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
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.
Is 1,4-dioxane expected to accumulate in the trees?

How would this be tested?

1,4-Dioxane is expected to pass through the trees.

- 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?

As a dead tree dries, 1,4-dioxane will vent to atmosphere.
- 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.
Efficient Search Patterns
Monitoring Well Spacing
Monitoring Well Spacing
Plumes are three dimensional!
So what do we do?
A. Delineation
Gelman 4th Amended CJ

- 14 new monitoring well locations
- Western Area GSI study
- West Park GSI study
Selective delineation in sensitive areas.
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
First Sister Lake and the surrounding wetlands are a dynamic, interconnected system.
1. How much is 200 gpm?

<table>
<thead>
<tr>
<th>gpm</th>
<th>gph</th>
<th>gpd</th>
<th>gpmo</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>12,000</td>
<td>288,000</td>
<td>8,640,000</td>
</tr>
</tbody>
</table>

garden hose ≈ 5 gpm → ~ 40 garden hoses
1. How much is 200 gpm?

<table>
<thead>
<tr>
<th>gpm</th>
<th>gph</th>
<th>gpd</th>
<th>gpmo</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>12,000</td>
<td>288,000</td>
<td>8,640,000</td>
</tr>
</tbody>
</table>

Area \(\approx\) 3 acres \(= 136,000 \text{ ft}^2\)

\[ d = \frac{38,500 \text{ ft}^3}{136,000 \text{ ft}^2} = 0.28 \text{ ft} = 3.4 \text{ in} \]
First Sister Lake

1. How much is 200 gpm?

<table>
<thead>
<tr>
<th>gpm</th>
<th>gph</th>
<th>gpd</th>
<th>gpmo</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>12,000</td>
<td>288,000</td>
<td>8,640,000</td>
</tr>
</tbody>
</table>

Area ≈ 3 acres (136,000 ft²)
Volume ≈ 1,340,000 ft³ (10 million gallons)

Residence or Exchange Time ≈ 35 days

1942 bathymetric map
Where will that water go?
First Sister Lake

Where will that water go?

Elevation 908'

Spill point elevation ~908.5 feet
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
\[ \Delta h \approx 25 \text{ft} \]
$\Delta h \approx 150\text{ft}$
Need to determine:
1. Dioxane presence
2. Aquifer lithology
3. Water table elevation

First well nest

Tetra Tech
March 2020
Aquifer Restoration

Mass Removal
12,000 lbs

>90% Decrease

800 lbs

Pumping Rates
2001 = 700 GPM
2019 = 450 GPM
~35% Decrease

Mass Reduction = Pumping Rate x Concentration
- 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

\[ \Delta \approx -4,000 \text{ kg (8,800 lbs)} \]
Mass removal to concentrations below 280 ppb remains a viable strategy to prevent GSI noncompliance.
Aquifer Restoration

Gelman Sciences
1,4-Dioxane Mass Removed by Groundwater Extraction

Year

Pounds of 1,4-Dioxane (cumulative) Pounds of 1,4-Dioxane (per year)
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 A² 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.