Gelman 4th Amended CJ
Technical Questions and Concerns

Lawrence D. Lemke

September 24, 2020

Question and Answer Session for Gelman 1,4-Dioxane Plume Litigation Settlement Agreement

WASHTENAW COUNTY BOARD OF COMMISSIONERS

COALITION FOR ACTION ON REMEDIATION OF DIOXANE (CARD)

Technical Questions and Concerns

1. Source Area Cleanup
   - Soil & water concentrations
   - Phytoremediation
2. Delineation
3. First Sister Lake / Parklake well
4. Barton Pond / Ann Arbor water supply
5. Aquifer restoration

Source Area – soil & water concentrations

- *What scientific investigations and data support the proposed approach?*
- *Why aren't the areas with the highest remaining concentrations being addressed?*

Phytoremediation

- Is 1,4-dioxane expected to accumulate in the trees?
  - How would this be tested?
- What will happen to the trees after they die?
  - Would they be left to decompose and release dioxane back into the environment?

This is an emerging technology – pilot project!

What is learned here could be applied along Allen Creek.

Tree tissue monitoring should be required.

Phytoremediation

- Is 1,4-dioxane expected to accumulate in the trees?
  - How would this be tested?

<u>1,4-Dioxane is expected to pass through the trees</u>.

- dioxane moves with GW to tree roots
- transformed by bacteria in roots or enters as dioxane dissolved in the water
- flows through tree's water transport system
- transpired to atmosphere through leaves

Tested by periodic tree cores analyzed for dioxane

Phytoremediation

- What will happen to the trees after they die?
  - Would they be left to decompose and release dioxane back into the environment?

<u>As a dead tree dries, 1,4-dioxane will vent to atmosphere.</u>

- After decomposition, remaining concentration should be small (less than surrounding source area soils and water).
- If dioxane is re-released to soil, precipitation would move it back to GW and tree roots – starting the cycle again.

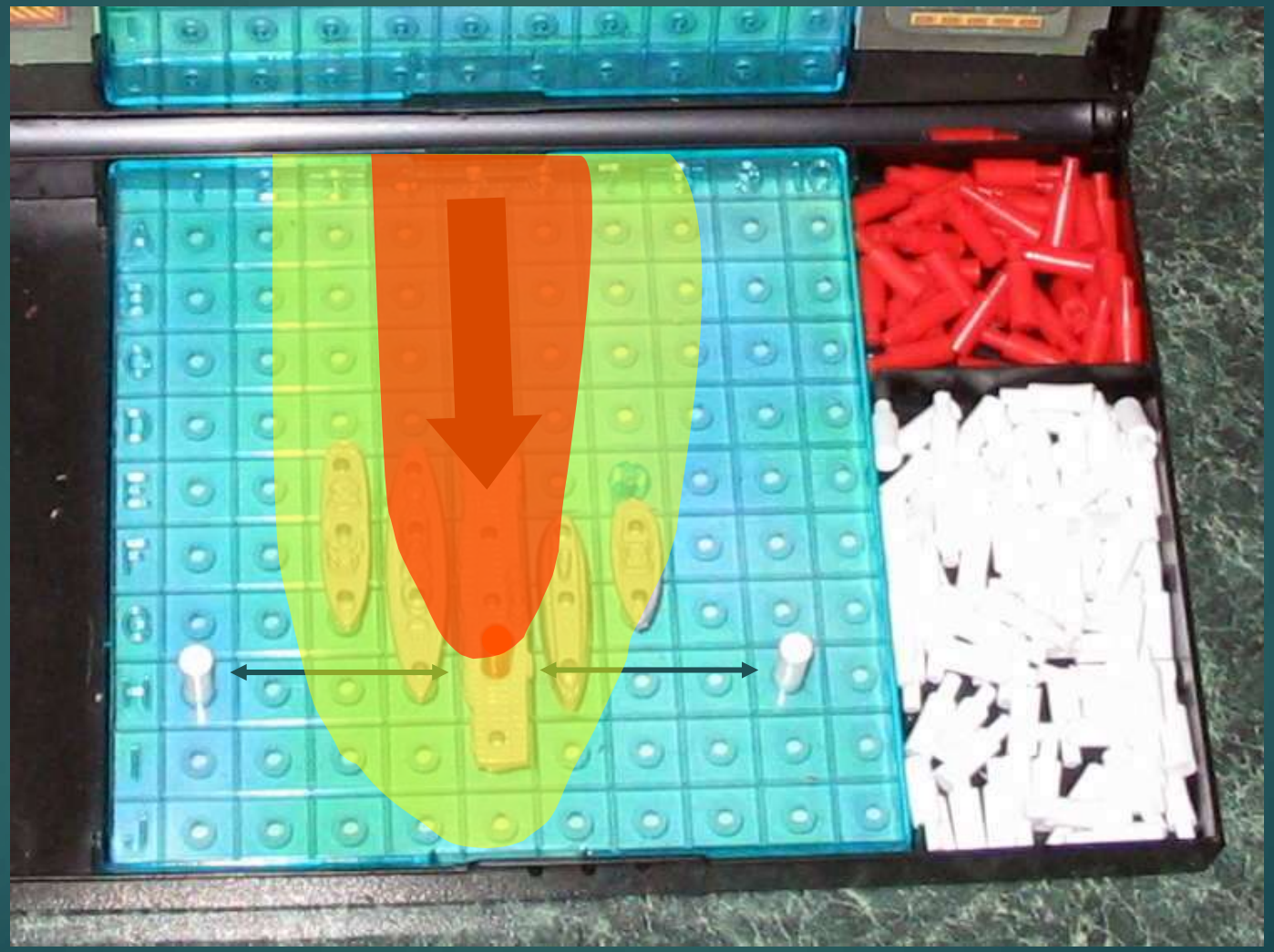
Should be evaluated via tree tissue monitoring.
Harvested trees should be properly landfilled or incinerated.

Plume Detection and Delineation

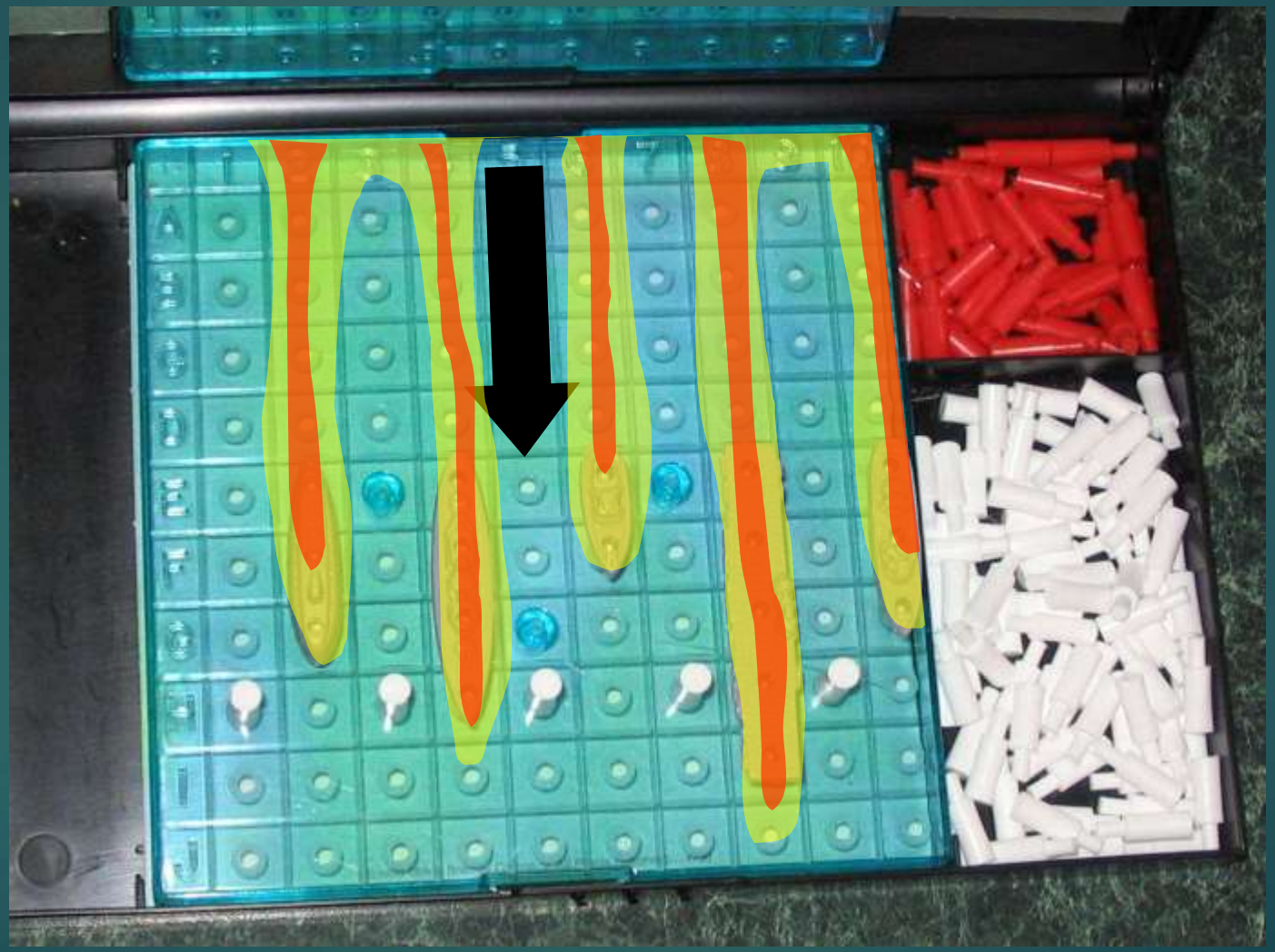
Plume Detection and Delineation

Efficient Search Patterns

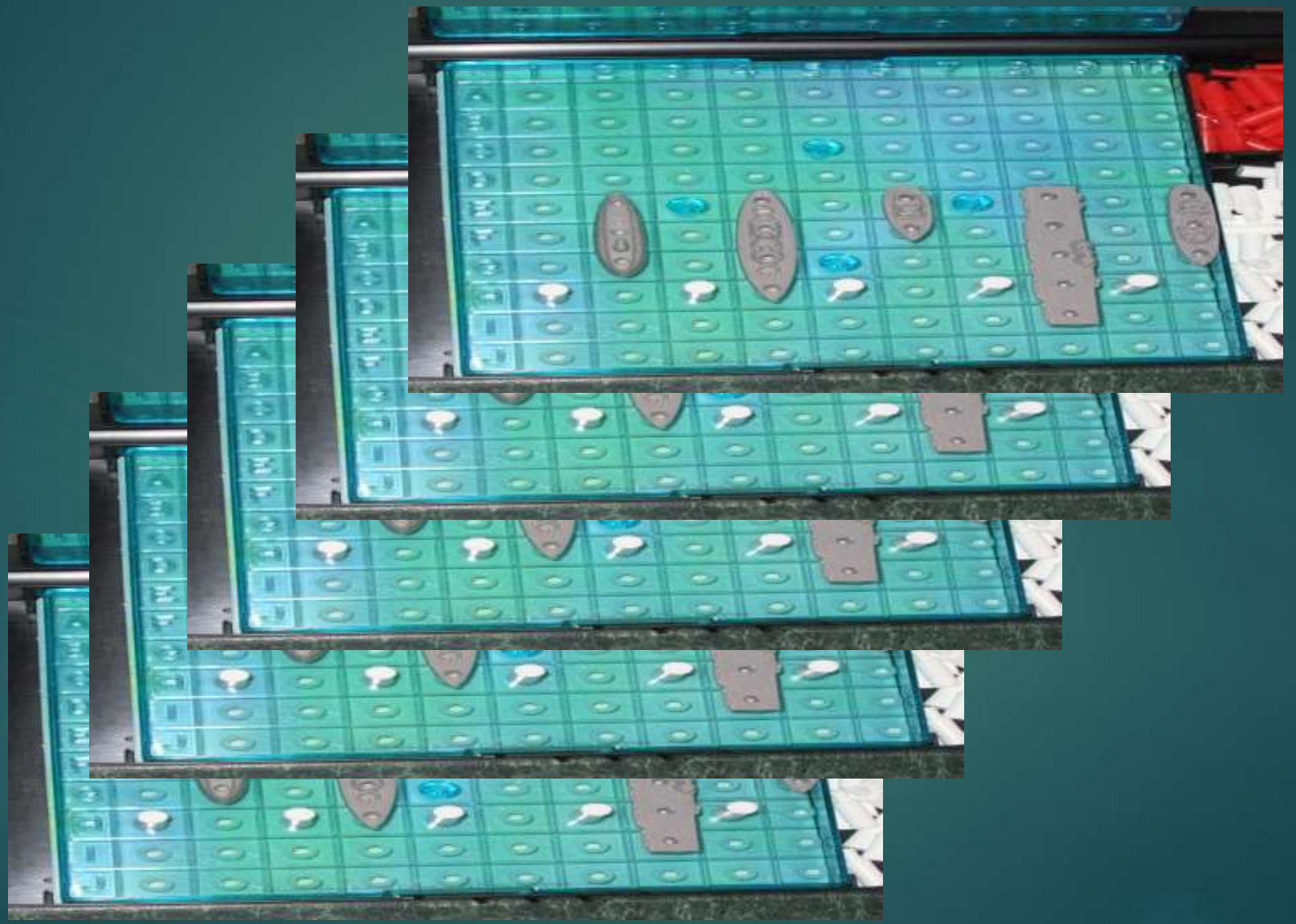
Monitoring Well Spacing

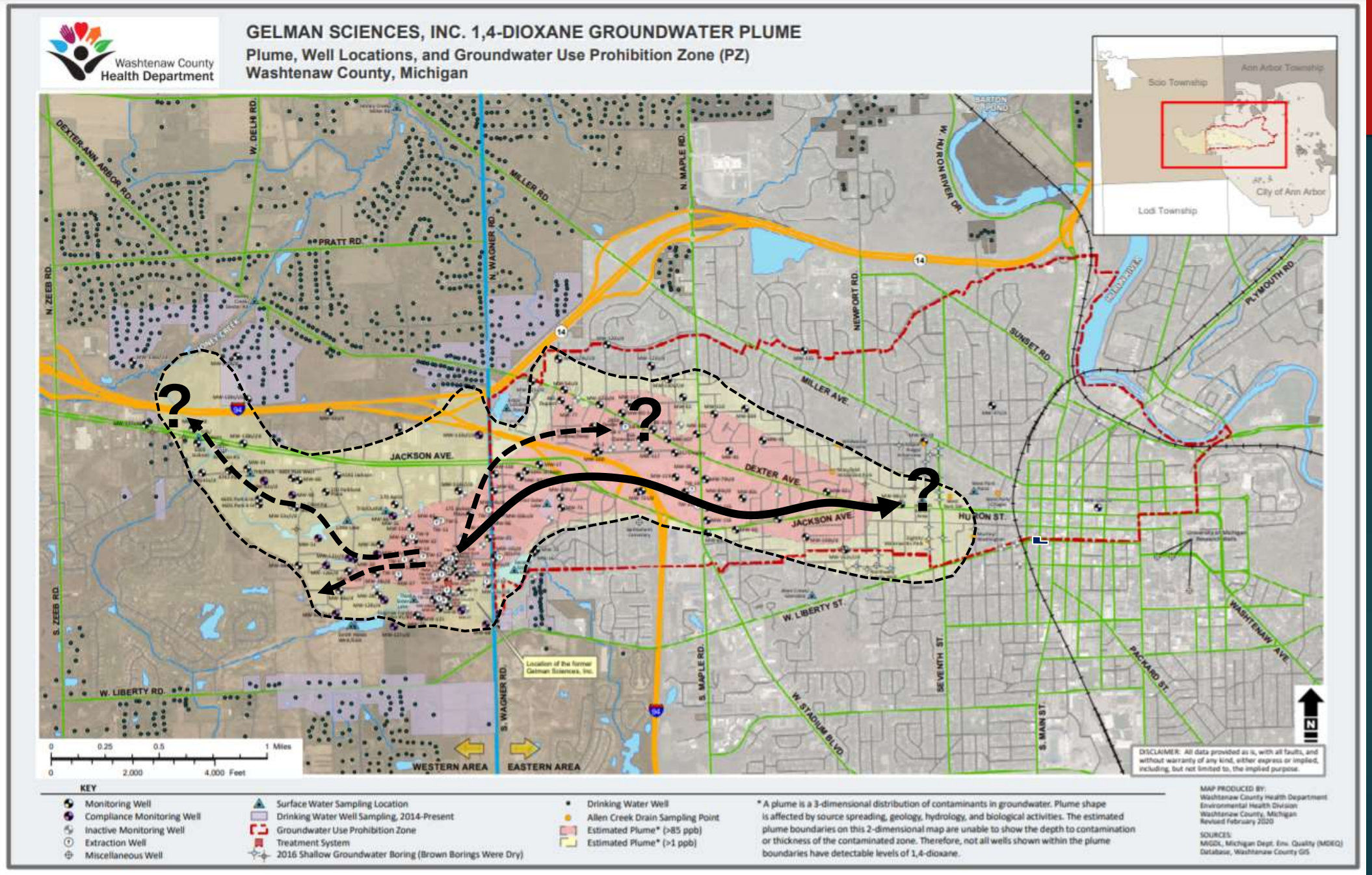


Monitoring Well Spacing



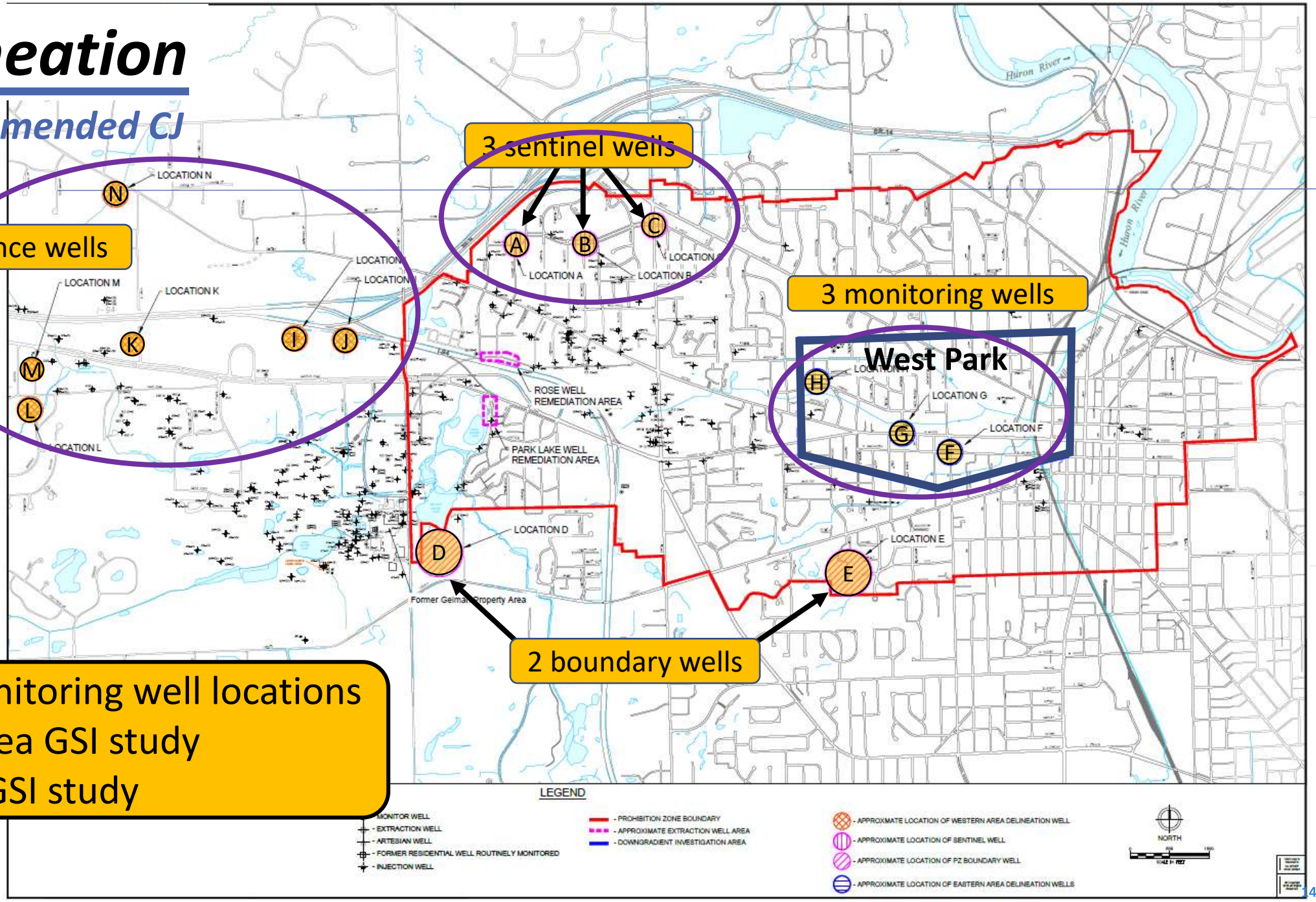
Plumes are three dimensional!



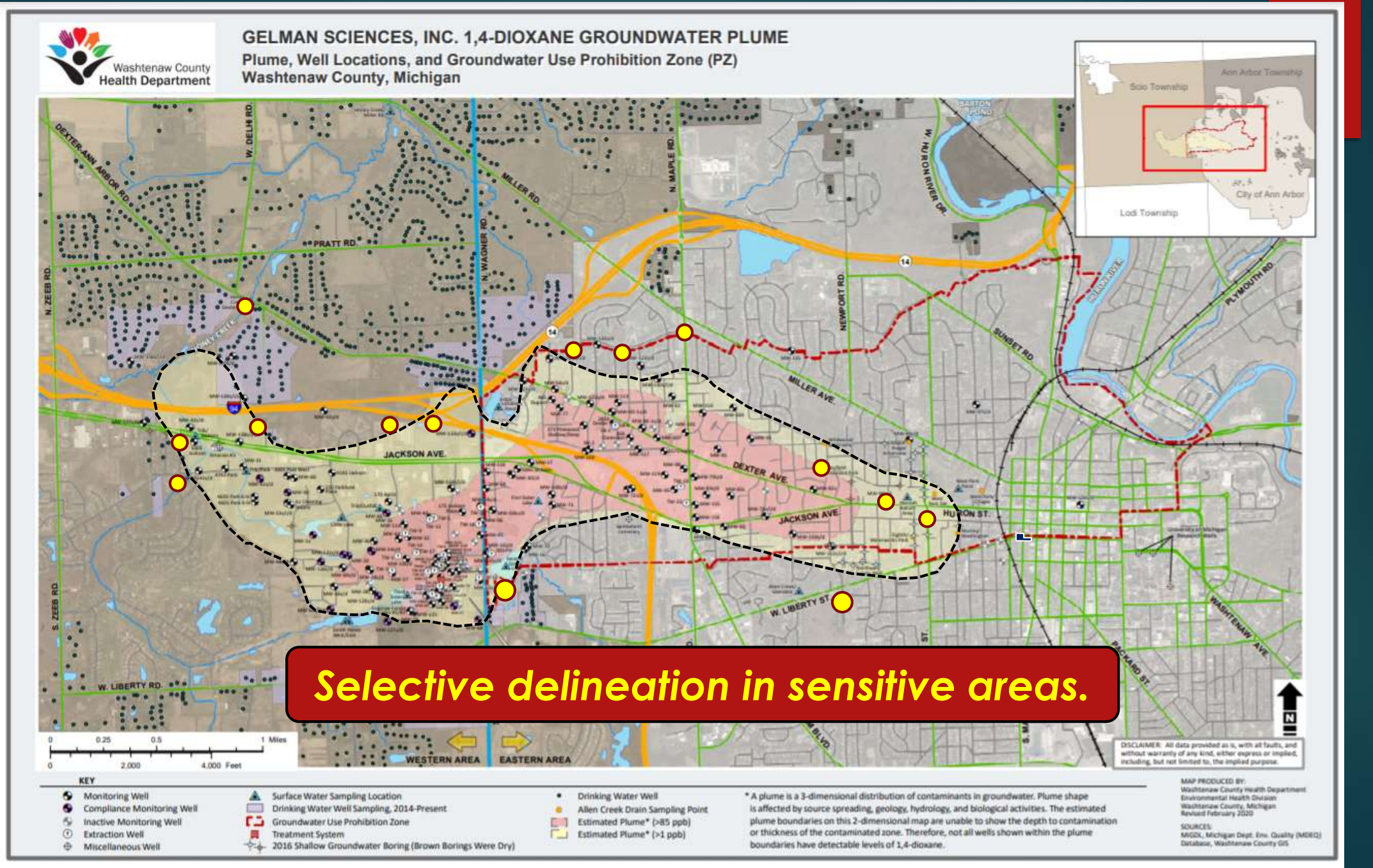

Washtenaw County Health Department
GELMAN SCIENCES, INC. 1,4-DIOXANE GROUNDWATER PLUME
Plume, Well Locations, and Groundwater Use Prohibition Zone (PZ)
Washtenaw County, Michigan
Scio Township
Ann Arbor Township
City of Ann Arbor
Lodi Township
DEXTER-ANN ARBOR RD.
W. DELHI RD.
N. ZEEB RD.
PRATT RD.
MILLER RD.
N. WAGNER RD.
N. MAPLE RD.
W. HURON RIVER DR.
NEWPORT RD.
SUNSET RD.
PLYMOUTH RD.
MILLER AVE.
JACKSON AVE.
DEXTER AVE.
HURON ST.
W. LIBERTY ST.
SEVENTH ST.
WASHTENAW AVE
PACKARD ST.
S. MAPLE RD.
W. STADIUM BLVD.
S. MAIN ST.
S. ZEEB RD.
W. LIBERTY RD.
S. WAGNER RD.
Location of the former Gelman Sciences, Inc.
WESTERN AREA
EASTERN AREA
0 0.25 0.5 1 Miles
0 2,000 4,000 Feet
N
DISCLAIMER: All data provided as is, with all faults, and without warranty of any kind, either express or implied, including, but not limited to, the implied purpose.
KEY
Monitoring Well
Compliance Monitoring Well
Inactive Monitoring Well
Extraction Well
Miscellaneous Well
Surface Water Sampling Location
Drinking Water Well Sampling, 2014-Present
Groundwater Use Prohibition Zone
Treatment System
2016 Shallow Groundwater Boring (Brown Borings Were Dry)
Drinking Water Well
Allen Creek Drain Sampling Point
Estimated Plume* (>85 ppb)
Estimated Plume* (>1 ppb)
* A plume is a 3-dimensional distribution of contaminants in groundwater. Plume shape is affected by source spreading, geology, hydrology, and biological activities. The estimated plume boundaries on this 2-dimensional map are unable to show the depth to contamination or thickness of the contaminated zone. Therefore, not all wells shown within the plume boundaries have detectable levels of 1,4-dioxane.
MAP PRODUCED BY:
Washtenaw County Health Department
Environmental Health Division
Washtenaw County, Michigan
Revised February 2020
SOURCES:
MGDL, Michigan Dept. Env. Quality (MDEQ) Database, Washtenaw County GIS

A. *Delineation*

Gelman 4th Amended CJ



- 14 new monitoring well locations
- Western Area GSI study
- West Park GSI study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W. LIBERTY RD.
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PACKARD ST
Selective delineation in sensitive areas.
WESTERN AREA
EASTERN AREA
0 0.25 0.5 1 Miles
0 2,000 4,000 Feet
N
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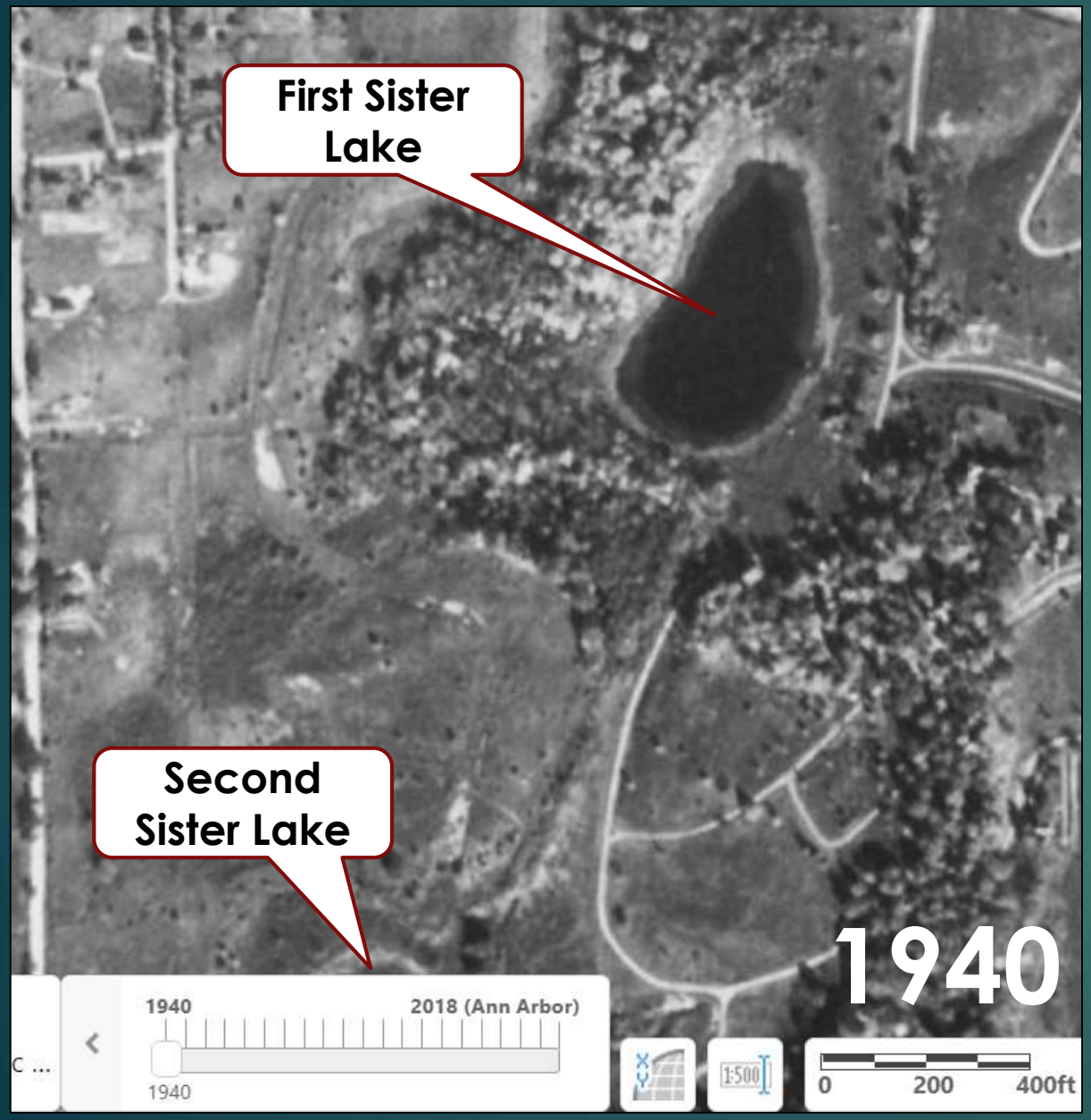
First Sister Lake

1. How much water is 200 GPM?
2. Where will the water go?
3. Will it cause or exacerbate flooding?
4. What are the environmental impacts?
5. What about dioxane contamination?



Washtenaw County Map Viewer

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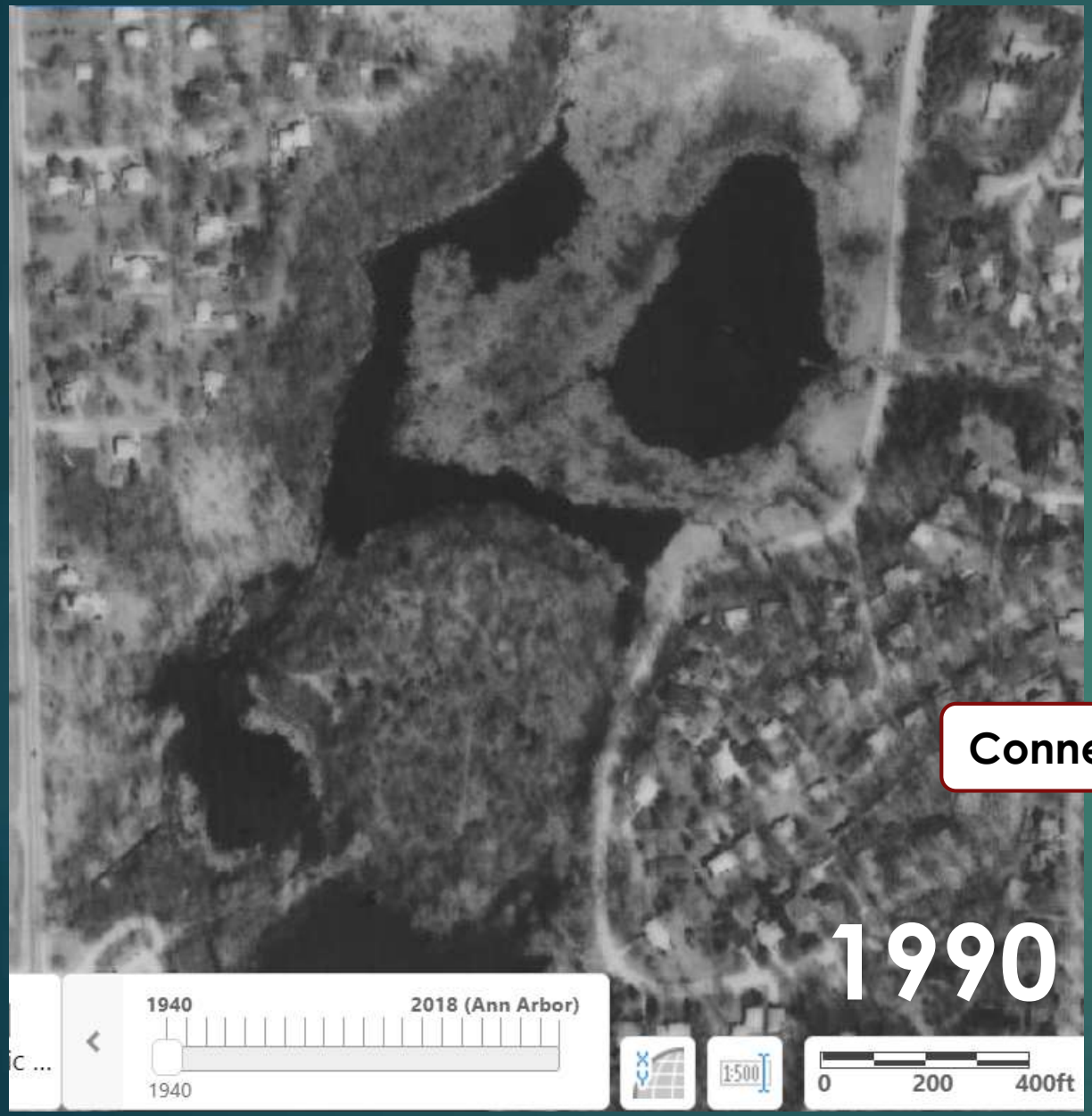
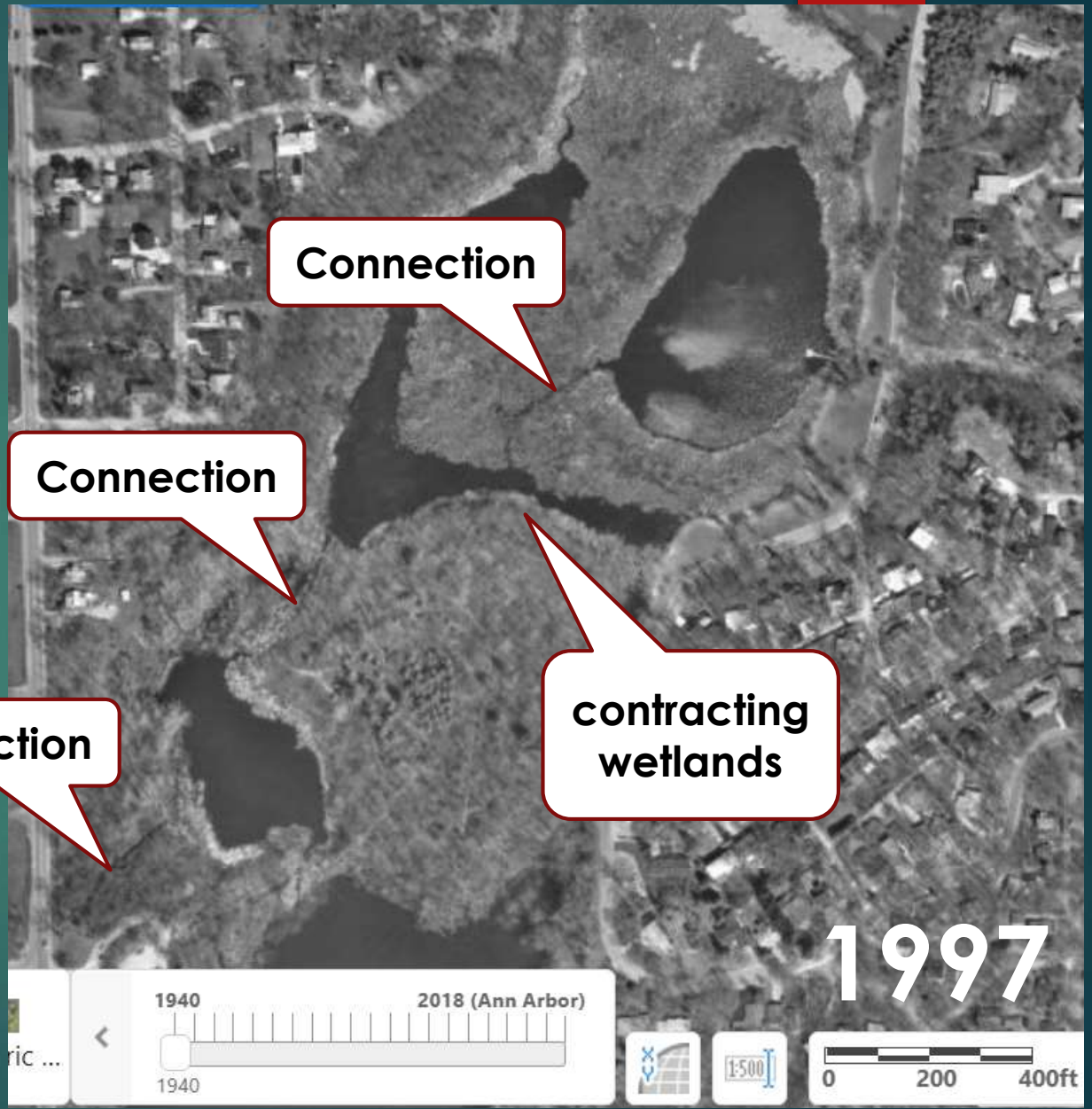




Washtenaw County Map Viewer

Washtenaw County Map Viewer

Washtenaw County Map Viewer

Google

First Sister Lake and the surrounding wetlands are a dynamic, interconnected system.

First Sister Lake

1. How much is 200 gpm?

gpm	gph	gpd	gpmo
200	12,000	288,000	8,640,000

garden hose ≈ 5 gpm → ~ 40 garden hoses

First Sister Lake

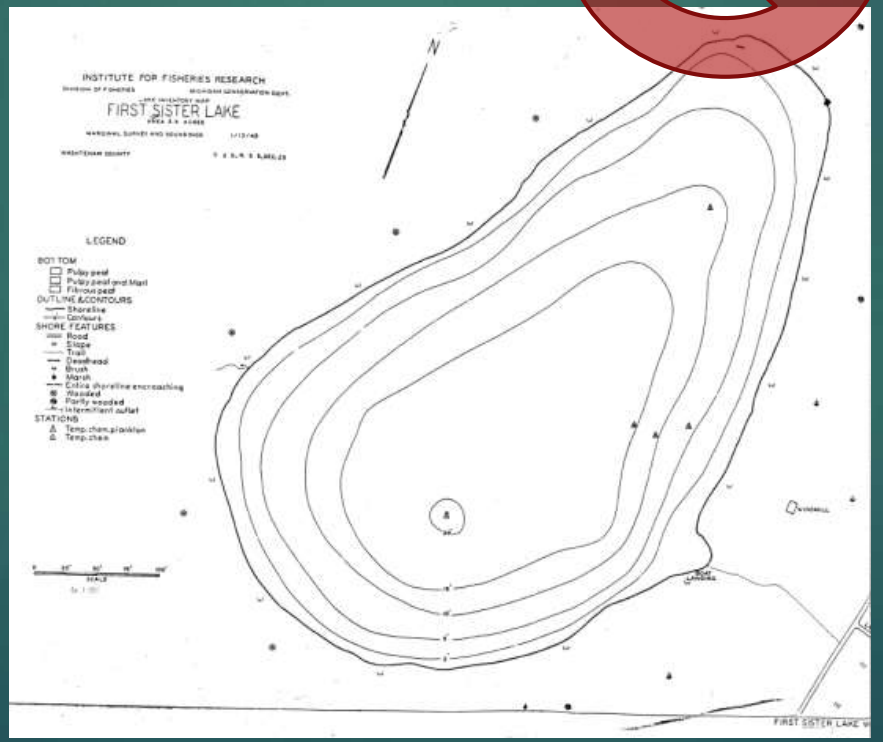
1. How much is 200 gpm?

gpm	gph	gpd	gpmo
200	12,000	288,000	8,640,000

~~100-year rainfall event~~

~~10-year rainfall event~~

NOAA Atlas 14 Point Precipitation Frequency Estimates



1942 bathymetric map

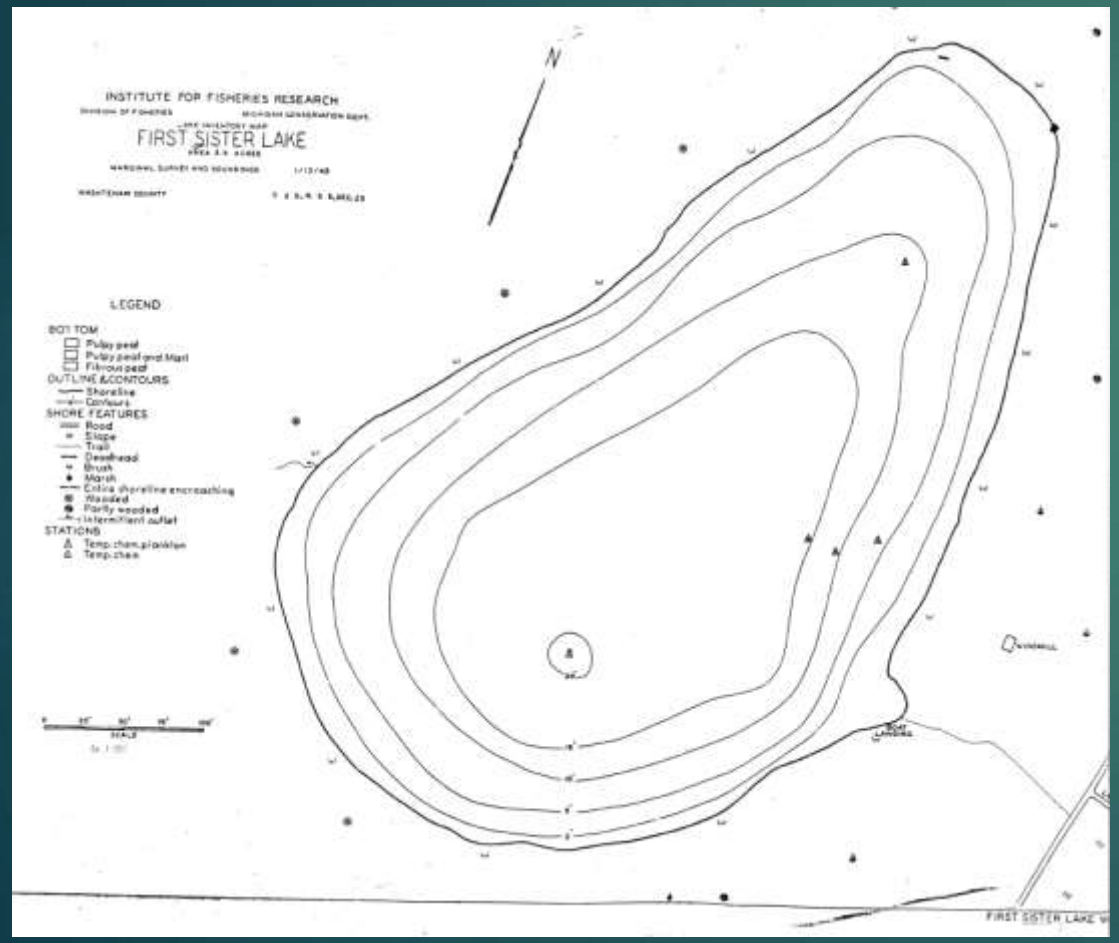
Area ≈ 3 acres (136,000 ft^2)

$$d = \frac{38{,}500\ ft^3}{136{,}000\ ft^2} = 0.28\text{ft} = \mathbf{3.4\ in}$$

First Sister Lake

1. How much is 200 gpm?

gpm	gph	gpd	gpmo
200	12,000	288,000	8,640,000



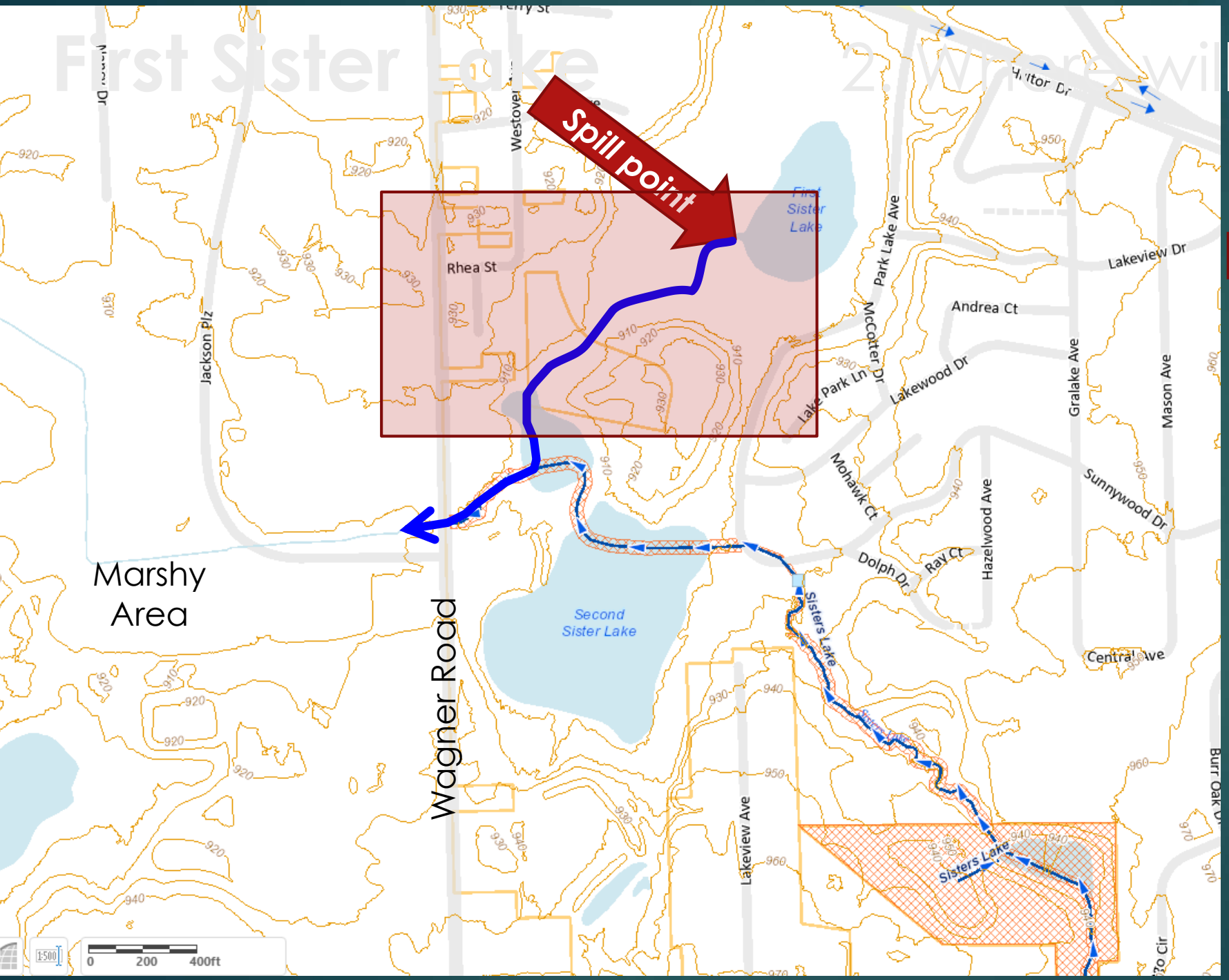
1942 bathymetric map

Area ≈ 3 acres (136,000 ft^2)

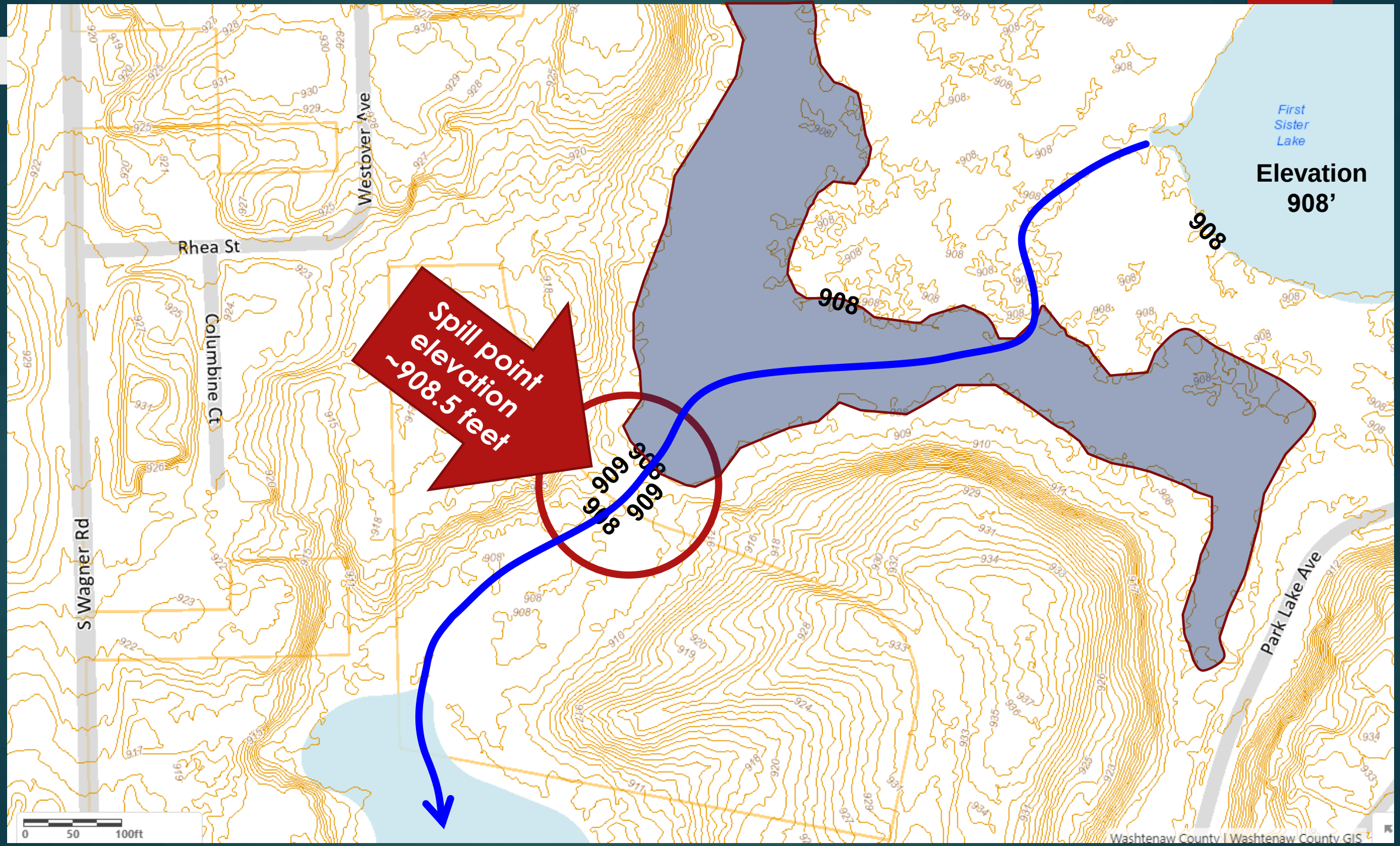
Volume ≈ 1,340,000 ft^3 (10 million gallons)

Residence or Exchange Time ≈ 35 days

First Sister Lake 2 Where will that water go?



Spill point


First Sister Lake
Elevation 908’
908
908
Spill point elevation ~908.5 feet
909
909
909
Rhea St
Westover Ave
Columbine Ct
S Wagner Rd
Park Lake Ave
0
50
100ft
Washtenaw County | Washtenaw County GIS

First Sister Lake

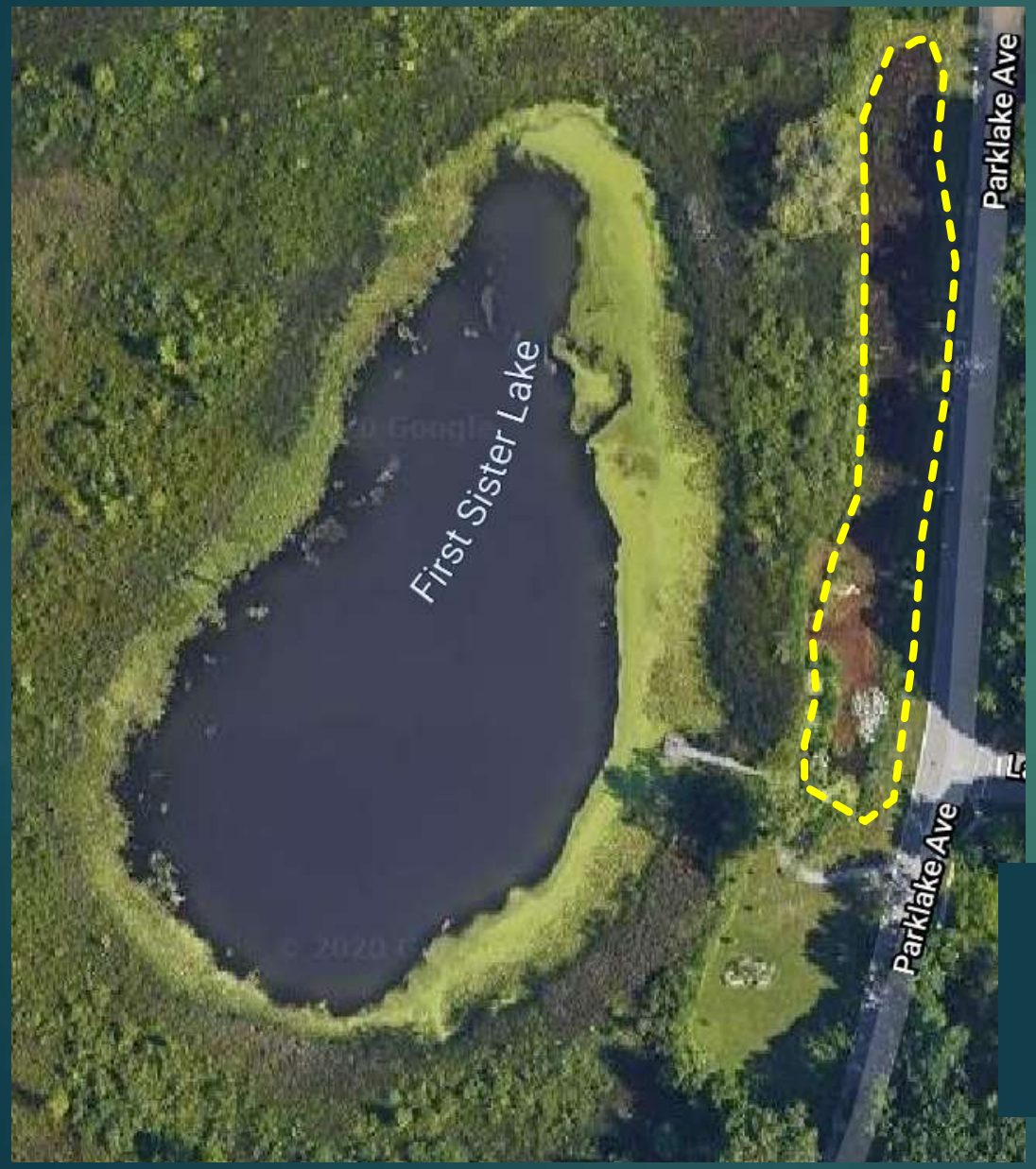
3. What about flooding?

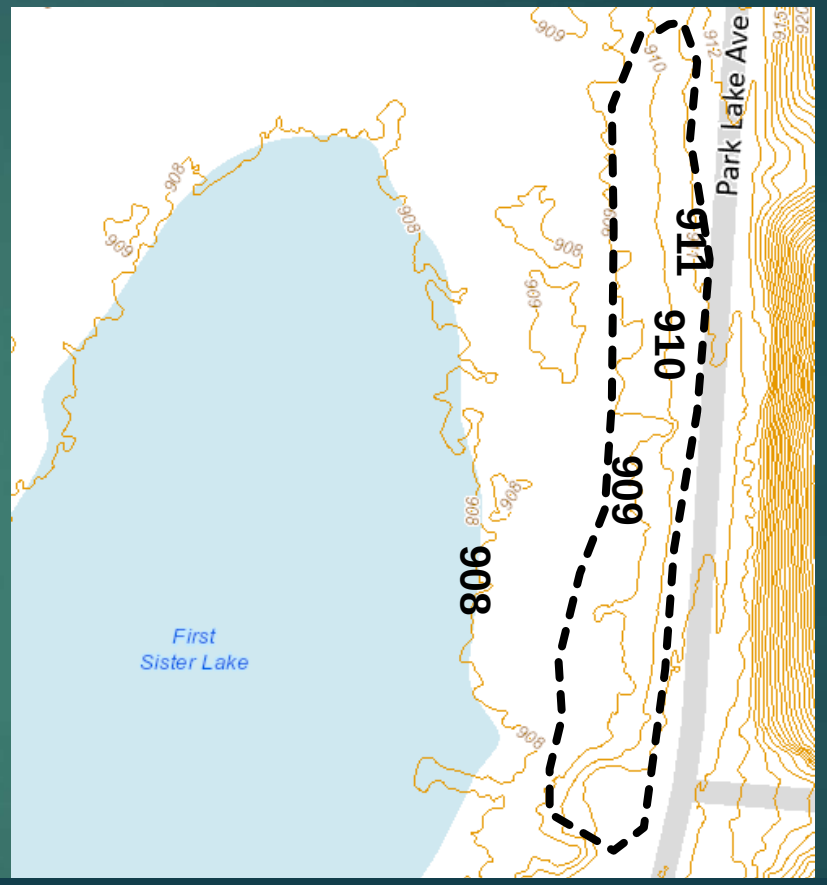
- **First Sister Lake receives storm water runoff from surrounding natural, residential, and commercial areas.**
  - Storm runoff is likely to greatly exceed 200 gpm.
  - Water entering the lake will either…
    - Drain along the identified route, or
    - Infiltrate (no information on this)
- **Gelman will limit flow or suspend treatment during storm events / high water**
  - Float in culvert
- **Downstream flow capacity**
  - Culvert under Wagner Road seems large enough
  - 6” board 10 yards in front of culvert may control marsh/lake level
  - Current Gelman discharge ~ 450 gpm (< historical 1200 gpm)

First Sister Lake 4. Other environmental impacts?

- **Protected Area?**
- **Wetlands damage?**
  - Likely to get wetter or stay wetter.
- **Ice formation in winter?**
  - Groundwater temperature about 55°F.
  - Treatment system effluent temperature unknown.
  - Water likely warmer than lake in winter, cooler in summer.
- **Rain Garden?**
  - Bioswale designed to catch and infiltrate first inch of rainfall runoff from several Lakewood subdivision streets.

First Sister Lake Rain garden





- Surface elevation between 909 and 911 feet.
- Holding more water than anticipated.
- Should not be flooded, but could be impaired.

First Sister Lake

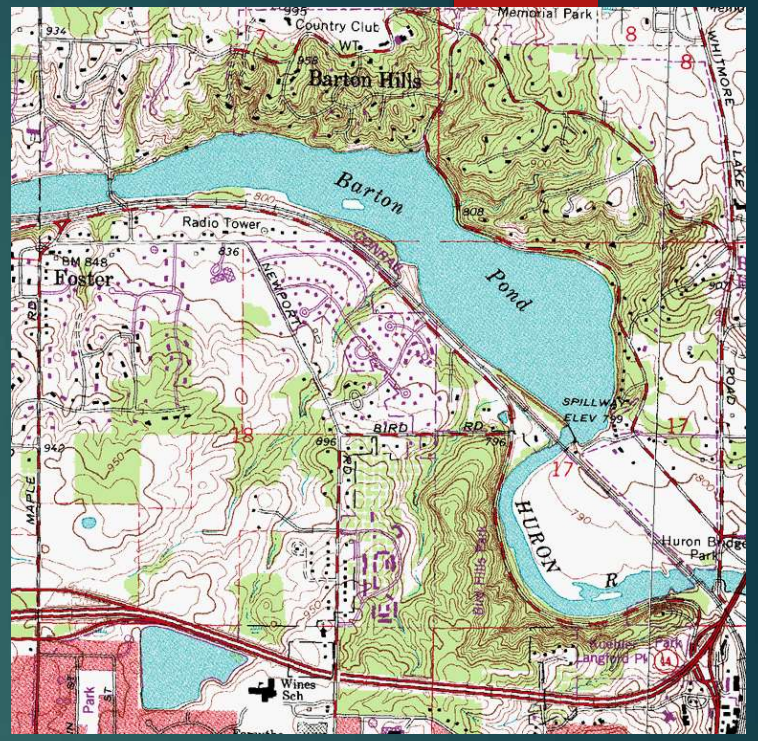
5. Dioxane contamination?

- **Lake concentrations**
  - Treated (*not untreated*) water released
  - 7.0 ppb expected monthly average NPDES discharge limit
    - < 7.2 Michigan drinking water cleanup standard
    - < 280 ppb GSI criterion
    - << 22,000 ppb protective of aquatic life
  - 10 ppb bromate
    - = EPA bromate drinking water MCL
- **Groundwater concentrations**
  - Same level or less
  - Technically safe under State of Michigan standards

Environmental monitoring and modeling are needed.

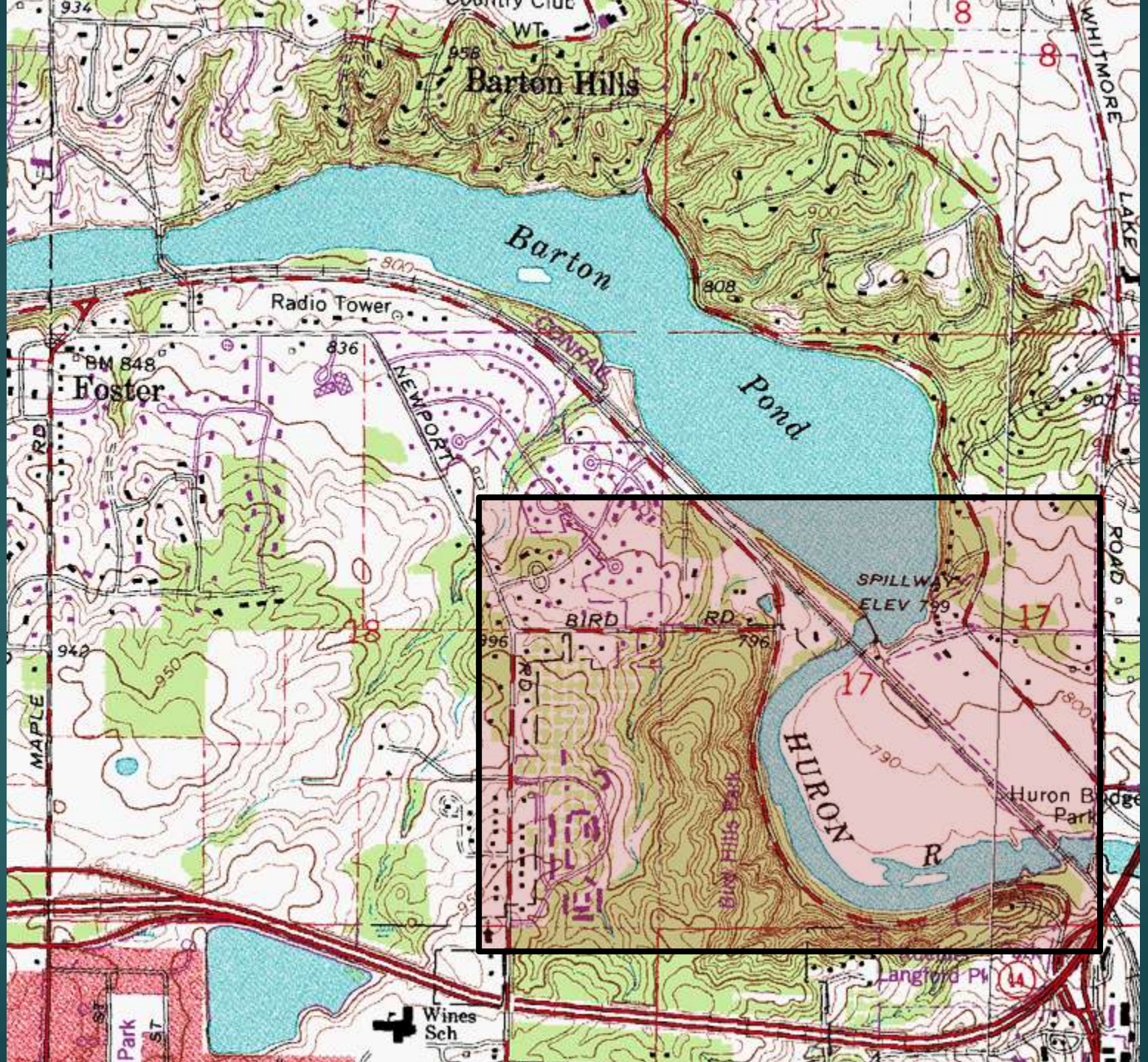
Northward migration toward Barton Pond

- The risk of 1,4-dioxane migration to Barton Pond is small.
- However, we cannot rule it out with complete certainty.

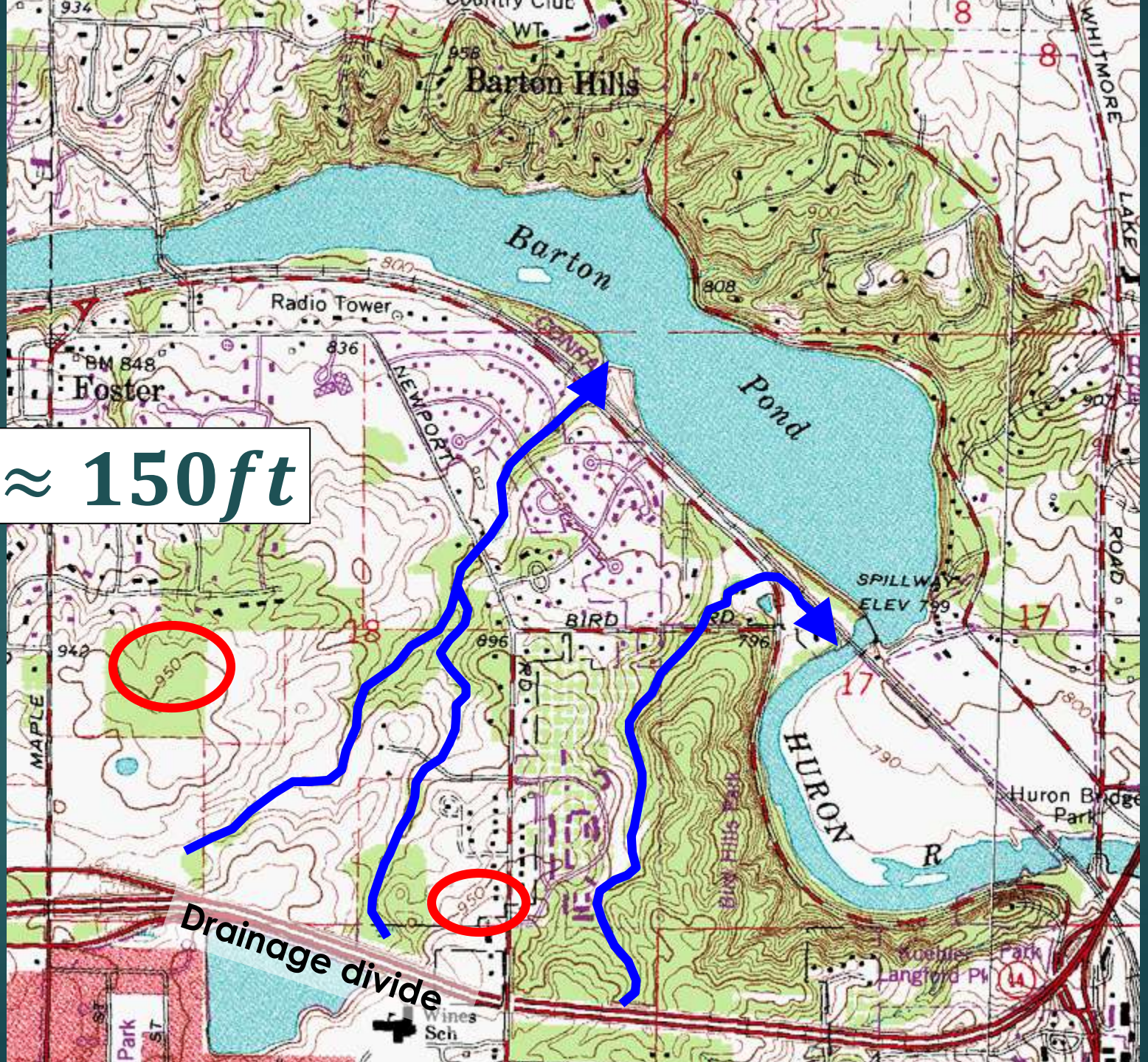


Similar Conclusions

- Neven Kresic – MACTEC Engineering and Consulting
- Doug Sutton - HGL HydroGeoLogic, Inc.
- Patti McCall – Tetra Tech

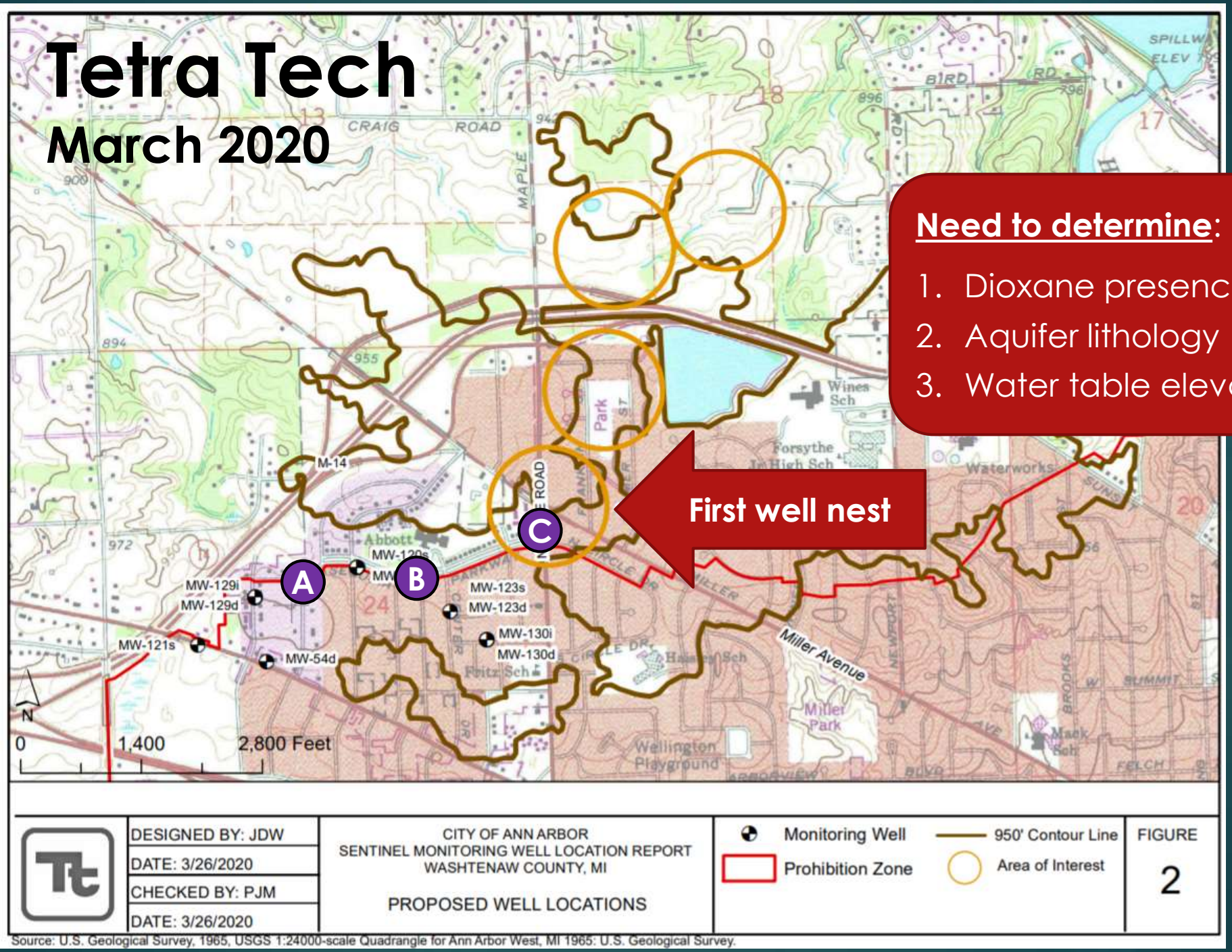

Barton Hills
Barton
Pond
Radio Tower
BM 848
Foster
NEWPORT
MAPLE RD
SPILLWAY
ELEV 799
BIRD RD
HURON
R
Huron Bridge Park
Wines Sch
Langford Pl
WHITMORE LAKE ROAD
934
956
900
808
836
942
950
796
790


$\Delta h \approx 25ft$
SPILLWAY
ELEV 799
BIRD RD
896
796
≈ 775
HURON R
790
800
950
Huron Bridge Park
Park
14
17
ROAD


$\Delta h \approx 150ft$
Barton Hills
Barton
Pond
Radio Tower
BM 848
Foster
NEWPORT
BIRD
SPILLWAY
ELEV 799
HURON
R
Huron Bridge
Park
MAPLE
950
950
Drainage divide
Wines
Sch
Park
ST
Langford Pl
Park

Tetra Tech

March 2020



<u>Need to determine</u>:

1. Dioxane presence
2. Aquifer lithology
3. Water table elevation

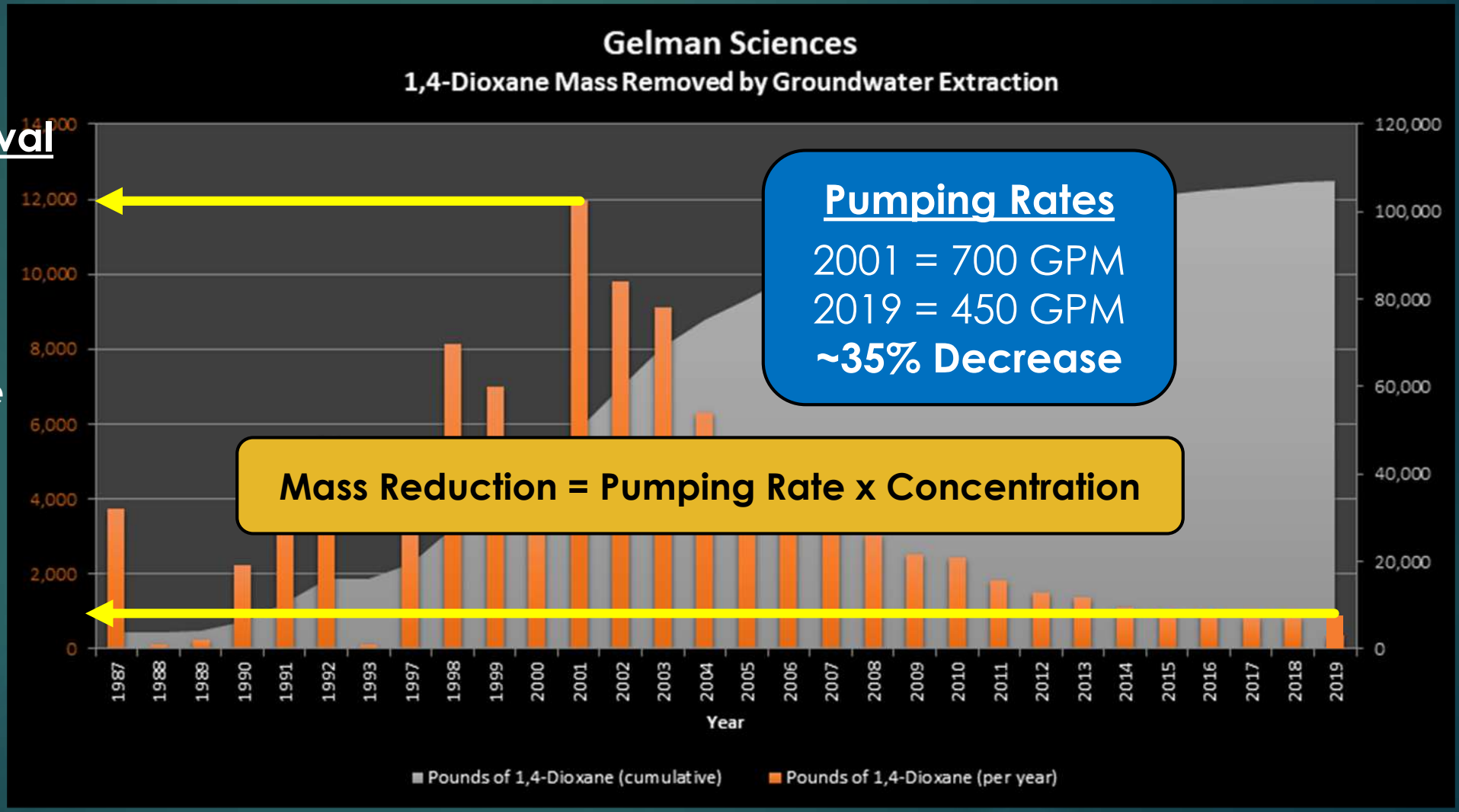
Aquifer Restoration

Mass Removal

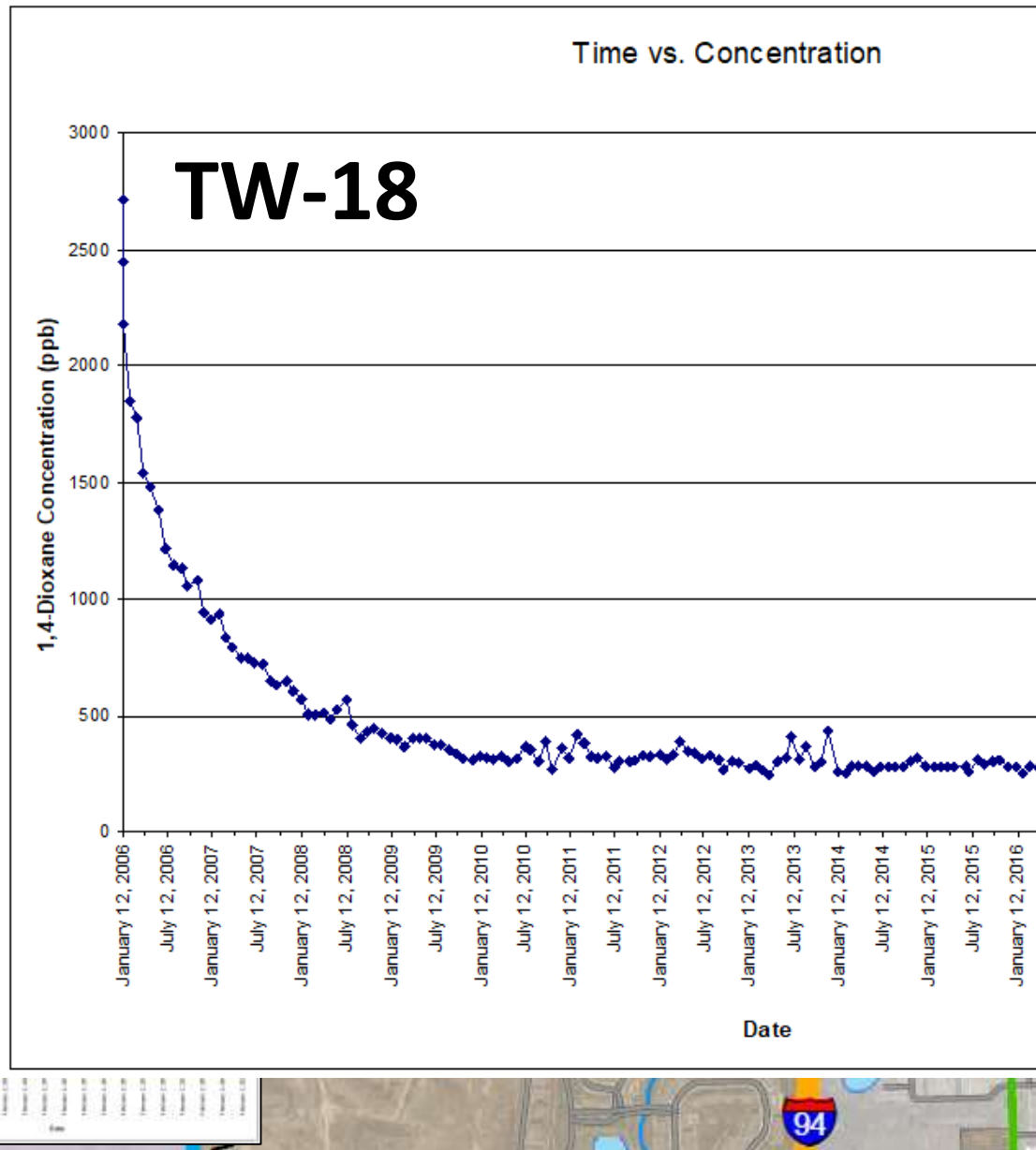
12,000 lbs

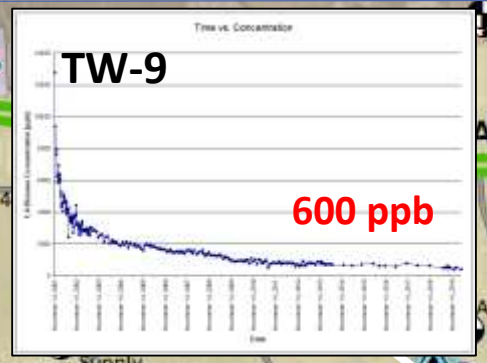
>90% Decrease

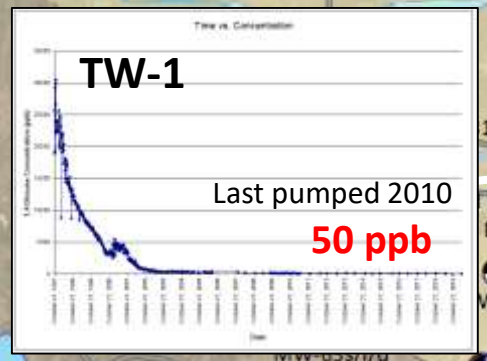
800 lbs

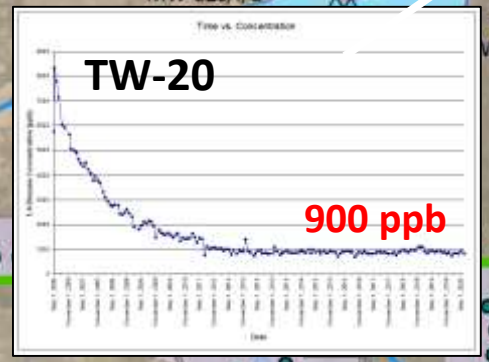


- **Significant *initial* mass removal**
- **Concentrations fall and level off over time**
- **Continuing secondary source: *back diffusion from low-k zones***

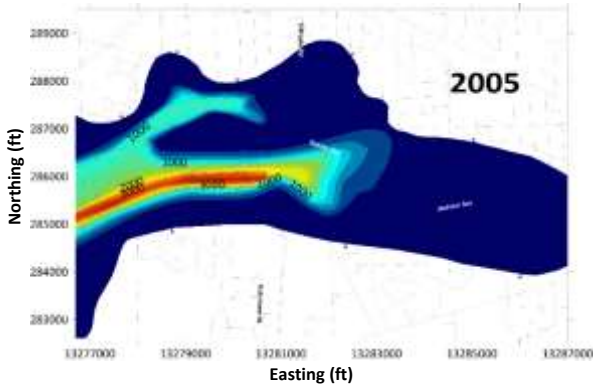


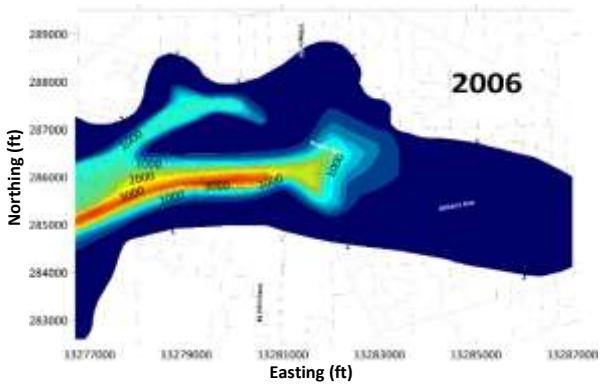


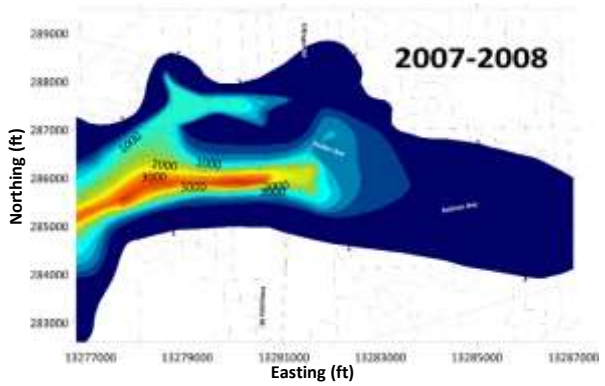


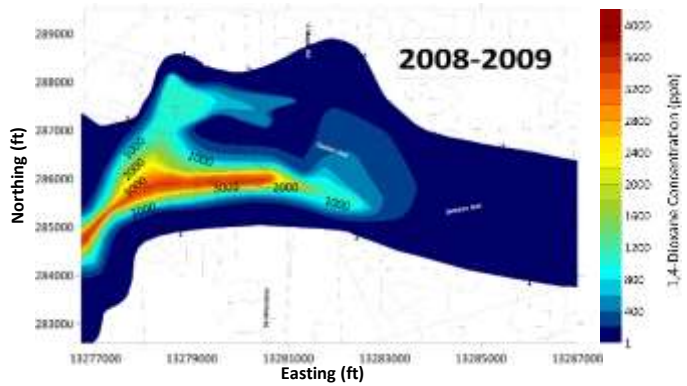


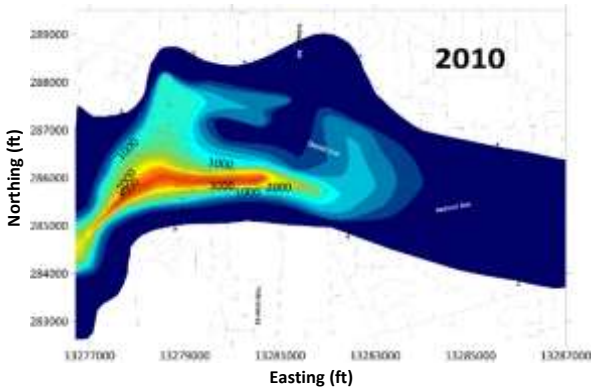
EASTERN AREA ANNUAL CONCENTRATION MAPS

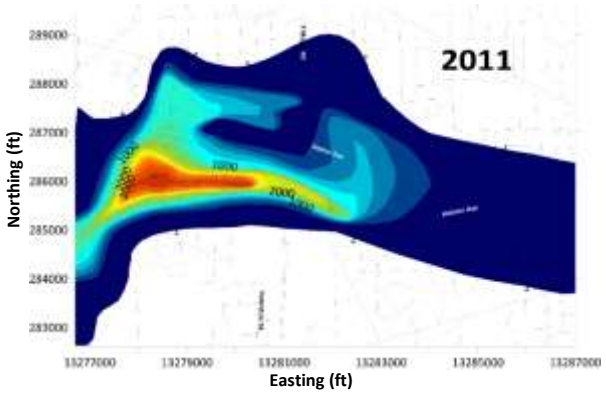


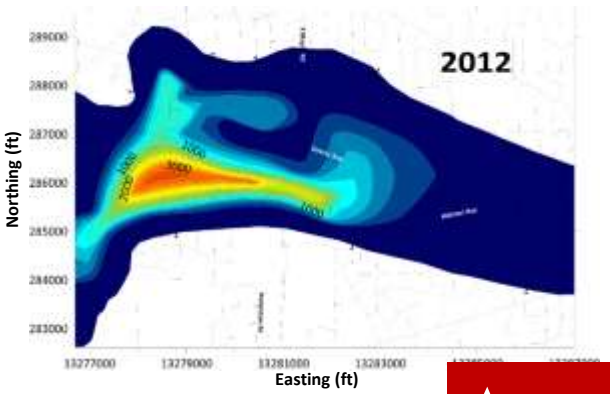


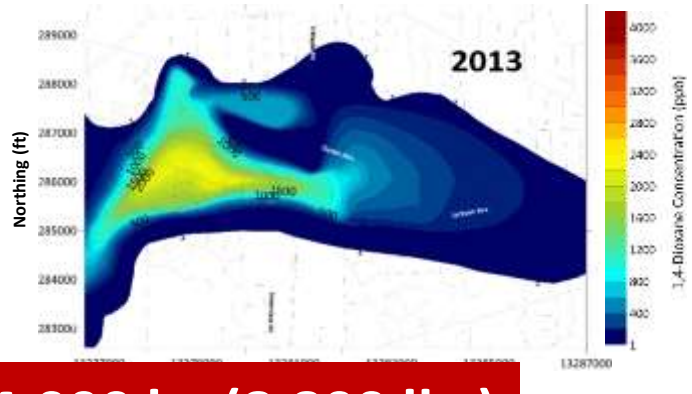




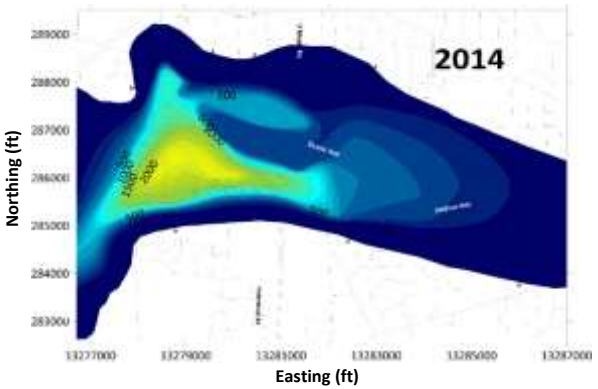


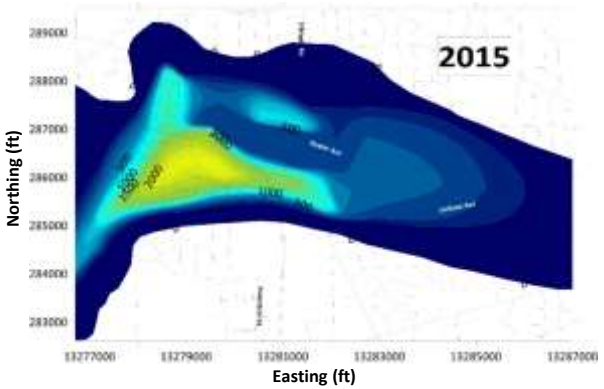


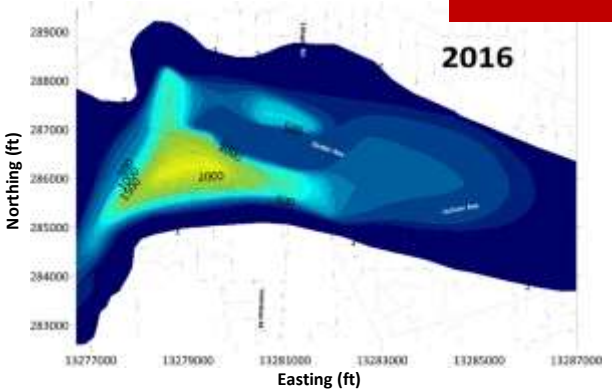


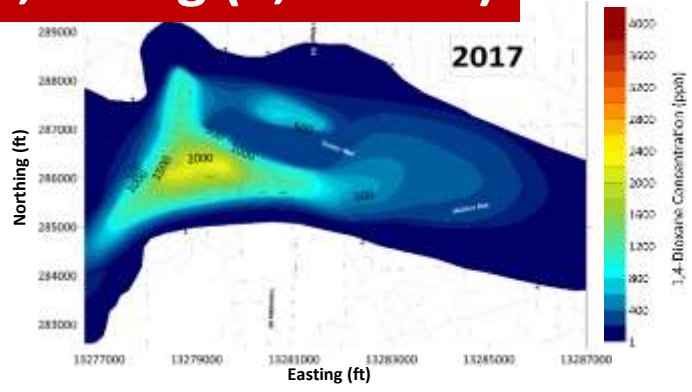


Δ ≈ - 4,000 kg (8,800 lbs)

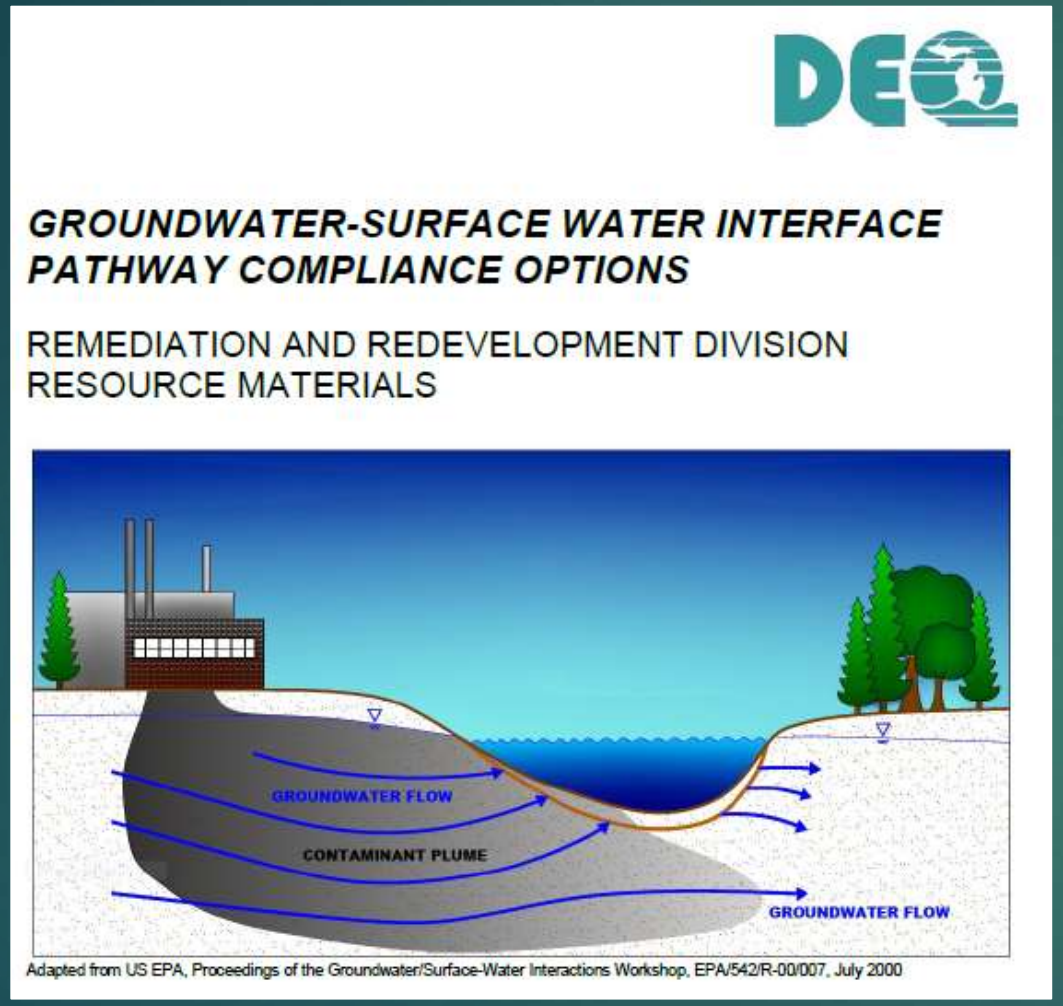




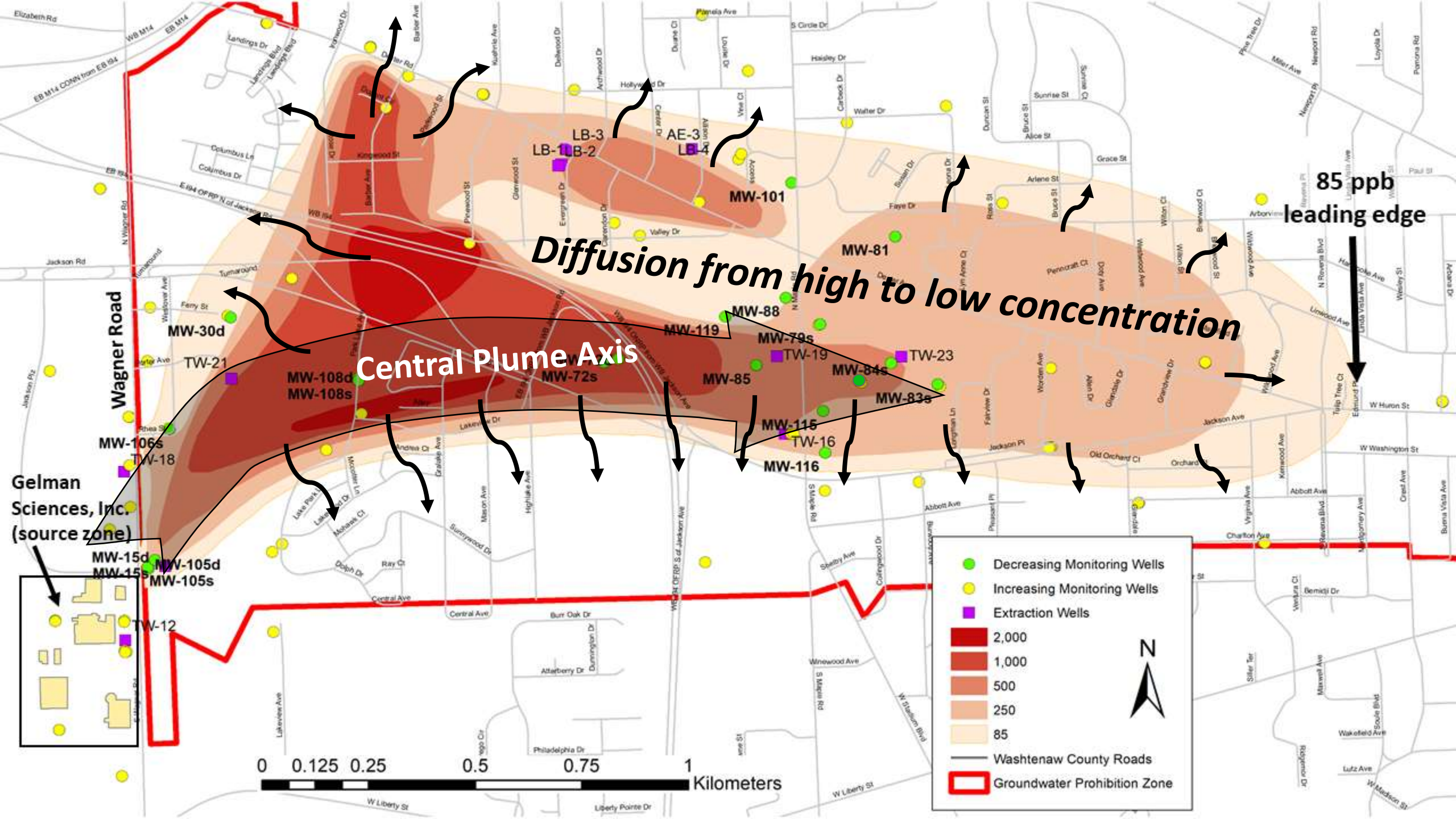




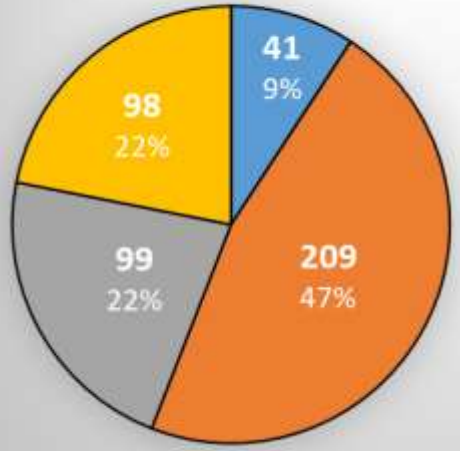
Aquifer Restoration



Mass removal to concentrations below 280 ppb remains a viable strategy to prevent GSI noncompliance.


Diffusion from high to low concentration
Central Plume Axis
85 ppb
leading edge
Wagner Road
Gelman
Sciences, Inc.
(source zone)
LB-1
LB-2
LB-3
LB-4
AE-3
MW-101
MW-81
MW-88
MW-119
MW-79s
TW-19
TW-23
MW-84s
MW-83s
MW-85
MW-72s
MW-115
TW-16
MW-116
MW-30d
TW-21
MW-108d
MW-108s
MW-106s
TW-18
MW-15d
MW-15s
MW-105d
MW-105s
TW-12
Decreasing Monitoring Wells
Increasing Monitoring Wells
Extraction Wells
2,000
1,000
500
250
85
Washtenaw County Roads
Groundwater Prohibition Zone
N
0
0.125
0.25
0.5
0.75
1
Kilometers

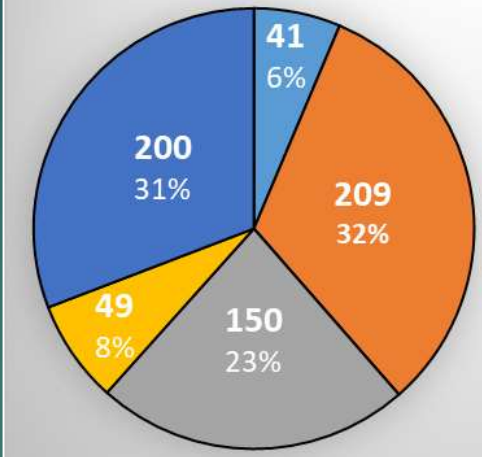
No change: Avg Pumping Rate (gpm)



Total Pumping 450 gpm

- Gelman Site (41 gpm)
- Wagner Rd (209 gpm)
- Evergreen (99 gpm)
- Maple Rd (98 gpm)

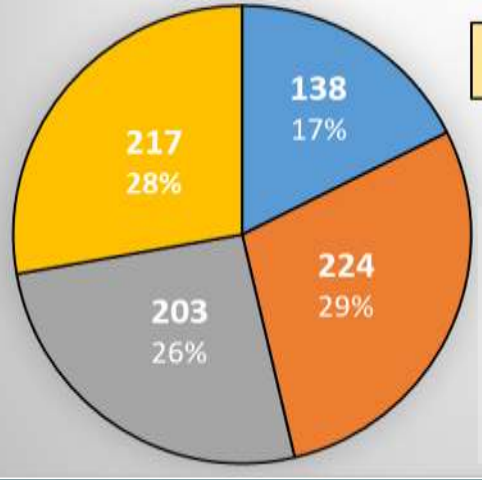
Amended CJ: Avg Pumping Rate (gpm)



Total Pumping 650 gpm

- Gelman Site (41 gpm)
- Wagner Rd (209 gpm)
- Evergreen (150 gpm)
- Maple Rd (49 gpm)
- Parklake (200 gpm)

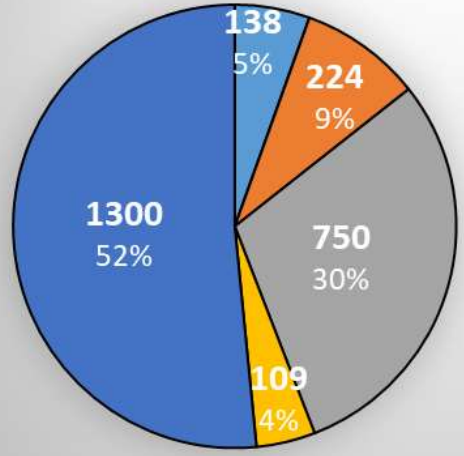
No change: Avg Mass Removed (lbs/yr)



Mass Removed 800 lbs/yr

- Gelman Site (756 ppb)
- Wagner Rd (242 ppb)
- Evergreen (460 ppb)
- Maple Rd (502 ppb)

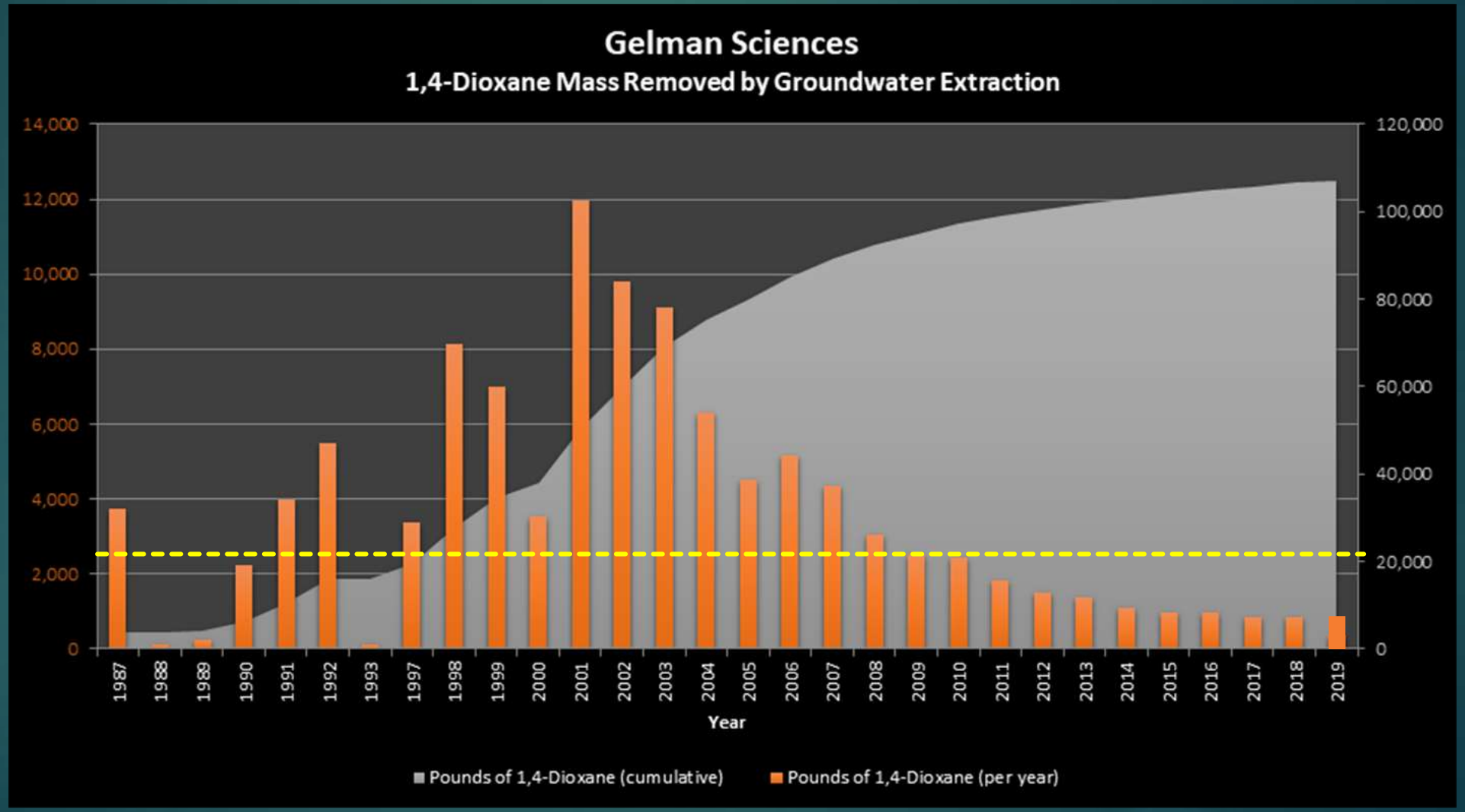
Amended CJ: Avg Mass Removed (lbs/yr)



Mass Removed 2500 lbs/yr

- Gelman Site (756 ppb)
- Wagner Rd (224 ppb)
- Evergreen (1150 ppb)
- Maple Rd (502 ppb)
- Parklake (1500 ppb)

Aquifer Restoration



Aquifer Restoration

Is it possible to restore the aquifer to pristine conditions?

Is it possible to reduce dioxane below 7.2 everywhere?

2000 Five-Year Cleanup Plan

2004 Feasibility Study

2005 Prohibition Zone

Aquifer Restoration

Is it possible to restore the aquifer to pristine conditions?

Is it possible to reduce dioxane below 7.2 everywhere?

Reality Check!

Comments from environmental engineers, scientists, and hydrogeologists are needed.

Expert urges A^2 environmental professionals to weigh in on Gelman CJ

4th Amended CJ assessment

- The revised CJ is not perfect.
- It contains sensible, beneficial activities that mitigate potential for future dioxane loading and migration.
    - Source zone remediation
    - Hot spot dioxane mass removal
    - GSI evaluations in the Eastern and Western Areas
    - Monitoring wells in important new locations
- The revised CJ represents an improvement over what is in place now.