrusion screening levels beneath residential homes
- CVOCs present in residential basement sump water



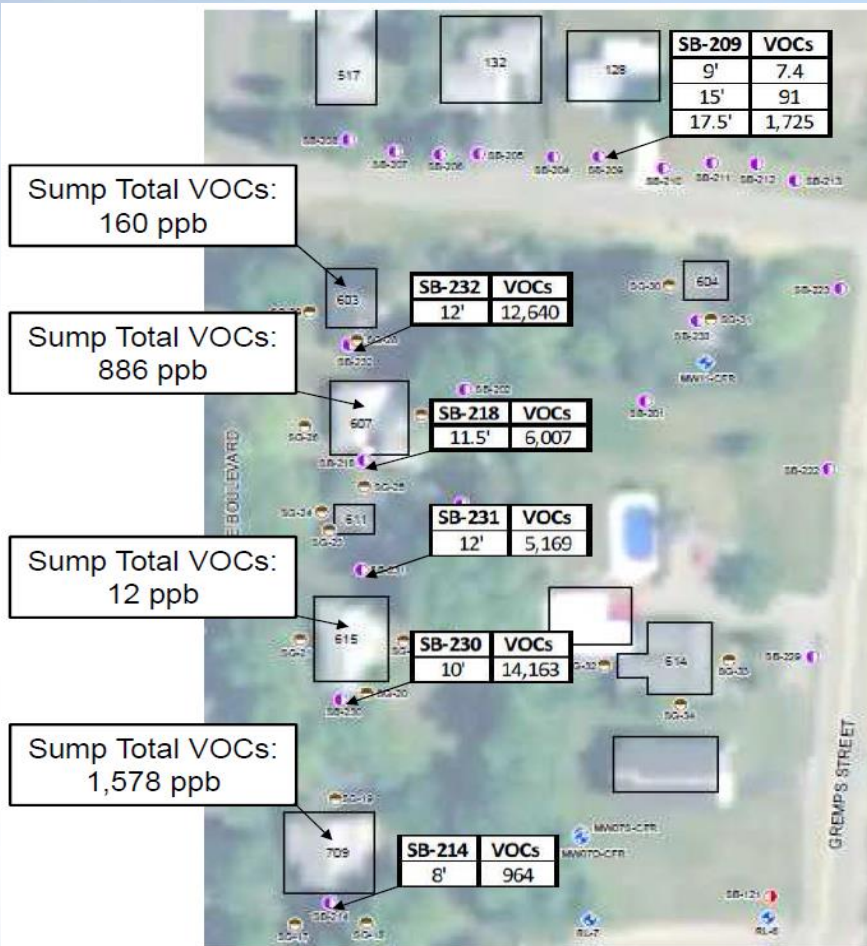
REGENESIS[®]



Land Science[®]
A DIVISION OF REGENESIS

- Total VOC's in residential sumps >1,500 ppb
- Total VOCs in groundwater >14,000 ppb

Mostly chlorinated VOCs present with some SVOCs



REMEDIAL APPROACH

A combined remedy including vapor intrusion mitigation in the residential basements and groundwater plume treatment using in-situ bioremediation.

Short-term Goals:

- Eliminate Vapor Intrusion risk within residential properties

Long-term Goals:

- Reduction of groundwater contaminants a priority
- No long-term cleanup system or O&M
 - Limited Funding Source
- In-situ strategy selected for pilot study (January/February 2010)

REMEDIAL APPROACH

REMEDY ADDRESSING GROUNDWATER PLUME –

- Multi-phase injection approach:
 - Electron donor and bioaugmentation – Pilot Scale, Plume Wide and Source treatments
 - Liquid activated carbon (LAC) – polishing treatment
- Design Challenges
 - Fast-moving aquifer ($>1\text{ft/day}$ GW velocity)
 - Residential neighborhood
- Response
 - Within plume use widely spaced treatment lines at approximate 200' apart between residential properties.



REMEDIAL APPROACH

Groundwater Remedy Part 1 - Plume-Wide In Situ Bioremediation Treatment (2010-2011) –

2010 - Successful enhanced reductive dechlorination (ERD) pilot test

- Engineered electron donor
 - Staged hydrogen release profile
 - Wide-area subsurface distribution properties (to be shown)
 - Staged hydrogen release profile

2011 – Plume-Wide Treatment

- Near source - treatment lines ~50 feet apart.
- Residential Area - Widely spaced treatment lines (~200 ft)
- Used groundwater gradient to sweep the treatment from line to line; minimize impact to the residents.
- Low volume – approx. 1% pore volume displacement within treatment zone





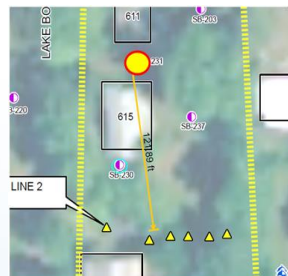
Spotlight Focus: Plume Area in Neighborhood Showing Distribution of ERD Reagent Over Time

Well 230

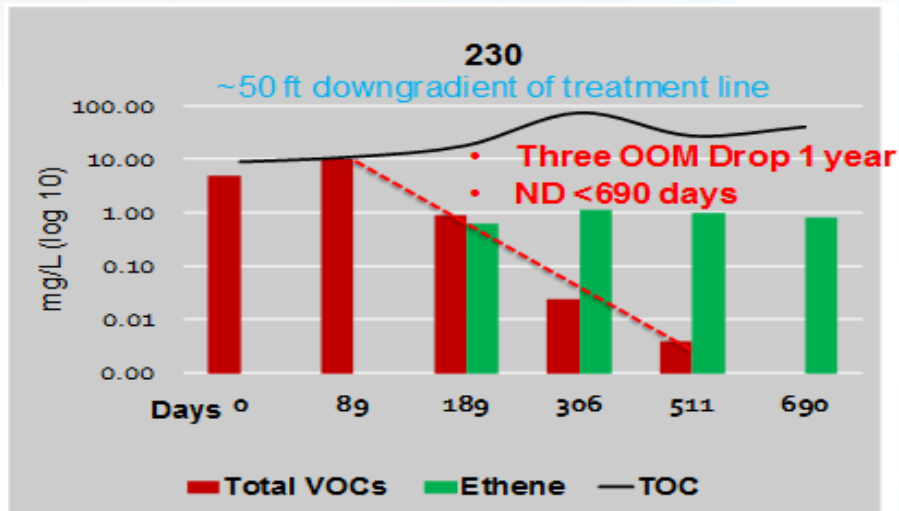
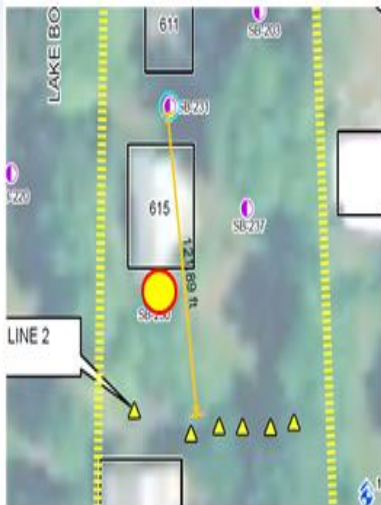
50 ft DG of
line

Well 231

120 ft DG of
line

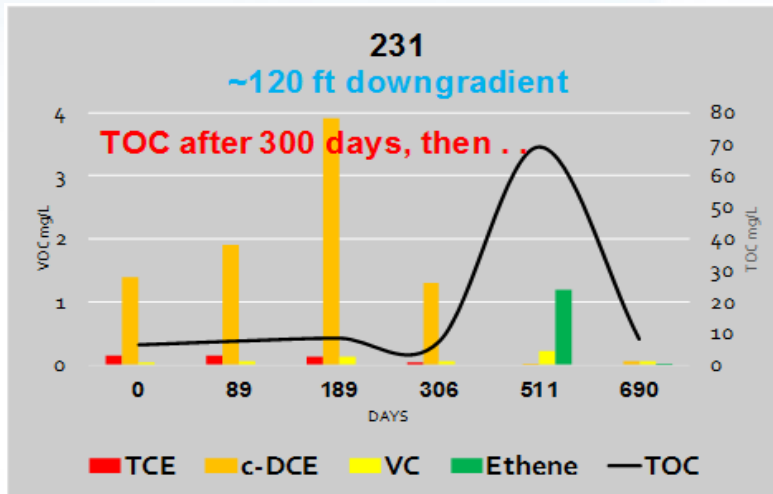
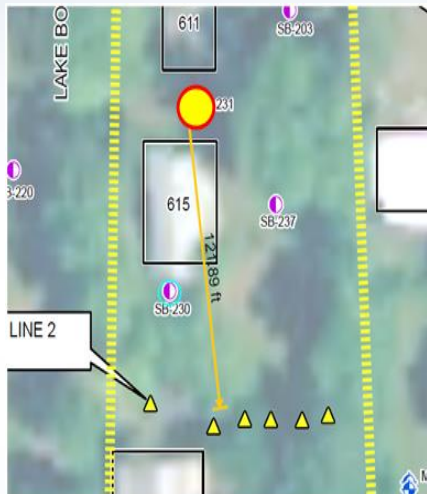


At Well #230, approximately 50 ft away from the nearest upgradient treatment line: Total chlorinated VOC concentrations were reduced 3 orders of magnitude within 1 year once the mobile portion of the electron donor was observed as indicated by the rise in total organic carbon (TOC).

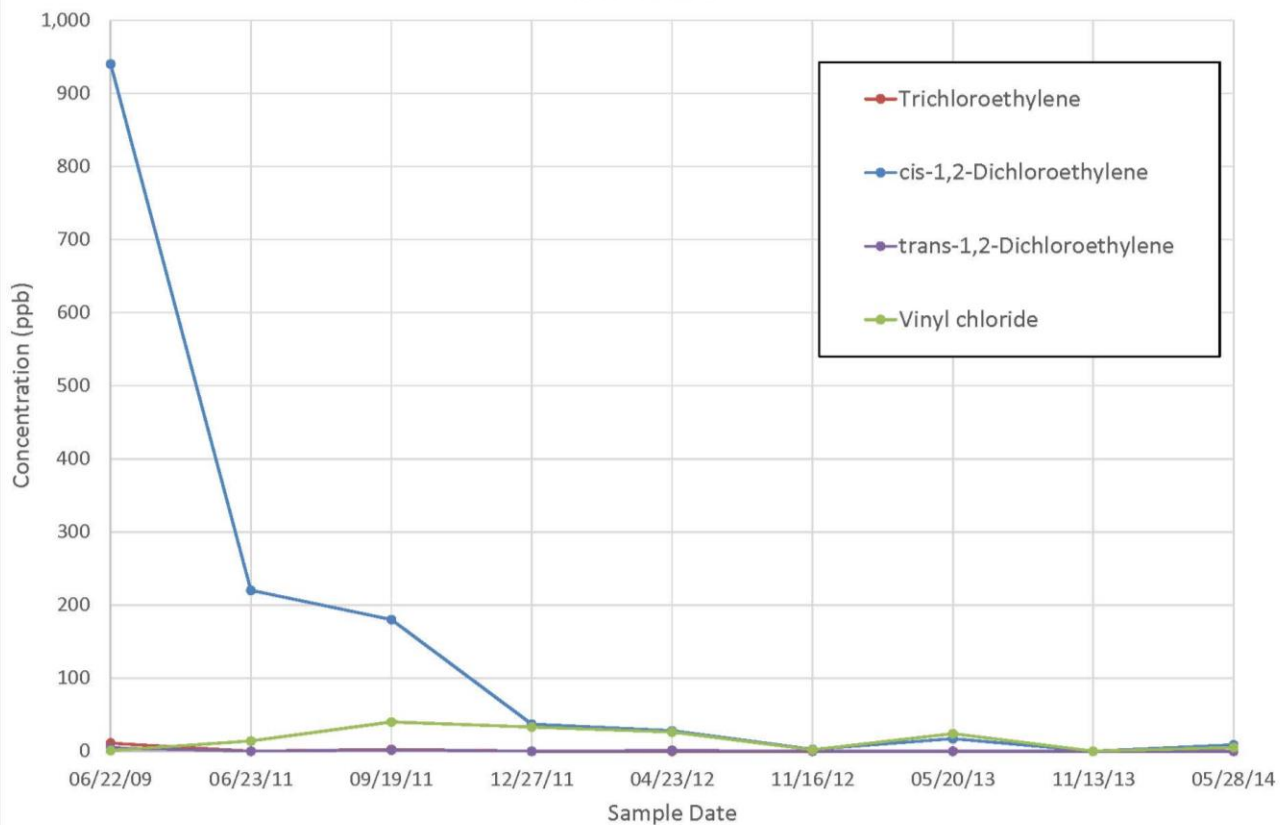


At Well #231, approximately 120 ft away from the nearest upgradient treatment line: After 300 days, TOC shows up and then . . . Complete conversion of CVOCs to ethene.

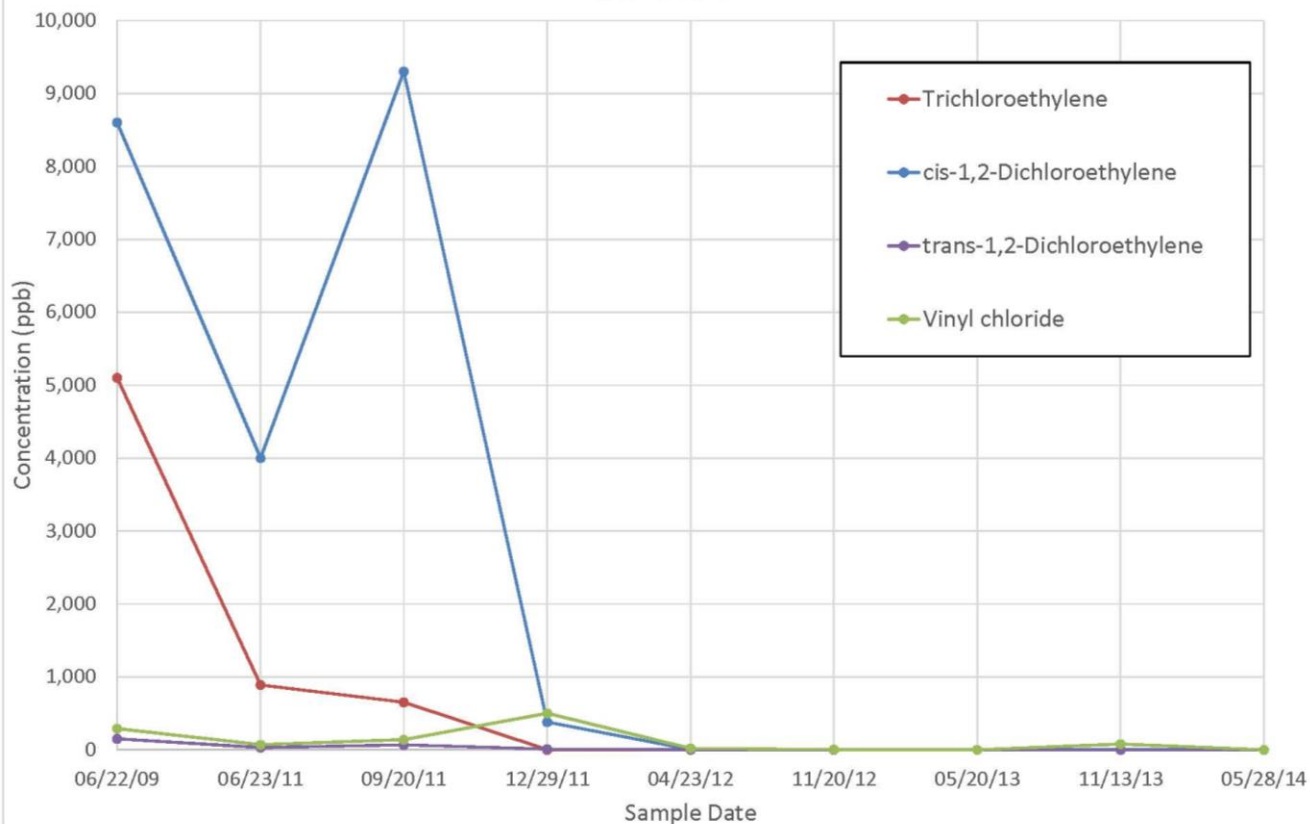
Mobility and Longevity Established with this treatment!!



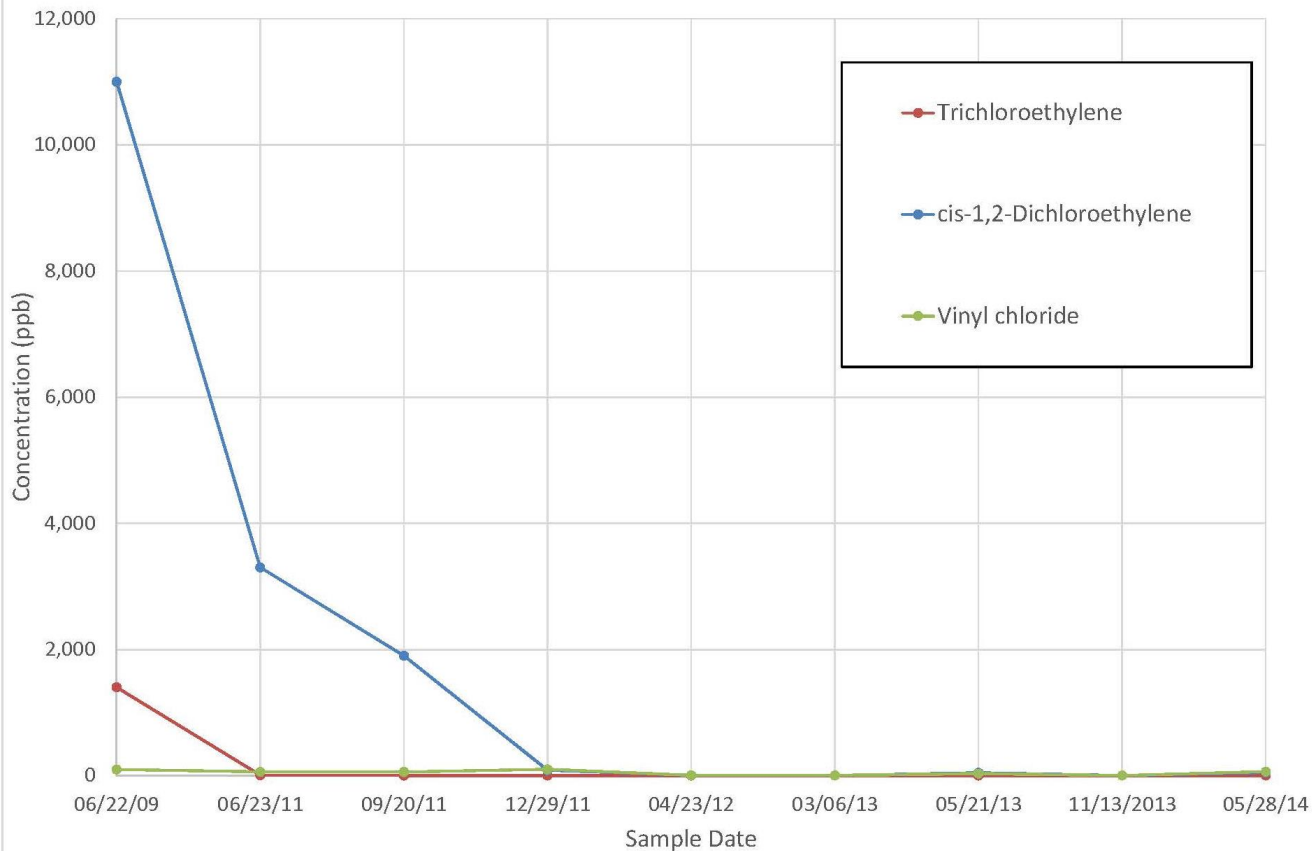
SB-214



SB-230



SB-232



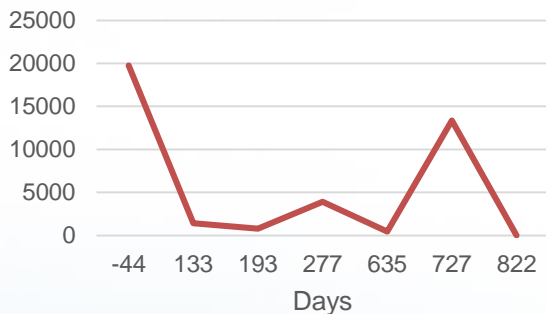
Groundwater Remedy Part 2 - Source Area In Situ Bioremediation Following Building Demolition (2013)

- ERD approach applied here following building demo
- Simple grid array
- Contaminants were quickly and drastically reduced in this area consistent with plume-wide treatment



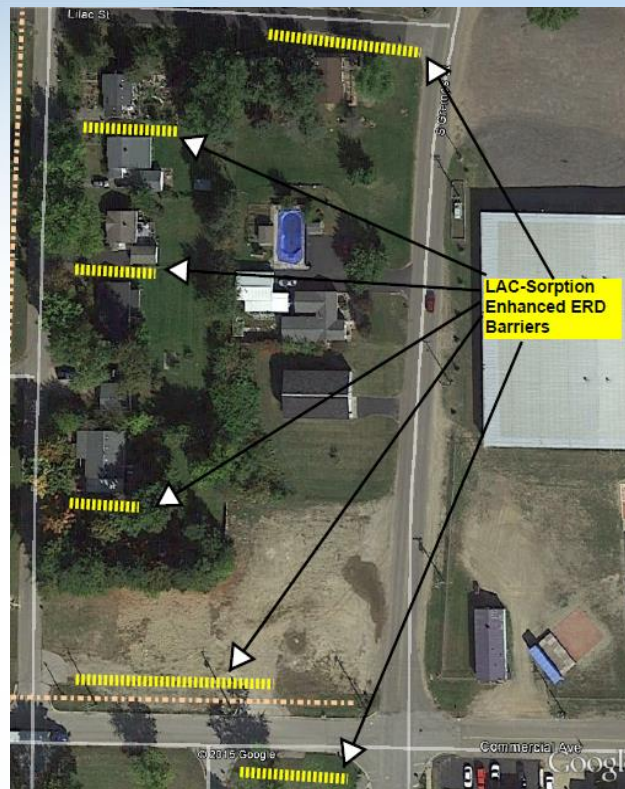
Former Building Area Injections – October 2013

MW-111 Total CVOCs ($\mu\text{g/L}$)



Groundwater Remedy Part 3 - Residential Area Plume Maintenance - Liquid Activated Carbon Injection (2015)

To protect against any further migration of residual chlorinated VOCs over the long-term from untreated or not-fully treated areas, a series of bio-barriers were emplaced within the residential plume area. The bio-barriers utilized a liquid activated carbon (LAC) reagent along with a polylactate electron donor to promote sorption-enhanced ERD.



PLUME STOP
Liquid Activated Carbon

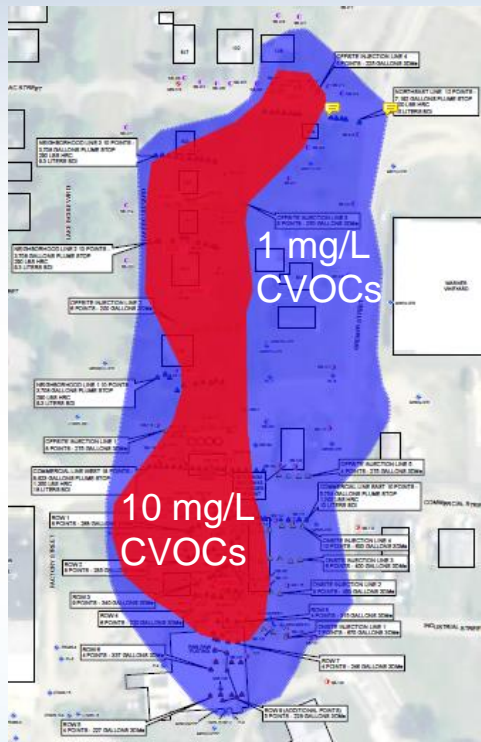


REGENESI^S

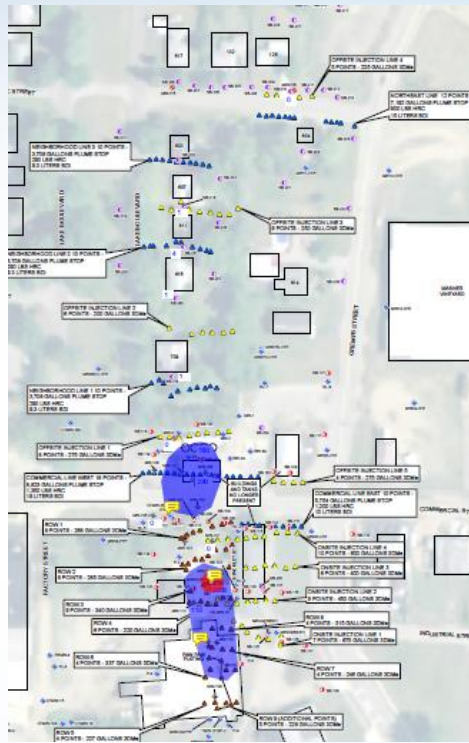


Land Science
a division of REGENESI^S

2010 Plume



2016 Plume



RESULTS

CVOC Plume
is Virtually
Eliminated

Small-scale
polishing injection
planned for 2018
in/near original
source area



PLUME STOP
Liquid Activated Carbon

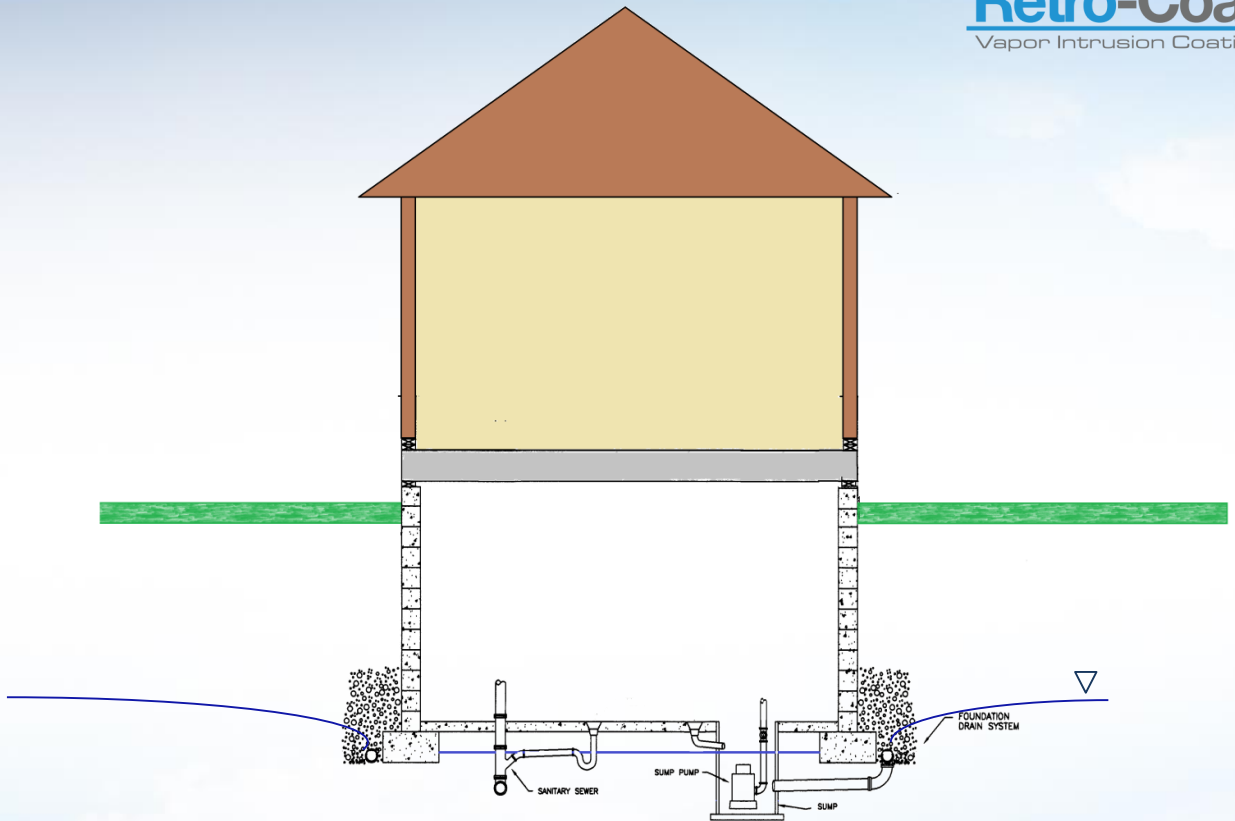
REMEDY ADDRESSING DIRECT CONTACT AND VAPOR INTRUSION CONCERNS

The basement sumps were capped and vented and a vapor intrusion protection coating (Retro-Coat™) was applied to the floor and walls.

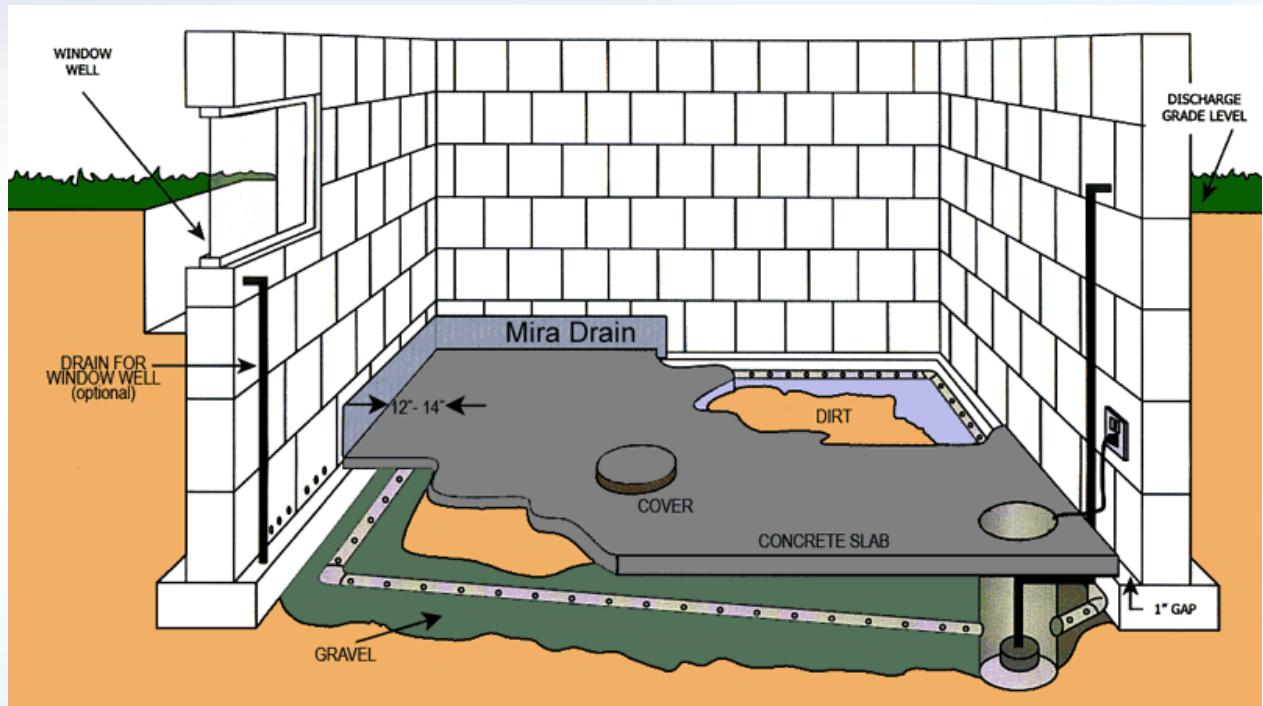


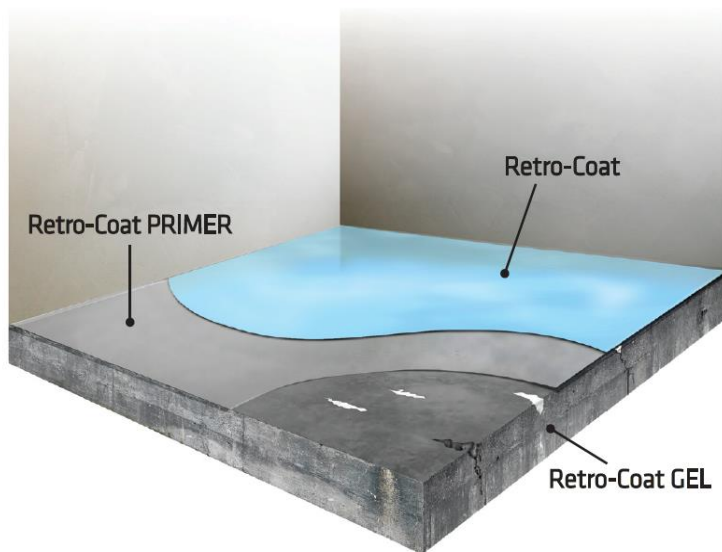
REMEDIAL APPROACH – VAPOR MITIGATION





Sub-Slab Depressurization Not an Option...





Retro-Coat[™]

Vapor Intrusion Coating



REGENESIS[®]



Land Science[®]
A DIVISION OF REGENESIS

Retro-Coat Prep/Application



Retro-Coat Prep/Application



Retro-Coat Prep/Application



Retro-Coat Prep/Application



Retro-Coat Prep/Application



Vapor Intrusion Mitigation Follow Up

MDEQ collected indoor air samples within the residential basements following the installation of the vapor mitigation and coating system

- No VOC's were detected in any of the indoor air samples above laboratory MDLs



REGENESIS



Land Science
A DIVISION OF REGENESIS

SUMMARY AND CONCLUSIONS

- Unique site conditions = unique challenges
- Combined approach utilizing 3DMe and PlumeStop dramatically reduced CVOC concentrations
- Capping/venting of sumps and application of Retro-Coat controlled VI risks to residences



ACKNOWLEDGEMENTS

- Regenesi[®]
- Land Science[®]
- MDEQ
- DLZ Michigan, Inc.
- Village of Paw Paw
- Residents of Paw Paw

