

CLOSURE OF A LEGACY CHLORINATED VOC SITE USING PHYTOREMEDIATION



Douglas Burge, PG, RG
St. Louis, Missouri

RAMBOLL

OUTLINE

- Site Setting & Background
- Historic Remedial Efforts
- Pivot to Endophyte Assisted Phytoremediation
- Site Closure

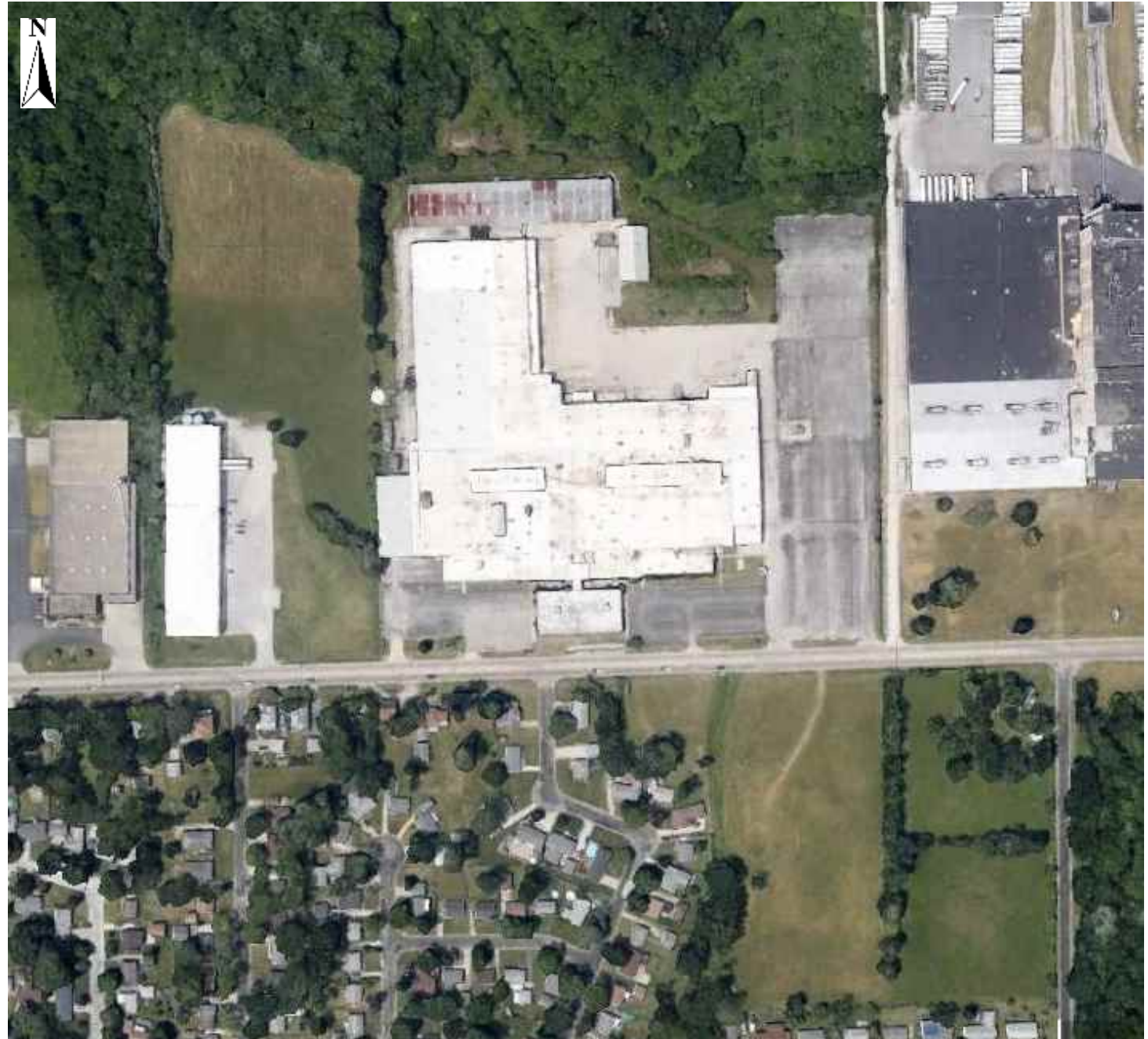
Bright
ideas.
Sustainable
change.

RAMBOLL

EAST CENTRAL ILLINOIS SITE; BACKGROUND

Former Manufacturing Facility

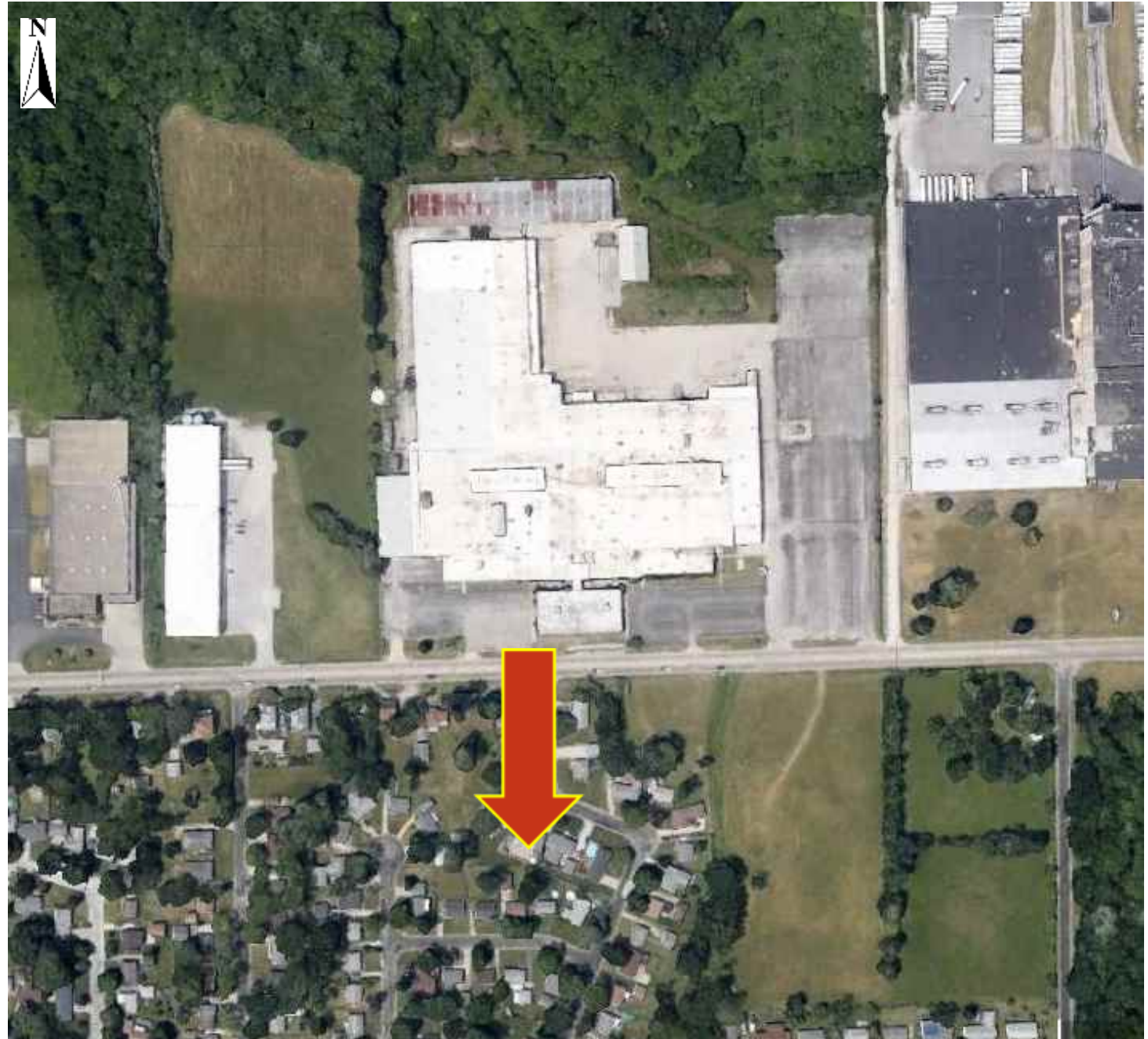
- Used degreasing chemicals for 35 years
 - Primarily TCE with limited TCA
- Groundwater; 2-6 feet below ground
- Aquiclude; 15-20 feet below ground
- RCRA closure followed by Illinois voluntary cleanup program (SRP)
- Facility closed 2008 & demolished 2016
- Sold to local city 2018



EAST CENTRAL ILLINOIS SITE; BACKGROUND

Former Manufacturing Facility

- Used degreasing chemicals for 35 years
 - Primarily TCE with limited TCA
- Groundwater; 2-6 feet below ground
- Aquiclude; 15-20 feet below ground
- RCRA closure followed by Illinois voluntary cleanup program (SRP)
- Facility closed 2008 & demolished 2016
- Sold to local city 2018
- **Groundwater flow to south
(towards residential area)**



GROUNDWATER PLUMES & PRIMARY SOURCE AREAS

Two Plumes – West & East

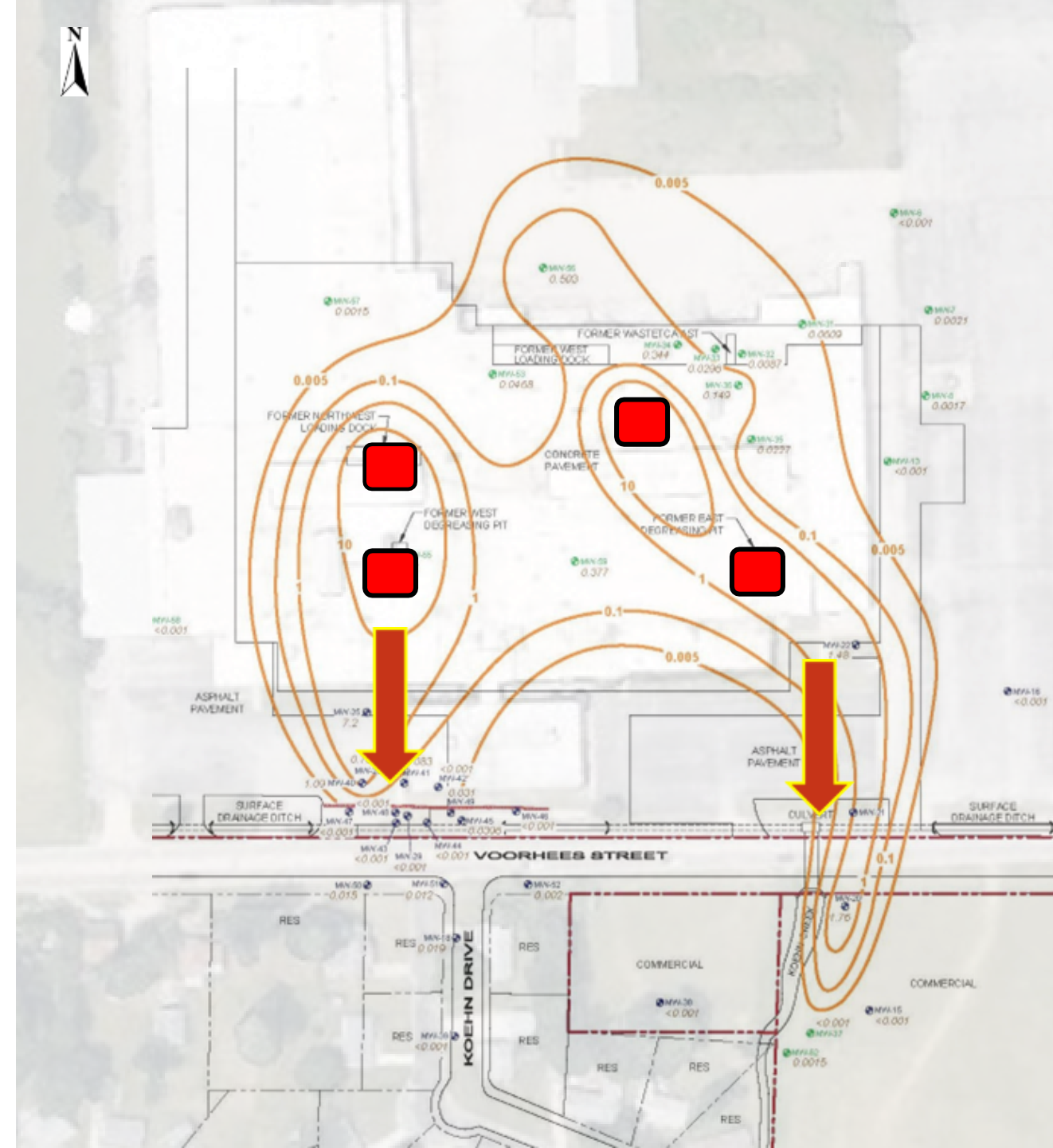
- Chlorinated VOCs
- Total VOCs range up to 81 mg/L

Two Primary Source Areas

- West Degreasing Pit
- East Degreasing Pit

Secondary Source Areas

- Former Loading Docks



GROUNDWATER PLUMES & PREVIOUS REMEDIATION

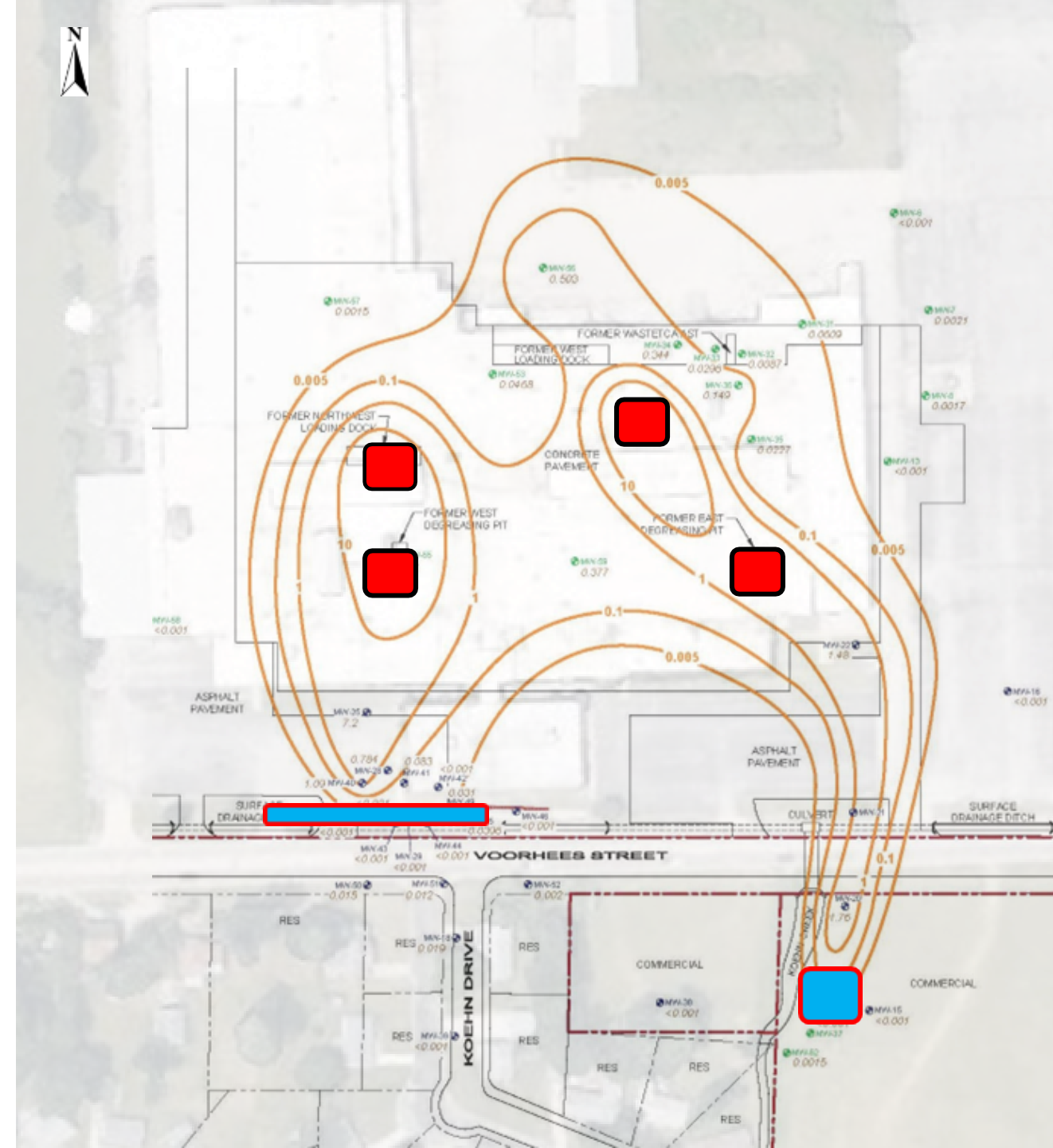
Permeable Reactive Barrier

- Constructed 2005
- Zero Valent Iron

Liquid Activated Carbon

- Late 2017
- Focused Injection

Served primarily as leading-edge interim actions.

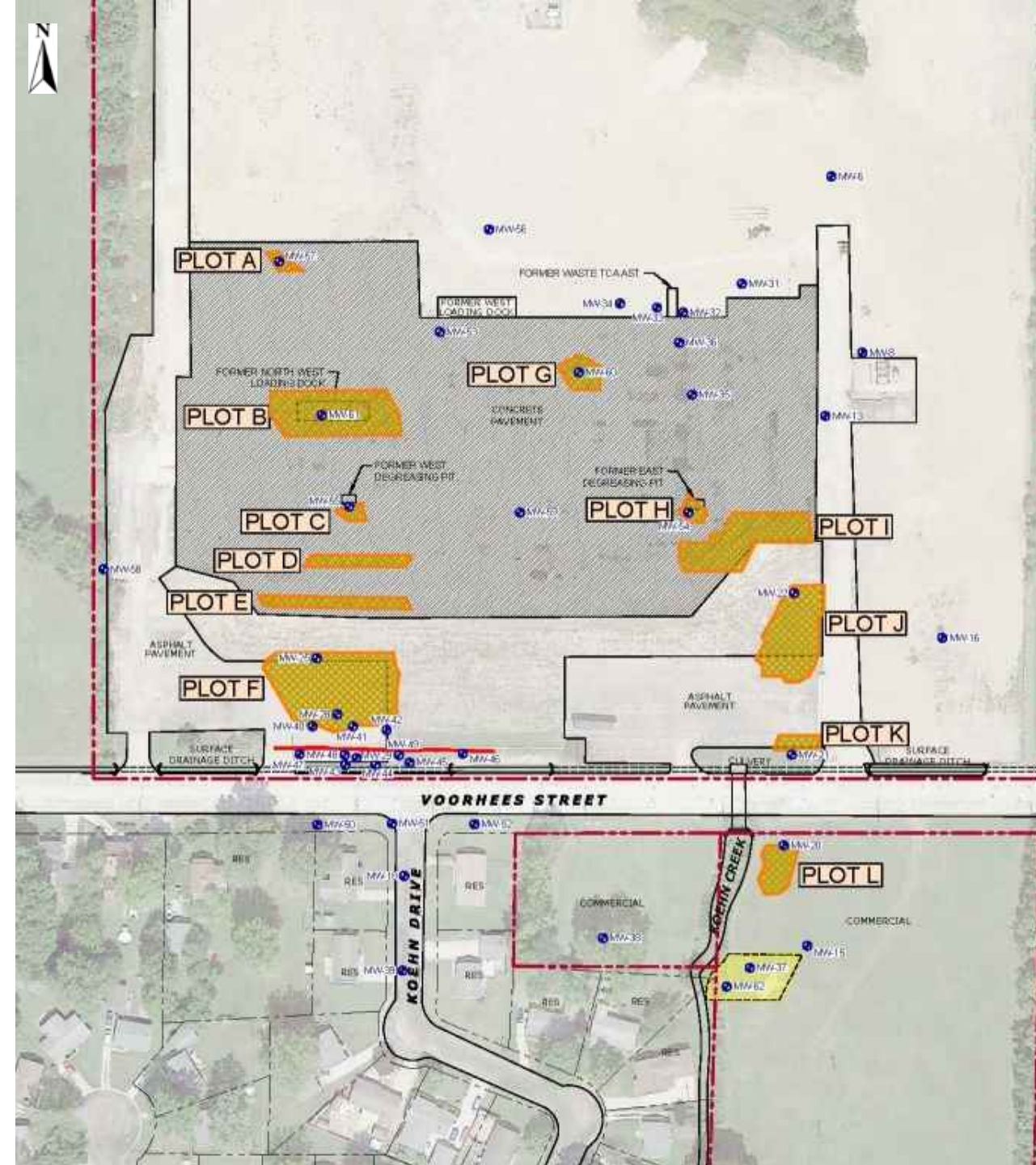


PHYTOREMEDIATION TREE PLOTS

12 Individual Plots

(2018/2019 post-demolition)

- Partnered with Intrinsyx Environmental
- 600+ Poplars and Willows
 - Inoculated with PDN3 Bacterial Endophyte; Purpose to increase remedial effectiveness and tolerance to cVOCs)
- Total Area Planted Approximately One Acre
- Installed within both Source Areas and Groundwater Plumes



TREE STOCK & INOCULATION



INSTALLATION



INSTALLATION & SIX MONTHS OF GROWTH

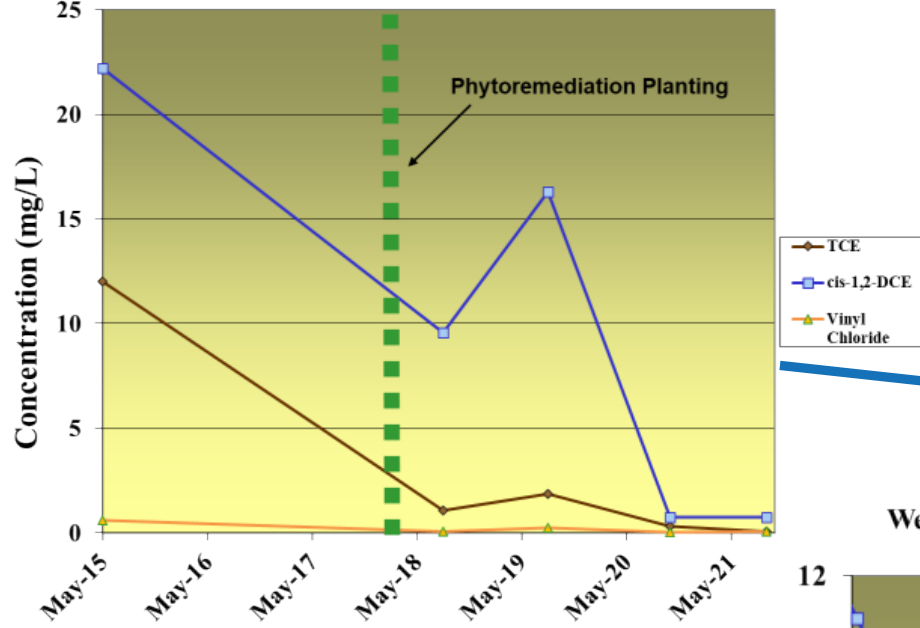


THREE YEARS OF GROWTH

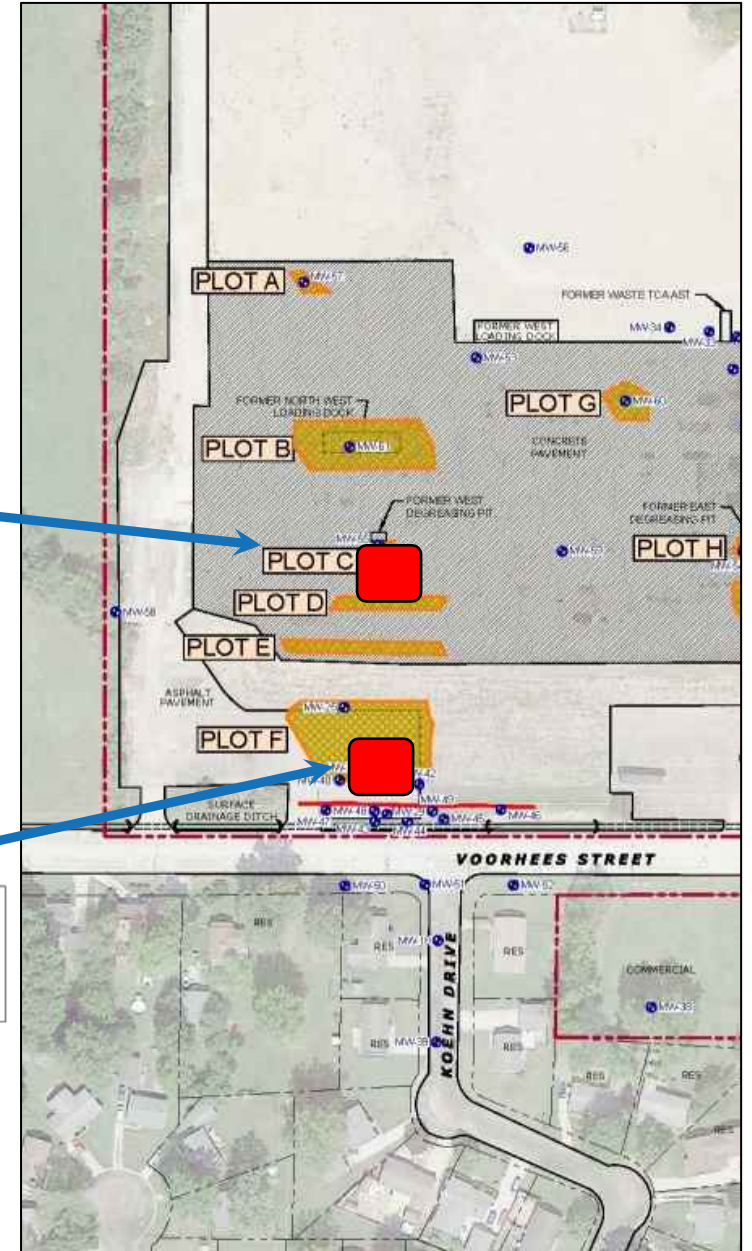
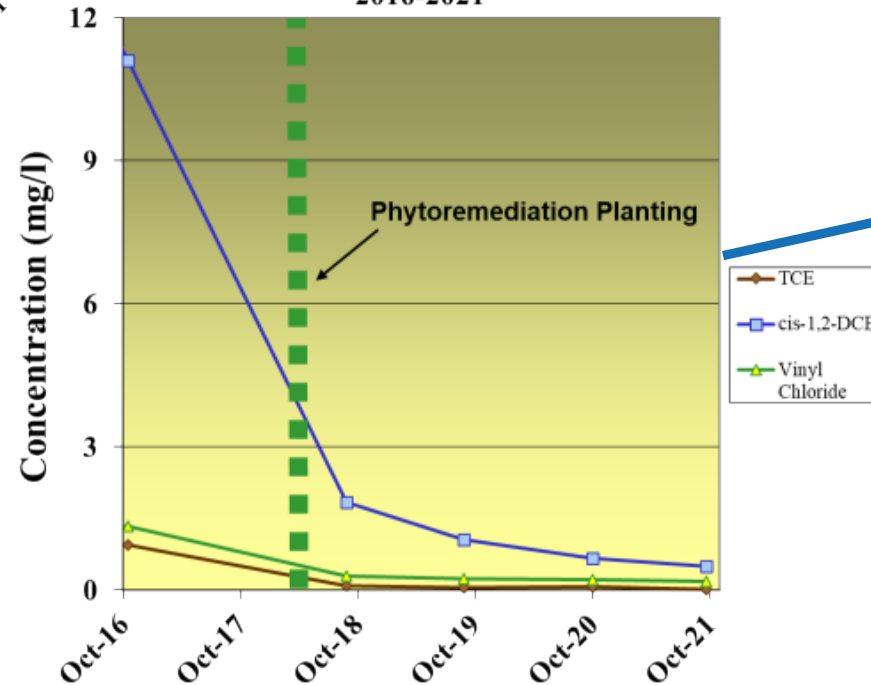


TIME TREND PLOTS

West Degreasing Pit Source; Groundwater
2015 to 2022



West Plume Downgradient; Groundwater
2016-2021



STRESS (Chemical)



Former Degreasing Pit (81.5 mg/L total VOCs)

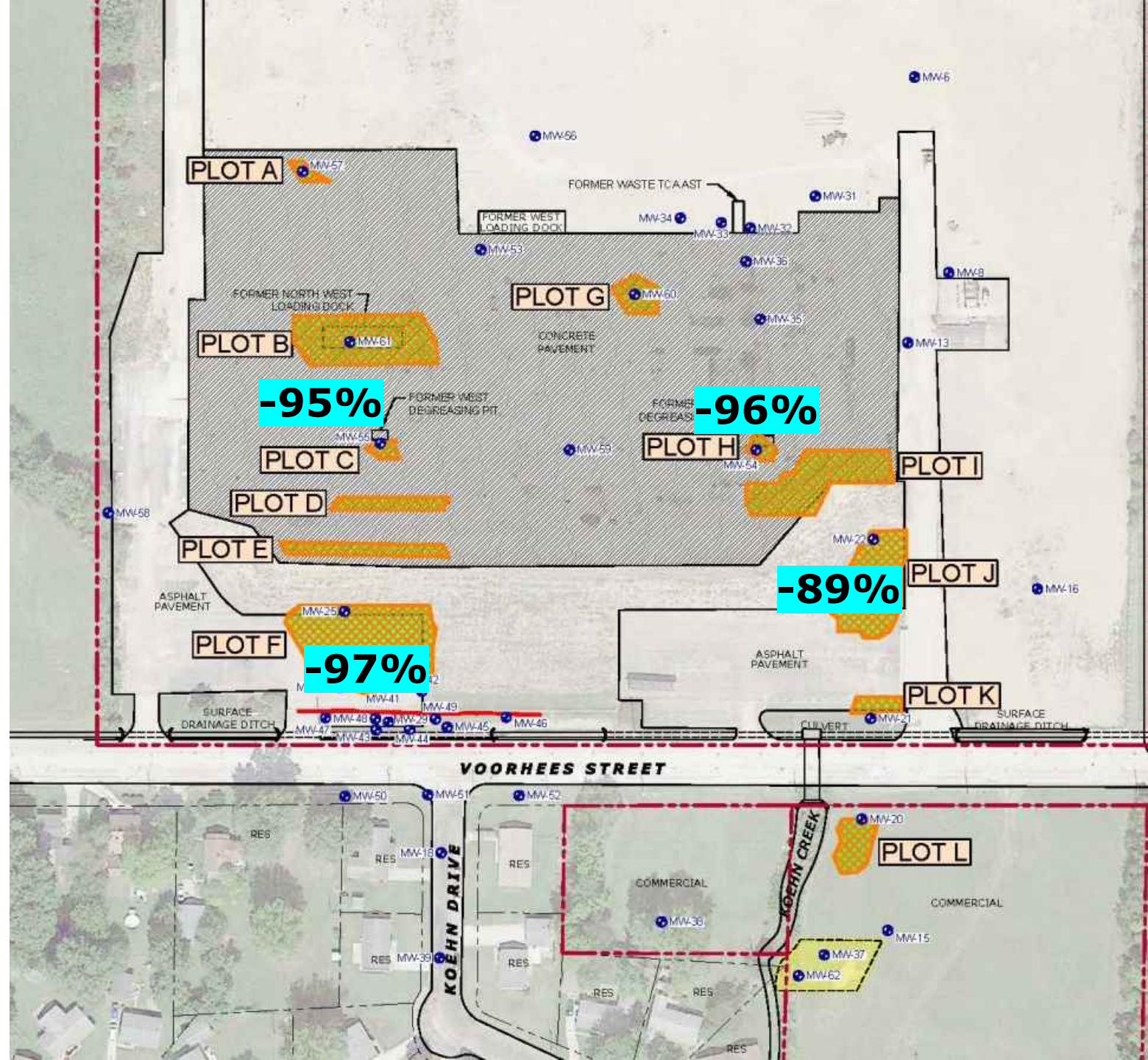


Downgradient (<5 mg/L total VOCs)

MEASURED DECREASES

Total VOCs Reductions (mg/L)

- Plot C – Degreasing Pit
81 to 4.4 mg/L
- Plot H – Degreasing Pit
11.6 to 0.45 mg/L
- Plot F – Downgradient
21.9 to 0.74 mg/L
- Plot J – Downgradient
22 to 2.5 mg/L



CARBON SEQUESTRATION



MyTree Benefits

For this year

Danville Phyto Tree: Cottonwood spp, (populus)

Serving Size: 5.00 in. diameter

Condition: Excellent

Estimated this year: \$1.72

Discover benefits of all your [community trees](#)!

	Annual values
Carbon Dioxide Uptake	\$1.59
Carbon Sequestered	18.65 lbs
CO ₂ Equivalent	68.39 lbs
Storm Water Mitigation	\$0.13
Runoff Avoided	14.35 gal
Rainfall intercepted	133.5 gal
Air Pollution Removal	\$0.00
Carbon Monoxide	<0.1 oz
Ozone	1.3 oz
Nitrogen Dioxide	0.12 oz
Sulfur Dioxide	<0.1 oz
PM _{2.5}	< 0.1 oz

Values are totals to date	
Carbon Dioxide Uptake	\$9.47
Carbon Storage	111.01 lbs
CO ₂ Equivalent	407.03 lbs



Benefits are based on USDA Forest Service research and are meant for guidance only. Visit www.itreetools.org to learn more.

MyTree Benefits

Over 20 years

Danville Phyto Tree: Cottonwood spp, (populus)

Serving Size: 5.00 in. diameter

Condition: Excellent

Estimated Over 20 years: \$70.34

Discover benefits of all your [community trees](#)!

	Annual values
Carbon Dioxide uptake	\$64.69
Carbon Sequestered	758.61 lbs
CO ₂ Equivalent	2,781.59 lbs
Storm water Mitigation	\$5.19
Runoff Avoided	580.33 gal
Rainfall intercepted	5,398.78 gal
Air Pollution Removal	\$0.46
Carbon Monoxide	0.71 oz
Ozone	64.79 oz
Nitrogen Dioxide	6.08 oz
Sulfur Dioxide	4.16 oz
PM _{2.5}	3.67 oz



FAST TRACK CLOSURE



Achieved Remedial Objectives
within 3-4 years of initial
plantings



Broad acceptance by
Stakeholders

- Client
- Illinois EPA
- City Government
- Local Residents

RAMBOLL



THE END

